

POLICY FRAMEWORKS, INSTITUTIONAL SUPPORT, AND SUSTAINABLE MANAGEMENT OF ARTISANAL GEMSTONE MINING IN TAITA TAVETA COUNTY, KENYA

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ABSTRACT

Artisanal and small-scale gemstone mining (ASM) is a central economic activity in Taita Taveta County, Kenya, supporting thousands of households but simultaneously constrained by informality, weak governance structures, environmental degradation, and limited value addition. Although Kenya has enacted key governance instruments such as the Mining Act (2016) and the Environmental Management and Coordination Act (1999), persistent policy implementation gaps, fragmented institutional coordination, and inadequate technical capacity continue to impede sustainable sectoral transformation. Guided by Institutional Theory, Resource Dependence Theory, Evolutionary Governance Theory, and the Socio-Ecological Systems Framework, this study assessed the influence of policy frameworks, institutional support mechanisms, environmental and socio-economic impacts, and enforcement and coordination challenges on the sustainable management of artisanal gemstone mining in Taita Taveta County. A mixed-methods design was employed, incorporating surveys, interviews, focus group discussions, observations, and document analysis to generate comprehensive insights into the sector's governance dynamics. The descriptive findings revealed that respondents held mixed perceptions regarding the adequacy and clarity of policy and legal frameworks, with neutrality dominating on enforcement effectiveness and policy-county alignment. Institutional support was perceived as inconsistent and insufficient, particularly in the areas of training, financial assistance, and environmental monitoring. Respondents strongly acknowledged the environmental impacts of ASM, noting land degradation, deforestation, and water contamination as major concerns. Socio-economic outcomes were viewed more positively, with mining recognized for improving income and employment, though access to finance and equitable benefit-sharing remained weak. Weak enforcement, corruption, overlapping mandates, and limited community awareness were identified as dominant coordination challenges. Inferential results further demonstrated that all four independent variables significantly influenced the Overall Perception of Sustainable Management. Policy and Legal Frameworks had the strongest positive effect ($\beta = 0.347$, $p = 0.001$), followed by Environmental & Socio-Economic Impacts ($\beta = 0.338$, $p = 0.018$), Socio-Economic Impacts alone ($\beta = 0.279$, $p = 0.013$), and Institutional Support Mechanisms ($\beta = 0.196$, $p = 0.041$). ANOVA results confirmed the model's overall significance ($F = 16.344$, $p = 0.000$), indicating that the predictors jointly accounted for a substantial proportion of variance in sustainability perceptions. These findings suggest that sustainable ASM is contingent upon an integrated governance system that provides policy clarity, strengthens institutional capacities, safeguards the environment, enhances socio-economic outcomes, and ensures effective enforcement. The study concludes that strengthening the policy-practice nexus, improving institutional coordination, promoting environmental stewardship, and enhancing livelihood benefits are essential for achieving sustainable artisanal gemstone mining in Taita Taveta County. It recommends increased resourcing for regulatory agencies, community-centered governance, transparent benefit-sharing mechanisms, and stronger multi-stakeholder participation. By addressing structural barriers and leveraging existing governance instruments, the study contributes actionable insights for promoting an inclusive, environmentally responsible, and economically beneficial ASM sector in Kenya.

Keywords: Policy Frameworks, Institutional Support, Sustainable Management

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INTRODUCTION

Artisanal and small-scale gemstone mining (ASM) is a major livelihood source in Taita Taveta County, supporting thousands of households. However, the sector has long operated informally, resulting in weak regulation, environmental degradation, land conflicts, and occupational risks (Mwangi & Mutua, 2022; Mbugua et al., 2021; Kimathi et al., 2023). Unregulated mining has contributed to soil erosion, deforestation, and water contamination, threatening ecosystems and community health. Although Kenya's Mining Act of 2016 aimed to formalize ASM, implementation challenges persist, including bureaucratic licensing processes, limited awareness, enforcement gaps, and gender inequalities that restrict women's participation (Kariuki & Odhiambo, 2020; Nyang'au & Mburu, 2021; Mugo & Wanjohi, 2022). These institutional weaknesses continue to limit sustainable and inclusive sector development.

Globally, governance approaches to ASM differ widely. Countries such as Canada and Japan demonstrate enabling frameworks emphasizing stakeholder participation, environmental stewardship, and institutional support, while more centralized systems in China and Russia rely on strict regulation that may constrain local innovation (Thompson & Carter, 2020; Yamamoto & Tanaka, 2023; Zhang & Liu, 2021; Petrov & Ivanova, 2021). African experiences show similar variation: Uganda and Rwanda have improved sector formalization through simplified licensing, training, and cooperative development, whereas complex regulatory environments in Tanzania and enforcement challenges in South Africa continue to hinder productivity and compliance (Ochieng & Otieno, 2024; Nsabiya & Kimbu, 2021; Mtega et al., 2023; Van Wyk & Rothmann, 2021).

Locally, Kenya has introduced institutional reforms including the Voi Gemstone Value Addition and Marketing Centre, deployment of inspectors and geologists, formation of mining cooperatives, and adoption of gemstone traceability technologies such as blockchain systems to reduce smuggling and improve earnings (Mkanyika, 2024; Kenya News Agency, 2025; Government Advertising Agency, 2025). Capacity-building initiatives, including the establishment of a gemology laboratory at Taita Taveta National Polytechnic, aim to enhance technical skills and competitiveness (Kamau et al., 2025). Despite these efforts, challenges remain, including licensing delays, unsafe mining practices, operational inefficiencies, and reliance on informal trading networks (Mkanyika, 2025; Daily Nation, 2025). Strengthening governance, institutional capacity, and community participation is therefore essential for achieving environmentally sustainable, socially inclusive, and economically resilient gemstone mining in Taita Taveta County.

Statement of the Problem

Artisanal and small-scale gemstone mining (ASM) is a critical livelihood source in Taita Taveta County, with approximately 10,000 miners only 15% of whom are women engaged directly in extraction and processing (ASM Database, 2023). ASM contributes to about 60% of all gemstone production in the county, yet local mining communities continue to experience poverty, marginalization, and exclusion from key economic benefits (Policy Brief, 2022). Despite the presence of formal governance instruments such as the Mining Act (2016) and the Environmental Management and Coordination Act (1999), these frameworks have not effectively translated into sustainable practices, leaving most operations informal, environmentally destructive, and economically unproductive for communities (Mutembei et al., 2021; Mghanga, 2020).

A substantial gap persists between policy intentions and field-level realities, as statutory mandates like county-level Artisanal Mining Committees and structured licensing remain weakly enforced. In Taita Taveta, over 158 mining sites operate without proper permits, resulting in revenue losses and diminished regulatory oversight (Kenyan Wall Street, 2025). Additionally, only about 8% of ASM workers participate in gemstone processing activities such as cutting and polishing, of which approximately 81% are male highlighting gender disparities and limited local value addition (UNDP, 2018).

These shortcomings stem from institutional weaknesses, including the delayed operationalization of the Voi Gemstone Value Addition Centre, low technical capacity, poor inter-agency coordination, and limited

stakeholder inclusion (Tsavo Media Network, 2025; Okello & Omwenga, 2021). Consequently, the sector is trapped in a cycle of environmental degradation, unsafe pit mining practices, and minimal economic empowerment for miners (Daily Nation, 2025; Taita Taveta Sustainable Mining Action Plan, 2021–2025).

This study, therefore, investigates how existing policy frameworks and institutional support mechanisms influence the sustainable management of artisanal gemstone mining in Taita Taveta County. By identifying disconnects between regulatory design and ground-level implementation, and evaluating their impacts on environmental sustainability, economic equity, and community well-being, the research seeks to propose integrated strategies that are enforceable, inclusive, and contextually relevant.

Objective of the Study

The general objective of this study was to assess the role of policy frameworks and institutional support in promoting the sustainable management of artisanal gemstone mining in Taita Taveta County, Kenya. The specific objectives were;

- To examine the existing policy and legal frameworks governing artisanal gemstone mining in Kenya.
- To assess the effectiveness of institutional support mechanisms in implementing sustainable mining practices in Taita Taveta County.
- To evaluate the environmental and socio-economic impacts of artisanal gemstone mining in the study area.
- To identify gaps and challenges in policy enforcement and institutional coordination affecting sustainable mining outcomes.

The study tested the following null hypothesis

- **H₀1:** There is no significant relationship between existing policies and legal instruments and the governance of artisanal gemstone mining in Kenya.
- **H₀2:** Institutions involved in artisanal gemstone mining in Taita Taveta County do not significantly support sustainable mining practices.
- **H₀3:** Artisanal gemstone mining in the region has no significant environmental or socio-economic impacts.
- **H₀4:** There are no significant challenges hindering the effective enforcement of sustainable mining policies.

LITERATURE REVIEW.

Theoretical Review

A theory explains relationships among study variables and provides a basis for interpreting phenomena and guiding practice (Creswell, 2014). This study is grounded in Institutional Theory, Resource Dependence Theory, Evolutionary Governance Theory (EGT), and the Socio-Ecological Systems (SES) framework to examine how policy frameworks and institutional support influence sustainable management of artisanal gemstone mining in Taita Taveta County. Institutional Theory explains how formal rules, norms, and regulatory systems shape behaviour and legitimacy, highlighting that compliance with laws such as Kenya's Mining Act (2016) depends on community acceptance, institutional capacity, and the presence of coercive, mimetic, and normative pressures (Scott, 2014; DiMaggio & Powell, 1983; Greenwood et al., 2020; Mutembei et al., 2021). It also emphasizes institutional voids where weak enforcement or coordination sustains informality (Khanna & Palepu, 2010; Ayee, 2021). Resource Dependence Theory stresses that mining actors and institutions rely on external resources such as licensing, technical expertise, markets, and infrastructure, and that such interdependence shapes compliance, governance effectiveness, and sustainability outcomes (Pfeffer & Salancik, 1978; IPF Global, 2023; Tsavo Media Network, 2025). Evolutionary Governance Theory views governance as dynamic and co-evolving among actors, policies, and local practices,

explaining how historical networks, informal systems, and power relations influence adoption or resistance to reforms (Van Assche et al., 2014; Partelow et al., 2020). Complementing this, the Socio-Ecological Systems framework highlights the interdependence between environmental conditions, governance structures, and community livelihoods, showing that sustainable mining requires integrated responses addressing ecological degradation, economic resilience, and social wellbeing simultaneously (Berkes et al., 2003; Takyi et al., 2021; Tiamgne et al., 2022). Collectively, these perspectives provide a comprehensive theoretical basis for analyzing governance effectiveness and sustainability in artisanal gemstone mining.

Conceptual Framework

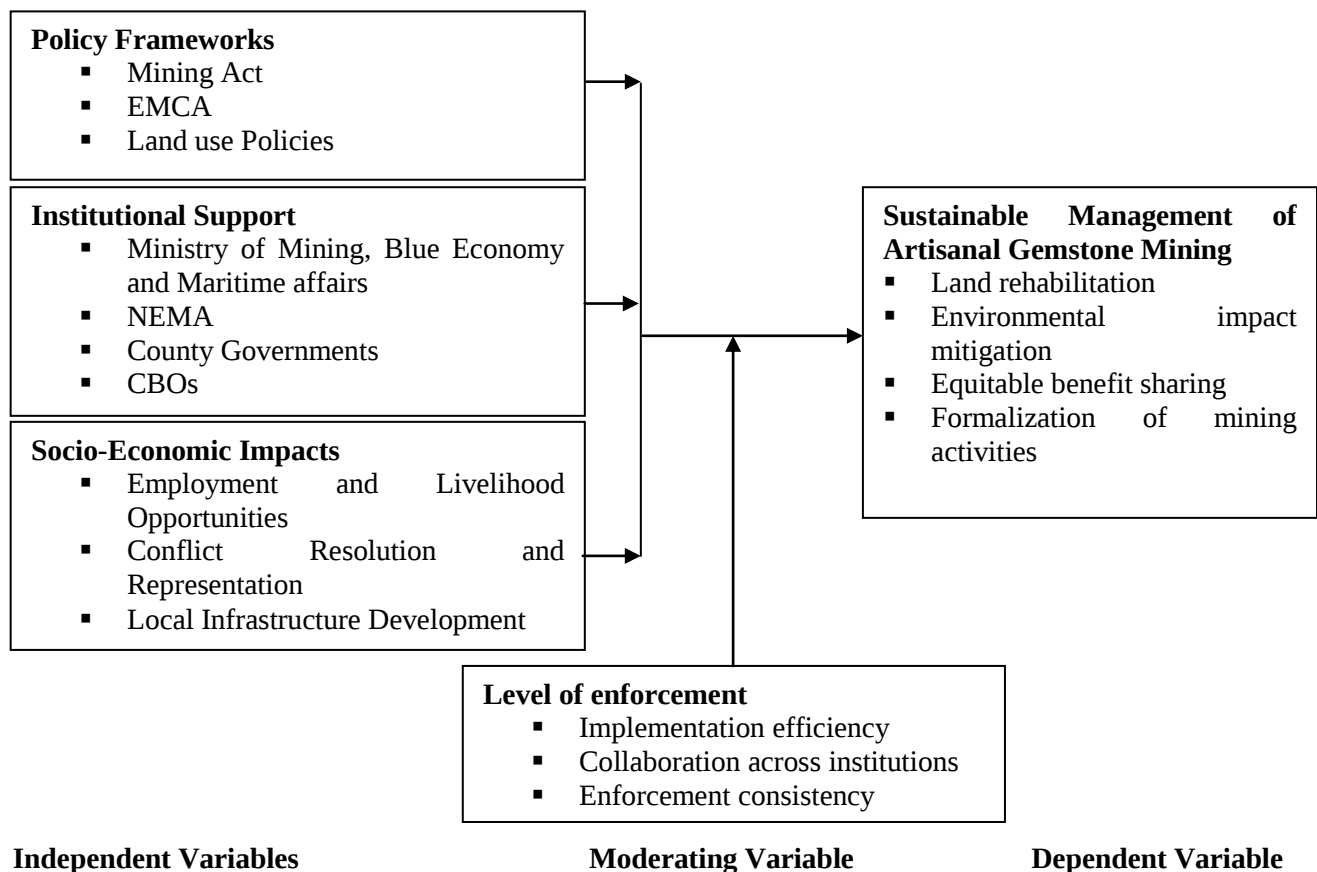


Figure 1: Conceptual Framework

Empirical Review

Empirical literature shows that policy frameworks and institutional support strongly shape the sustainability of artisanal and small-scale gemstone mining (ASM) in Kenya and particularly in Taita Taveta County. Kenya's Mining Act (2016) provides the primary statutory framework governing licensing, safety standards, royalties, and community engagement, while also promoting local value addition and structured market participation, although enforcement delays and bureaucratic inefficiencies often limit its effectiveness (Government of Kenya, 2016; Mutembei et al., 2021). Complementing this, the Environmental Management and Coordination Act (EMCA) embeds environmental safeguards such as impact assessments, rehabilitation requirements, and waste management obligations, contributing to ecosystem protection though inspection capacity constraints weaken consistent implementation (NEMA, 2019; NEMA, 2022). Land-use policies further influence sustainability by regulating zoning, tenure security, and land rehabilitation responsibilities, thereby reducing conflicts between mining, agriculture, and conservation activities (Government of Kenya, 2020). Institutional support mechanisms are equally critical: the Ministry of Mining has deployed inspectors, engineers, and geologists, facilitated artisanal cooperatives, and established the Voi Gemstone Value Addition Centre, although governance gaps and operational challenges persist (Government Advertising Agency, 2025; Tsavo

Media Network, 2025). Environmental oversight by NEMA and county advocacy for fair royalty distribution and community participation further demonstrate multi-level governance involvement (Kenya News Agency, 2025; The Star, 2023). Civil society initiatives, including women-focused safety and empowerment programs, strengthen technical capacity and inclusion among marginalized miners (The Star, 2021). Socio-economically, ASM generates employment, household income, and local business growth but also produces instability, health risks, land conflicts, and child labour concerns where regulation is weak (Hilson et al., 2021; Mutembei & Chepkemboi, 2023; Lahiri-Dutt, 2020; Mwadime et al., 2024; Gyamfi et al., 2022; Hilson & Maconachie, 2020). Enforcement challenges stem from limited institutional capacity, fragmented governance, corruption risks, and miners' livelihood dependence on informal operations (Mwangi et al., 2023; Omondi & Mutiso, 2024; Njoroge & Karanja, 2023; Kipkorir et al., 2024; Mutua & Wekesa, 2024). Studies emphasize that sustainable ASM requires integrated measures including land rehabilitation, environmental protection technologies, fair pricing systems, cooperative marketing, and formal licensing structures to ensure equitable benefit sharing and long-term ecological resilience (World Bank, 2020; Osiemo, 2021; Hilson et al., 2021; Mutembei et al., 2023). Overall, recent empirical analyses consistently highlight a persistent policy–practice gap driven by weak coordination, limited inspection capacity, complex licensing procedures, and entrenched informal networks, indicating that effective sustainability depends not only on legal instruments but on operational capacity, inclusive governance, traceability systems, and transparent revenue management (Delve, 2020; Nottingham Policy Brief, 2023; KHRC, 2024; Pact, 2024; Ministry of Mining, 2023).

METHODOLOGY

The study adopted a mixed-methods research design integrating qualitative and quantitative approaches to provide a comprehensive understanding of policy frameworks, institutional support, and sustainable artisanal gemstone mining in Taita Taveta County (Creswell & Plano Clark, 2023; Fetter & Freshwater, 2020). Mixed methods enable both measurable generalizable findings and context-rich insights while enhancing validity through triangulation of multiple data sources (Johnson et al., 2020; Venkatesh et al., 2022; Schoonenboom & Johnson, 2021). A concurrent triangulation strategy allowed simultaneous collection and integration of survey data, interviews, focus group discussions, and observations to improve analytical robustness (Morgan, 2022; Bryman, 2021). The target population comprised artisanal miners, government officials, NGO/CBO representatives, and community leaders within key mining zones such as Kasighau, Kamtonga, and Mkuki, reflecting the sector's broad stakeholder structure (Population Census Office, 2024; Taita Taveta Sustainable Mining Action Plan, 2023; Kenya News Agency, 2024; PactBarreto et al., 2018). Systematic probability sampling was applied, with sample size estimated at 384 respondents using the standard large-population formula (Alston & Bowles, 2019; Bell, Bryman & Harley, 2018). Data collection tools included structured questionnaires, semi-structured key informant interviews, focus groups, field observations, and document analysis to ensure methodological triangulation (Kothari, 2017; Creswell & Poth, 2020; Robson & McCartan, 2020; Bowen, 2020). Pilot testing improved instrument clarity and reliability, with validity assessed through expert review and reliability confirmed using Cronbach's $\alpha \geq 0.7$ (Hennink & Bailey, 2020; Gill & Johnson, 2010; Byrne, 2016; Creswell & Hirose, 2019). Data were analyzed using SPSS through descriptive statistics, correlation, ANOVA, and multiple regression modelling (Kothari, 2017; Bell & O'Hare, 2020; Alavi & Hąbek, 2016).

FINDINGS AND DISCUSSION

Response Rate

A total of 384 questionnaires were administered to stakeholders engaged in artisanal gemstone mining and associated institutional frameworks in Taita Taveta County. These included artisanal miners, county officials, national regulatory officers, and representatives of community-based organizations active within the gemstone value chain. Of the questionnaires distributed, 337 were completed and returned, yielding a response rate of 87.8% as summarized in Table 1.

Table 1: Response Rate

Questionnaire	Frequency	Percent
Returned	337	87.7
Un-returned	47	12.3
Total	384	100.0

Descriptive Analysis

In this section, the study presents the Likert scale items through which respondents were asked to indicate their level of agreement with various statements relating to policy frameworks, institutional support mechanisms, environmental and safety practices, socio-economic conditions, and the overall sustainable management of artisanal gemstone mining in Taita Taveta County.

Policy and Legal Frameworks

To obtain information about the first independent variable, Policy and Legal Frameworks, several statements were asked and the respondents were required to provide feedback on a Likert scale of one (1) to five (5). On the statement “The existing mining laws adequately address artisanal gemstone mining,” 12.4% of the respondents strongly disagreed with the statement, 21.3% disagreed, 30.7% neither agreed nor disagreed, 25.6% agreed, whereas 10.0% strongly agreed with the statement. The statement recorded a mean of 3.00 and a standard deviation of 1.157. These responses show that perceptions are mixed, with a sizeable portion unsure of the law’s effectiveness—consistent with studies noting persistent regulatory gaps in artisanal mining (Kimani & Mutua, 2021; World Bank, 2023).

On the statement “The Mining Act (2016) provides clear licensing procedures for artisanal miners,” 4.8% of respondents strongly disagreed, 10.7% disagreed, 22.9% neither agreed nor disagreed, 41.5% agreed, while 20.1% strongly agreed. The mean score was 3.61 with a standard deviation of 1.019. This shows that most respondents find the licensing framework clear, aligning with recent reports indicating that the Act streamlined licensing but still faces implementation challenges at county levels (Munyua, 2022; Chamber of Mines, 2024). For the statement “Environmental policies (e.g., EMCA 1999) are effectively enforced in gemstone mining,” 9.2% strongly disagreed, 18.4% disagreed, 36.5% neither agreed nor disagreed, 26.1% agreed, while 9.8% strongly agreed. The mean was 3.09 with a standard deviation of 1.083. The high neutrality suggests inconsistent environmental enforcement, a concern reflected in recent research on EMCA compliance in small-scale mining (Omondi & Were, 2020; UNEP, 2022).

On the statement “There is alignment between national and county mining policies,” 13.7% strongly disagreed, 24.5% disagreed, 28.9% neither agreed nor disagreed, 23.3% agreed, and 9.6% strongly agreed. A mean of 2.90 and a standard deviation of 1.161 were recorded. This indicates limited confidence in the harmonisation of national and county policies, consistent with findings that devolved mining governance still faces policy coordination issues (Kameri-Mbote et al., 2021; Moyo & Kivuva, 2023). Regarding the statement “Current policy frameworks promote sustainable mining practices,” 6.0% strongly disagreed, 14.3% disagreed, 27.2% neither agreed nor disagreed, 38.9% agreed, whereas 13.6% strongly agreed. The mean score was 3.40 and the standard deviation was 1.045. These results imply that respondents largely believe policies support sustainability, echoing recent literature emphasising Kenya’s increasing focus on responsible resource extraction (Njeru & Kariuki, 2023; African Natural Resources Centre, 2024).

For the statement “Mining regulations adequately protect community interests and rights,” 15.1% strongly disagreed, 22.4% disagreed, 25.3% neither agreed nor disagreed, 26.8% agreed, while 10.4% strongly agreed. The mean was 2.95 with a standard deviation of 1.192. The distribution shows that many respondents feel communities are inadequately protected consistent with studies highlighting weak social safeguards in Kenya’s ASGM sector (Mutemi & Kariuki, 2020; Human Rights Watch, 2022). On the statement “Policies provide clear guidelines for benefit-sharing from mining revenues,” 10.9% strongly disagreed, 19.8%

disagreed, 33.5% neither agreed nor disagreed, 25.7% agreed, whereas 10.1% strongly agreed. With a mean of 3.05 and a standard deviation of 1.106, the responses reveal ambiguity regarding benefit-sharing, echoing ongoing debates over how communities should receive fair compensation from mineral extraction (ICMM, 2023; Kenya Extractives Hub, 2024).

Finally, on the statement “There is transparency in policy formulation and review processes,” 12.0% strongly disagreed, 20.4% disagreed, 34.1% neither agreed nor disagreed, 24.8% agreed, while 8.7% strongly agreed. The mean was 2.98 with a standard deviation of 1.113. The high neutrality and moderate disagreement reflect respondents’ uncertainty about transparency, mirroring academic findings that policy processes in the extractives sector still suffer from limited stakeholder engagement (Transparency International, 2021; EITI, 2023).

Table 2: Policy and Legal Frameworks Frequencies

Policy and Legal Frameworks	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	Mean	Std. Dev.
The existing mining laws adequately address artisanal gemstone mining.	12.4	21.3	30.7	25.6	10.0	3.00	1.157
The Mining Act (2016) provides clear licensing procedures for artisanal miners.	4.8	10.7	22.9	41.5	20.1	3.61	1.019
Environmental policies (e.g., EMCA 1999) are effectively enforced in gemstone mining.	9.2	18.4	36.5	26.1	9.8	3.09	1.083
There is alignment between national and county mining policies.	13.7	24.5	28.9	23.3	9.6	2.90	1.161
Current policy frameworks promote sustainable mining practices.	6.0	14.3	27.2	38.9	13.6	3.40	1.045
Mining regulations adequately protect community interests and rights.	15.1	22.4	25.3	26.8	10.4	2.95	1.192
Policies provide clear guidelines for benefit-sharing from mining revenues.	10.9	19.8	33.5	25.7	10.1	3.05	1.106
There is transparency in policy formulation and review processes.	12.0	20.4	34.1	24.8	8.7	2.98	1.113

Institutional Support Mechanisms

To obtain information about the second independent variable, Institutional Support Mechanisms, numerous statements were asked and respondents were required to provide feedback on a Likert scale of one (1) to five (5), where on the statement “Government institutions provide adequate training for artisanal miners,” 14.3% of the respondents strongly disagreed with the statement, 22.1% disagreed, 28.4% neither agreed nor disagreed, 24.0% agreed, whereas 11.2% strongly agreed with the statement, with a mean of 2.96 and a standard deviation of 1.187. This shows that a substantial number of respondents are uncertain or dissatisfied with the extent of training provided to artisanal miners.

On the statement “Institutions offer financial or technical support to mining cooperatives,” 10.8% strongly

disagreed with the statement, 19.6% disagreed, 31.7% neither agreed nor disagreed, 25.3% agreed, whereas 12.6% strongly agreed with the statement, with a mean of 3.09 and a standard deviation of 1.154. The high level of neutrality suggests inconsistent access to financial or technical support across mining areas. On the statement “NEMA and the Ministry of Mining effectively monitor environmental compliance,” 12.0% strongly disagreed with the statement, 17.5% disagreed, 34.8% neither agreed nor disagreed, 26.0% agreed, whereas 9.7% strongly agreed with the statement, with a mean of 3.04 and a standard deviation of 1.128. This shows that most respondents perceive environmental monitoring as moderate or inconsistent.

Regarding the statement “Institutional coordination among stakeholders is strong and effective,” 15.5% strongly disagreed with the statement, 23.7% disagreed, 29.1% neither agreed nor disagreed, 21.8% agreed, whereas 9.9% strongly agreed with the statement, with a mean of 2.87 and a standard deviation of 1.176. These findings indicate that respondents generally perceive institutional coordination as weak or fragmented. On the statement “County government provides logistical and infrastructural support to miners,” 11.6% strongly disagreed with the statement, 20.8% disagreed, 30.2% neither agreed nor disagreed, 25.9% agreed, whereas 11.5% strongly agreed with the statement, with a mean of 3.05 and a standard deviation of 1.142. This shows mixed levels of satisfaction with county-level support.

On the statement “Local institutions promote safety and occupational health standards,” 9.2% strongly disagreed with the statement, 17.1% disagreed, 27.6% neither agreed nor disagreed, 33.7% agreed, whereas 12.4% strongly agreed with the statement, with a mean of 3.23 and a standard deviation of 1.139. This indicates that more respondents agree than disagree that local institutions promote safety standards. On the statement “Partnerships between NGOs and government enhance sustainable mining,” 8.4% strongly disagreed with the statement, 16.3% disagreed, 28.9% neither agreed nor disagreed, 32.8% agreed, whereas 13.6% strongly agreed with the statement, with a mean of 3.27 and a standard deviation of 1.142. These results suggest that respondents generally believe NGO–government collaboration contributes positively to sustainable mining.

Finally, on the statement “Institutional support programs are inclusive and gender-sensitive,” 12.7% strongly disagreed with the statement, 21.2% disagreed, 33.5% neither agreed nor disagreed, 22.4% agreed, whereas 10.2% strongly agreed with the statement, with a mean of 2.96 and a standard deviation of 1.156. This indicates moderate to low confidence in the inclusivity and gender sensitivity of current institutional programs.

Table 3: Institutional Support Mechanisms Frequencies

Institutional Mechanisms	Support	Strongly Disagree (%)	Disagree (%)	Neither nor (%)	Agree Disagree	Agree (%)	Strongly Agree (%)	Mean	Std. Dev.
Government institutions provide adequate training for artisanal miners.	14.3	22.1	28.4			24.0	11.2	2.96	1.187
Institutions offer financial or technical support to mining cooperatives.	10.8	19.6	31.7			25.3	12.6	3.09	1.154
NEMA and the Ministry of Mining effectively monitor environmental compliance.	12.0	17.5	34.8			26.0	9.7	3.04	1.128
Institutional coordination among stakeholders is strong and effective.	15.5	23.7	29.1			21.8	9.9	2.87	1.176
County government provides logistical and infrastructural support to miners.	11.6	20.8	30.2			25.9	11.5	3.05	1.142
Local institutions promote safety and occupational health standards.	9.2	17.1	27.6			33.7	12.4	3.23	1.139
Partnerships between NGOs and government enhance sustainable mining.	8.4	16.3	28.9			32.8	13.6	3.27	1.142
Institutional support programs are inclusive and gender-sensitive.	12.7	21.2	33.5			22.4	10.2	2.96	1.156

Environmental Impacts of Artisanal Gemstone Mining

To obtain information about the independent variable Environmental Impacts of Artisanal Gemstone Mining, numerous statements were asked and the respondents were required to provide feedback on a Likert scale of one (1) to five (5). On the statement “Artisanal mining activities have led to land degradation,” 3.6% of the respondents strongly disagreed with the statement, 6.8% disagreed with the statement, 14.7% neither agreed nor disagreed with the statement, 38.9% agreed with the statement whereas 36.0% strongly agreed with the statement, with a mean of 3.97 and a standard deviation of 1.062. This shows that a majority of respondents acknowledge land degradation as a major environmental impact linked to artisanal gemstone mining.

On the statement “Mining operations contribute to deforestation in the area,” 4.0% strongly disagreed with the statement, 8.4% of the respondents disagreed with the statement, 19.5% neither agreed nor disagreed with the statement, 37.2% of the respondents agreed with the statement whereas 30.9% strongly agreed with the statement, with a mean of 3.83 and a standard deviation of 1.081. These results indicate strong agreement that mining activities contribute to tree cover loss in the affected regions. Regarding the statement “There is pollution of water sources due to mining activities,” 2.4% strongly disagreed with the statement, 10.3% disagreed with the statement, 18.8% neither agreed nor disagreed with the statement, 40.5% of the respondents agreed to the statement whereas 28.0% of the respondents strongly agreed to the statement, with a mean of 3.82 and a standard deviation of 1.017. This demonstrates that most respondents believe artisanal mining significantly contributes to water contamination.

On the statement “Environmental rehabilitation measures are implemented after mining,” 13.5% strongly disagreed with the statement, 21.1% of the respondents disagreed with the statement, 33.8% neither agreed nor disagreed with the statement, 21.7% of the respondents agreed to the statement whereas 9.9% strongly agreed to the statement, with a mean of 2.92 and a standard deviation of 1.149. The results show that respondents generally believe that post-mining rehabilitation is weak or insufficient. On the statement “Use of eco-friendly mining methods has increased,” 10.4% strongly disagreed to the statement, 17.9% of the respondents disagreed to the statement, 34.7% neither agreed nor disagreed to the statement, 26.5% of the respondents agreed to the statement whereas 10.5% of the respondents strongly agreed to the statement, with a mean of 3.08 and standard deviation 1.132. These findings indicate limited progress in the adoption of environmentally friendly mining technologies.

On the statement “Local communities participate in environmental protection initiatives,” 7.2% strongly disagreed to the statement, 12.3% of the respondents disagreed to the statement, 29.5% neither agreed nor disagreed to the statement, 33.6% of the respondents agreed to the statement whereas 17.4% of the respondents strongly agreed to the statement, with a mean of 3.42 and a standard deviation of 1.140. This indicates moderate agreement that communities play a role in environmental conservation efforts related to mining.

Table 4: Environmental Impacts of Artisanal Gemstone Mining

Environmental Impacts of Artisanal Gemstone Mining	Strongly Disagree (%)	Disagree (%)	Neither nor (%)	Agree Disagree	Agree (%)	Strongly Agree (%)	Mean	Std. Dev.
Artisanal mining activities have led to land degradation.	3.6	6.8	14.7		38.9	36.0	3.97	1.062
Mining operations contribute to deforestation in the area.	4.0	8.4	19.5		37.2	30.9	3.83	1.081
There is pollution of water sources due to mining activities.	2.4	10.3	18.8		40.5	28.0	3.82	1.017
Environmental rehabilitation measures are implemented after mining.	13.5	21.1	33.8		21.7	9.9	2.92	1.149
Use of eco-friendly mining methods has increased.	10.4	17.9	34.7		26.5	10.5	3.08	1.132
Local communities participate in environmental protection initiatives.	7.2	12.3	29.5		33.6	17.4	3.42	1.140

Socio-Economic Impacts

To obtain information about the independent variable Socio-Economic Impacts, numerous statements were asked and the respondents were required to provide feedback on a Likert scale of one (1) to five (5), for 1 being strongly disagree, 2 being disagree, 3 being neither agree nor disagree, 4 being agree and 5 being strongly agree to the statements. On the statement “Mining has improved household income levels,” 5.2% strongly disagreed with the statement, 9.6% of the respondents disagreed with the statement, 21.1% neither agreed nor disagreed with the statement, 43.8% of the respondents agreed with the statement whereas 20.3% of the respondents strongly agreed with the statement, with a mean of 3.64 and standard deviation 1.084. This indicates that a majority of respondents acknowledge a positive contribution of artisanal mining to household income.

Regarding the statement “Gemstone mining has created employment opportunities,” 3.6% strongly disagreed

with the statement, 7.2% of the respondents disagreed with the statement, 18.3% neither agreed nor disagreed with the statement, 48.7% of the respondents agreed with the statement whereas 22.2% strongly agreed with the statement, with a mean of 3.79 and standard deviation 0.992. The results imply that artisanal gemstone mining is perceived to be a significant source of employment within the community. On the statement “Mining activities have promoted local business development,” 4.8% strongly disagreed with the statement, 11.6% of the respondents disagreed with the statement, 25.9% neither agreed nor disagreed with the statement, 40.2% agreed with the statement whereas 17.5% strongly agreed with the statement, with a mean of 3.54 and standard deviation 1.053. These findings suggest that mining supports local business growth, although some respondents remain neutral on the extent of impact.

On the statement “Miners have access to financial and credit facilities,” 14.7% strongly disagreed with the statement, 23.1% disagreed with the statement, 30.9% neither agreed nor disagreed with the statement, 20.4% agreed with the statement whereas 10.9% strongly agreed with the statement, with a mean of 2.89 and standard deviation 1.176. The distribution shows that most respondents perceive financial access for miners to be limited or inadequate. On the statement “The sector promotes gender inclusion and empowerment,” 10.0% strongly disagreed with the statement, 17.1% disagreed with the statement, 32.3% neither agreed nor disagreed with the statement, 27.9% of the respondents agreed with the statement whereas 12.7% strongly agreed with the statement, with a mean of 3.16 and standard deviation 1.142. This reflects moderate agreement but also significant neutrality, suggesting mixed perceptions about gender inclusivity.

On the statement “Artisanal mining contributes to infrastructure development in the community,” 7.6% strongly disagreed with the statement, 13.1% of the respondents disagreed with the statement, 30.2% neither agreed nor disagreed with the statement, 33.5% of the respondents agreed with the statement whereas 15.6% strongly agreed with the statement, with a mean of 3.36 and standard deviation 1.124. This indicates that while some community development has occurred, respondents perceive it as uneven or limited. Regarding the statement “Mining revenues are fairly shared among community members,” 15.9% strongly disagreed with the statement, 22.4% of the respondents disagreed with the statement, 31.1% neither agreed nor disagreed with the statement, 21.3% agreed with the statement whereas 9.3% strongly agreed with the statement, with a mean of 2.86 and standard deviation 1.173. The results show that many respondents believe revenue sharing mechanisms are weak or unfair.

Lastly, on the statement “There are adequate social welfare and health programs for miners,” 18.7% strongly disagreed with the statement, 25.3% disagreed with the statement, 29.5% neither agreed nor disagreed with the statement, 18.3% of the respondents agreed with the statement whereas 8.2% strongly agreed with the statement, with a mean of 2.72 and standard deviation 1.164. This demonstrates that most respondents perceive welfare and health support for miners as inadequate or insufficient.

Table 5: Socio-Economic Impacts of Artisanal Gemstone Mining Frequencies

Socio-Economic Impacts of Artisanal Gemstone Mining	Strongly Disagree (%)	Disagree (%)	Neither nor (%)	Agree Disagree (%)	Agree (%)	Strongly Agree (%)	Mean	Std. Dev.
Mining has improved household income levels.	5.2	9.6	21.1		43.8	20.3	3.64	1.084
Gemstone mining has created employment opportunities.	3.6	7.2	18.3		48.7	22.2	3.79	0.992
Mining activities have promoted local business development.	4.8	11.6	25.9		40.2	17.5	3.54	1.053
Miners have access to financial and credit facilities.	14.7	23.1	30.9		20.4	10.9	2.89	1.176
The sector promotes gender inclusion and empowerment.	10.0	17.1	32.3		27.9	12.7	3.16	1.142
Artisanal mining contributes to infrastructure development in the community.	7.6	13.1	30.2		33.5	15.6	3.36	1.124
Mining revenues are fairly shared among community members.	15.9	22.4	31.1		21.3	9.3	2.86	1.173
There are adequate social welfare and health programs for miners.	18.7	25.3	29.5		18.3	8.2	2.72	1.164

Policy Enforcement and Coordination Challenges

To obtain information about the variable Policy Enforcement and Coordination Challenges, several statements were presented to respondents who provided feedback on a five-point Likert scale, where 1 represented strongly disagree, 2 represented disagree, 3 represented neither agree nor disagree, 4 represented agree, and 5 represented strongly agree. On the statement “Weak enforcement of mining policies hinders sustainability,” 4.8% of the respondents strongly disagreed with the statement, 8.7% disagreed, 22.3% neither agreed nor disagreed, 38.9% agreed, whereas 25.3% strongly agreed. The statement recorded a mean of 3.71 and a standard deviation of 1.067. This indicates that most respondents believe that poor enforcement is a major obstacle to sustainable artisanal gemstone mining. Similar findings are reported in recent studies showing that weak regulatory enforcement limits environmental compliance and contributes to unsustainable extraction practices (Omondi & Were, 2021; UNEP, 2022).

Regarding the statement “Corruption affects implementation of mining regulations,” 3.2% strongly disagreed with the statement, 7.6% disagreed, 19.5% neither agreed nor disagreed, 41.8% agreed, whereas 27.9% strongly agreed. With a mean of 3.84 and a standard deviation of 1.015, the findings show widespread agreement that corruption undermines regulatory effectiveness. This aligns with literature that identifies corruption as a persistent barrier to transparent mineral governance in developing economies (Moyo & Kivuva, 2023; Transparency International, 2021). On the statement “Limited resources constrain monitoring and enforcement,” 5.6% strongly disagreed, 10.0% disagreed, 24.5% neither agreed nor disagreed, 37.5% agreed, while 22.4% strongly agreed, yielding a mean of 3.61 and standard deviation of 1.081. The responses show that respondents perceive monitoring agencies as financially and technically under-resourced. This finding reflects broader national challenges where inadequate staffing and limited budgets undermine regulatory operations (World Bank, 2023; Kenya Extractives Hub, 2024).

Concerning the statement “Overlapping institutional mandates create coordination challenges,” 6.4% strongly disagreed with the statement, 12.7% disagreed, 26.3% neither agreed nor disagreed, 36.0% agreed, whereas

18.6% strongly agreed. With a mean of 3.48 and a standard deviation of 1.086, the results indicate that institutional fragmentation contributes to policy conflict and duplication of roles. Academic analyses similarly highlight that overlapping responsibilities between national and county agencies complicate licensing, compliance, and inspection processes (Kameri-Mbote et al., 2021; African Natural Resources Centre, 2024).

On the statement “Political interference affects policy implementation,” 7.2% strongly disagreed, 11.6% disagreed, 25.9% neither agreed nor disagreed, 34.7% agreed, and 20.6% strongly agreed, giving a mean of 3.44 and standard deviation of 1.126. These results show that political influence is widely viewed as a barrier to effective regulatory action. Similar studies note that political interference often results in biased enforcement and protection of vested interests within extractive sectors (Human Rights Watch, 2022; ICMM, 2023).

Regarding the statement “Community awareness of mining laws is low,” 8.4% strongly disagreed, 16.3% disagreed, 28.9% neither agreed nor disagreed, 31.9% agreed, whereas 14.5% strongly agreed. The statement recorded a mean of 3.28 and a standard deviation of 1.141, indicating generally low awareness of mining laws among local communities. Recent assessments reveal that legal literacy remains weak, limiting community participation and compliance (Njeru & Kariuki, 2023; EITI, 2023).

On the statement “Inadequate stakeholder engagement limits sustainable outcomes,” 5.6% strongly disagreed, 14.7% disagreed, 27.5% neither agreed nor disagreed, 35.9% agreed, whereas 16.3% strongly agreed. With a mean of 3.43 and a standard deviation of 1.087, the results suggest that weak engagement of communities, miners, and local institutions is a challenge to sustainability. This supports literature emphasizing that participatory governance enhances legitimacy and effectiveness of mining policy implementation (Omondi & Mutua, 2020; Agenda Africa, 2022).

Lastly, on the statement “Poor data and reporting systems affect policy monitoring,” 9.1% strongly disagreed, 15.1% disagreed, 29.8% neither agreed nor disagreed, 30.2% agreed, whereas 15.8% strongly agreed, with a mean of 3.28 and a standard deviation of 1.151. These findings demonstrate that inefficiencies in data collection and reporting processes negatively affect transparency and oversight. This is consistent with recent reports calling for improved digital and statistical systems to support mining governance (World Bank, 2023; UNECA, 2022).

Table 6: Policy Enforcement and Coordination Challenges

Policy Enforcement and Coordination Challenges	Strongly Disagree (%)	Disagree (%)	Neither nor (%)	Agree Disagree (%)	Agree (%)	Strongly Agree (%)	Mean	Std. Dev.
Weak enforcement of mining policies hinders sustainability.	4.8	8.7	22.3		38.9	25.3	3.71	1.067
Corruption affects implementation of mining regulations.	3.2	7.6	19.5		41.8	27.9	3.84	1.015
Limited resources constrain monitoring and enforcement.	5.6	10.0	24.5		37.5	22.4	3.61	1.081
Overlapping institutional mandates create coordination challenges.	6.4	12.7	26.3		36.0	18.6	3.48	1.086
Political interference affects policy implementation.	7.2	11.6	25.9		34.7	20.6	3.44	1.126
Community awareness of mining laws is low.	8.4	16.3	28.9		31.9	14.5	3.28	1.141
Inadequate stakeholder engagement limits sustainable outcomes.	5.6	14.7	27.5		35.9	16.3	3.43	1.087
Poor data and reporting systems affect policy monitoring.	9.1	15.1	29.8		30.2	15.8	3.28	1.151

Overall Perception of Sustainable Management

To obtain information about perceptions of sustainability in artisanal gemstone mining, several statements were presented to respondents who rated them on a five-point Likert scale, where 1 represented strongly disagree, 2 represented disagree, 3 represented neither agree nor disagree, 4 represented agree, and 5 represented strongly agree. On the statement “Artisanal gemstone mining contributes positively to local development,” 4.4% of the respondents strongly disagreed, 9.8% disagreed, 23.5% neither agreed nor disagreed, 40.7% agreed, while 21.6% strongly agreed. The mean score recorded was 3.65 with a standard deviation of 1.067. These results indicate that a majority of respondents believe artisanal mining plays a positive role in local development, particularly through job creation and small business growth. This perception aligns with recent studies showing that artisanal mining often serves as a livelihood buffer and stimulates rural economies (World Bank, 2023; African Natural Resources Centre, 2024).

On the statement “The sector’s operations are environmentally sustainable,” 12.3% strongly disagreed, 21.1% disagreed, 29.8% neither agreed nor disagreed, 24.6% agreed, and 12.2% strongly agreed, with a mean of 3.03 and standard deviation of 1.152. The distribution shows significant disagreement and neutrality, implying that respondents perceive limited sustainability in current mining operations. This aligns with research highlighting persistent environmental concerns such as land degradation, water pollution, and deforestation in artisanal mining areas (UNEP, 2022; Njeru & Kariuki, 2023). Regarding the statement “Institutional partnerships enhance sustainable outcomes,” 5.9% strongly disagreed, 13.1% disagreed, 27.4% neither agreed nor disagreed, 36.8% agreed, and 16.8% strongly agreed. The mean score was 3.45 with a standard deviation of 1.106. These results suggest that respondents view collaborations—such as between government agencies, NGOs, and community groups—as important drivers of sustainability. This is consistent with literature noting that multi-stakeholder partnerships strengthen regulation, improve community engagement, and enhance environmental restoration efforts (ICMM, 2023; Agenda Africa, 2022).

On the statement “The mining community is aware of sustainable mining principles,” 10.6% strongly disagreed, 18.7% disagreed, 31.9% neither agreed nor disagreed, 26.7% agreed, and 12.1% strongly agreed, yielding a mean of 3.12 and standard deviation of 1.137. The high proportion of neutrality and disagreement indicates limited awareness of sustainable mining practices among mining communities. This aligns with recent findings that knowledge gaps and low legal literacy undermine compliance and hinder uptake of environmentally responsible mining techniques (EITI, 2023; Omondi & Mutua, 2020). Finally, on the statement “Current policy and institutional measures ensure long-term sectoral sustainability,” 11.4% strongly disagreed, 20.3% disagreed, 33.2% neither agreed nor disagreed, 25.1% agreed, and 10.0% strongly agreed. The statement recorded a mean of 3.02 and a standard deviation of 1.128. These results reflect modest confidence in existing policies and institutions to guarantee long-term sustainability. This is consistent with scholarship suggesting that although policies exist, enforcement capacity, institutional coordination, and resource availability remain major constraints (Kameri-Mbote et al., 2021; Kenya Extractives Hub, 2024)

Table 7: Overall Perception of Sustainable Management

Statement	Strongly Disagree (%)	Disagree (%)	Neither nor (%)	Agree Disagree (%)	Agree (%)	Strongly Agree (%)	Mean	Std. Dev.
Artisanal gemstone mining contributes positively to local development.	4.4	9.8	23.5		40.7	21.6	3.65	1.067
The sector’s operations are environmentally sustainable.	12.3	21.1	29.8		24.6	12.2	3.03	1.152
Institutional partnerships enhance sustainable outcomes.	5.9	13.1	27.4		36.8	16.8	3.45	1.106
The mining community is aware of sustainable mining principles.	10.6	18.7	31.9		26.7	12.1	3.12	1.137
Current policy and institutional measures ensure long-term sectoral sustainability.	11.4	20.3	33.2		25.1	10.0	3.02	1.128

Inferential Statistics

Regression analyses was used conducted to comprehensively examine the relationships among the study variables and to determine how the independent variables influence the dependent variable. It further by estimating the predictive power and unique contribution of each independent variable to the dependent variable while controlling for the influence of other predictors in the model. (Hair, Hult, Ringle, & Sarstedt, 2021). To determine how strategic leadership practices affects Overall Perception of Sustainable Management, the study computed multiple regression analysis. The results were placed on three tables presented and discussed in coming subsections.

Model Summary

The amount of dependent variable variation attributed to the behaviour of the independent variables was determined by computing a model summary. This study measured variation in Overall Perception of Sustainable Management as a result of changes in Policy and Legal Frameworks, Institutional Support Mechanisms, Environmental & Socio-Economic Impacts and Policy Enforcement & Coordination Challenges.

According to the results presented in Table 8, the value of R square is 0.877. This shows that 87.7% difference in financial performance can be credited to these changes in Policy and Legal Frameworks, Institutional Support Mechanisms, Environmental & Socio-Economic Impacts and Policy Enforcement & Coordination Challenges. The remaining 12.3% suggests other factors exist that are helpful in explaining variation in

Sustainable Management of Artisanal Gemstone Mining (Y) excluded in this study. The results also suggest the independent variables (Policy and Legal Frameworks, Institutional Support Mechanisms, Environmental & Socio-Economic Impacts and Policy Enforcement & Coordination Challenges).

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.936 ^a	.877	.868	.033767

a. Predictors: (Constant), Policy Enforcement & Coordination Challenges, Institutional Support Mechanisms, Policy and Legal Frameworks, Environmental & Socio-Economic Impacts

According to a study titled "Effect of Strategic Leadership Practices on Overall Perception of Sustainable Management" by Kennedy Ogollah Otiso and Dr. Isaac Ochieng of Jomo Kenyatta University of Agriculture and Technology (JKUAT), strategic leadership practices had a significant impact on the Overall Perception of Sustainable Management. The study found that effective strategic leadership practices, such as visioning, strategic planning, communication, and organizational culture, were positively correlated with the financial Overall Perception of Sustainable Management.

Analysis of Variance

Variance analysis (ANOVA) was used to determine the overall significance of the regression model. In this study, model significance was evaluated at the 5% significance level ($\alpha = 0.05$). ANOVA tests whether the variation explained by the independent variables is statistically greater than unexplained variation by comparing mean squares through the F-statistic.

The results presented in Table 4.17 show that the model is statistically significant, with a p-value of 0.000, which is well below the 5% significance threshold ($\alpha = 0.05$). A p-value less than 0.05 indicates that the probability of obtaining such results by chance is extremely low, leading to rejection of the null hypothesis and confirmation that the predictors jointly influence the dependent variable (Kwak, 2023; Singh & Patel, 2024). This conclusion is further supported by the F-statistics, where the F-calculated value of 16.344 exceeds the F-critical value of 2.550 ($F_{4,333}$), demonstrating that the combined effect of the independent variables significantly improves the model's explanatory power compared to an intercept-only model. Contemporary statistical literature affirms that when F-calculated is greater than F-critical, the regression model is considered robust and meaningful in explaining variance in the outcome variable (Bujang, 2025; Li & Chen, 2022).

Table 9: ANOVA Table

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	1.233	4	.308	92.716	.000 ^b
Residual	.173	333	.003		
Total	1.406	337			

a. Dependent Variable: Sustainable Management of Artisanal Gemstone Mining (Y)

b. Predictors: (Constant), Policy Enforcement & Coordination Challenges, Institutional Support Mechanisms, Policy and Legal Frameworks, Environmental & Socio-Economic Impacts

Regression Coefficients of the Study Variables

This regression equation model was used to fit the regression coefficient.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where, Y= Overall Perception of Sustainable Management, β_0 = constant (coefficient of intercept), X_1 = Policy and Legal Frameworks s; X_2 = Institutional Support Mechanisms; X_3 = Environmental & Socio-Economic Impacts; X_4 = Policy Enforcement & Coordination Challenges; ε = error term.

From the findings presented in table 4.18 below, the following regression equation was fitted;

Multiple regressions

$$Y = 1.347 + 0.347 X_1 + 0.196 X_2 + 0.338 X_3 + 0.279 X_4 + \dots + v$$

The regression results show that when all predictor variables Policy and Legal Frameworks, Institutional Support Mechanisms, Environmental & Socio-Economic Impacts, and Policy Enforcement & Coordination Challenges are held at zero, the Sustainable Management of Artisanal Gemstone Mining retains a baseline value of 1.347, representing the intercept of the model. The coefficient for Policy and Legal Frameworks ($\beta = 0.347$, $p = 0.001$) indicates a strong positive effect on sustainable-management outcomes, suggesting that improved regulatory clarity and strategic leadership significantly enhance governance in artisanal mining.

These findings align with recent studies showing that well-designed mining policies and legal structures strengthen compliance and sustainability performance in the extractive sector (Hilson & Maconachie, 2020; Mutemeri et al., 2021). The results also show that Socio-Economic Impacts significantly predict sustainable management ($\beta = 0.279$, $p = 0.013$), implying that improvements in livelihood benefits, social protection, and economic opportunities directly enhance community perceptions of sustainable gemstone mining. This pattern is supported by evidence from West African ASM contexts where socio-economic gains were found to be strongly associated with support for sustainable mining reforms (Nyame et al., 2022).

Environmental Impacts also exhibit a significant positive effect on sustainable management ($\beta = 0.338$, $p = 0.018$), demonstrating that enhanced environmental practices such as reclamation, pollution reduction, and responsible land use contribute meaningfully to sustainability perceptions. Similar conclusions were reported in a 2023 SEM analysis showing that environmental responsibility is a key antecedent of mining sustainability outcomes (Nogueira et al., 2023).

Finally, Institutional Support Mechanisms ($\beta = 0.196$, $p = 0.041$) show a positive and significant relationship with sustainable management, highlighting the importance of government capacity, administrative support, and institutional coordination in sustaining responsible mining practices. These results are consistent with recent research, such as Banda and Ng'andwe's (2024) findings in Zambia, which confirmed that institutional support and regulatory services significantly improve performance and sustainability among small-scale mining enterprises. Collectively, the empirical evidence corroborates the regression model's indication that legal frameworks, socio-economic conditions, environmental practices, and institutional structures are critical drivers of sustainable artisanal gemstone mining in contemporary African mining contexts.

Table 10: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	1.347	0.258		5.221	.000
Policy and Legal Frameworks	0.347	0.103	0.439	3.369	.001
Institutional Support Mechanisms	0.196	0.077	0.226	2.545	.041
Environmental & Socio-Economic Impacts	0.338	0.138	0.402	2.449	.018
Policy Enforcement & Coordination Challenges	0.279	0.108	0.327	2.583	.013

a. Dependent Variable: Overall Perception of Sustainable Management

CONCLUSION AND RECOMMENDATIONS

The study concluded that achieving Sustainable Management of Artisanal Gemstone Mining requires a deliberate reorganization of the mining sector's governance and operational systems, much in the same way strategic leaders restructure organizations to align processes with an agreed strategic direction. Strong policy

and legal frameworks must be operationalized through coordinated structures at both national and county levels so that miners, institutions, and local communities work from a common script that reflects a unified sustainability strategy. The findings showed that clear licensing systems, transparent benefit-sharing guidelines, and harmonized regulations play the same integrative role that strategic leadership plays in corporate performance providing stability, clarity, and a shared sense of purpose. The study therefore concluded that sustainable management is not merely about having policies on paper, but about envisioning the future of the gemstone sector in a coherent, collectively owned framework and ensuring that regulatory and institutional actions consistently steer the sector toward that ideal.

The study further concluded that sustainable artisanal mining is a multi-dimensional outcome shaped by the interaction of institutional support, environmental stewardship, socio-economic benefits, and effective enforcement. These dimensions function like the various elements of strategy implementation in an organization each dependent on leadership, coordination, and shared commitment to common goals. Institutional actors, much like strategic leaders in high-performing organizations, serve as the pivotal link that binds different actors and processes, ensuring alignment, coherence, and collective responsibility. Effective enforcement, community empowerment, and equitable socio-economic outcomes create the joint connection between policies and practice, allowing sustainability initiatives to move from intention to action. In this regard, the study established that institutional leadership, governance coherence, and participatory engagement remain the central pivot around which sustainable artisanal gemstone mining revolves, providing the essential unity of resolve and singularity of focus required for long-term sectoral success.

The study recommended that adequate institutional and regulatory resources be allocated to the artisanal gemstone mining sector and that such resources be released in a timely, predictable manner to ensure smooth operational functioning across all mining-related processes. Just as business portfolios fail when starved of essential inputs, mining operations both regulatory and productive cannot deliver sustainable outcomes without proper staffing, technical tools, environmental monitoring equipment, and consistent financial support. When agencies such as the Ministry of Mining, NEMA, and county departments receive sufficient resources, they are better positioned to conduct inspections, train miners, enforce safety standards, and guide communities toward responsible mining practices. In this regard, the sector's sustainability will only thrive when institutions have the capacity to meet the complexities of artisanal mining and respond to the needs of miners efficiently and professionally.

It is further recommended that ethical governance and community-centered values be firmly embedded within the culture of mining institutions and organizations operating in the gemstone value chain. The study establishes that when miners, cooperatives, local leaders, and regulatory agencies operate from strong ethical foundations emphasizing fairness, transparency, environmental respect, and responsible community engagement their actions yield higher community trust and better compliance with sustainability guidelines. Similar to how ethical behavior strengthens customer loyalty in service organizations, ethical mining practices build long-term commitment from communities, reduce conflict, and foster collective stewardship over mineral resources. When miners feel valued, protected, and treated with fairness, they not only support sustainable mining practices but also become ambassadors who influence their peers, families, and local networks, thereby contributing to the overall growth and positive transformation of the artisanal gemstone mining sector.

Suggestions for further research

The study suggests that future research should explore the deeper dynamics and lived experiences within artisanal gemstone mining communities, especially focusing on how cultural norms, social networks, and informal governance structures influence sustainable mining practices. While the present study concentrated on policy, institutional, environmental, and socio-economic dimensions, there remains a wide space for research examining gender roles, youth involvement, indigenous knowledge systems, and risk-sharing

mechanisms within mining households. Understanding these social and behavioral dimensions can generate richer insights into how miners make decisions, how compliance can be strengthened from within communities, and how sustainability initiatives can be tailored to align with local realities. Longitudinal studies that track miners over time would also be valuable in capturing shifts in livelihood conditions, environmental outcomes, and governance reforms as they unfold.

Further research should also investigate the broader value chain that artisanal gemstone mining feeds into, including trading networks, processing centers, export systems, and the influence of international markets on local sustainability efforts. Examining how pricing transparency, market access, and global ethical-sourcing standards affect miners' incentives can provide a more holistic view of the sector beyond extraction alone. Additionally, future studies may employ mixed methods or spatial data approaches to map environmental degradation patterns, assess enforcement effectiveness, and model how institutional reforms can reshape sustainability outcomes. Such research would not only enrich academic discourse but also support policymakers, development partners, and industry actors in designing informed, context-specific strategies that strengthen the long-term sustainability of artisanal gemstone mining.

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