

The Moderating Role of Indigenous Knowledge Systems in the Relationship between Social Sustainability and Performance of Artisanal Miners in Bindura, Zimbabwe

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Abstract

Indigenous Knowledge Systems (IKS) have been noted to improve social sustainability development efforts in localised communities. In the context of artisanal miners (AMs), the argument is that including IKS in social sustainability (SS) efforts leads to improved financial and operational performance of these entities. In the Zimbabwean context, there is a dearth in the literature to support this argument. Thus, there is a research gap in the studies on how IKS influences SS practices of AMs and how this moderation impacts the financial and operational performance of the AMs. The study seeks to establish the moderating effect of IKS on the relationship between SS practices and the performance of AMs. The study is based on the positivist research philosophy and uses the deductive approach. The quantitative method is used. Data for the study were collected using questionnaires distributed to AMs in Bindura District of Mashonaland Central. A total of 372 responses were obtained from a sample of 400, indicating a 93% response rate. The study found that IKS have a statistically significant positive moderating role in the relationship between SS and the performance of the AMs. This means that if AMs include elements of IKS in their SS practices, they stand a high chance of improving their operational and financial performance. The study contributes to the sustainability agenda through showing how IKS can be used as a vector in improving the performance of AMs once it gets integrated in the SS practices.

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The study provides empirical findings on how IKS moderates the impact of SS on performance, in the context of AMs.

Keywords: *artisanal mining; sustainable development; gold mining, policy, sustainability*

INTRODUCTION

Social sustainability (SS) refers to the use of resources which addresses issues of intra- and inter-generational equity and stresses the relationships between human activities and stakeholders, including the local community (Muthu, 2014:1). This understanding of SS shows that it is concerned mainly with the lives and livelihoods of humans in a community. The main differences between SS and environmental sustainability are that environmental sustainability focuses on the use of intra- and intergenerational resources which affect the flora and fauna around the community, while SS deliberates on livelihoods of community members. The difference between SS and economic sustainability is that economic sustainability focuses on the use of financial resources to generate revenue and profit. Governance sustainability, on the other hand, focuses on the politics of power, leadership and the running of entities, communities or countries, while performance is defined as the effectiveness of conversion of raw materials or inputs into desired output (Moumin, 2024:1). The effectiveness and efficiency of the process through which inputs are channelled to become the desired output, which is highly fit for the desired purpose, therefore, becomes high performance. In simpler terms, performance is the effective and efficient rate of conversion of input to output (Guttermann, 2023). On the flip side, indigenous knowledge systems (IKS) refer to the ways of knowing inherent within communities through culture and tradition and have stood the test of time in their teachings and applicable wisdom (Mapara, 2009). The research problem is centred on understanding the impact which SS practices have on operational and financial performance of artisanal miners (AMs). The study also considers the moderating role of IKS in the relationship between SS and performance of AMs.

Literature shows that small-scale and artisanal miners (SAMs) have a significant negative impact on society (Funoh, 2014:10). The SAMs are said to promote acts of violence, prostitution (Metcalf, 2008:58), crime, moral decay,

health hazards (Gibb and Leary, 2014), culture dilution, child marriages, child labour and other forms of social ills which speak against the agenda of social sustainability (Laing and Pinto, 2023:3). Despite this negative reputation, other scholars have acknowledged the positive contribution of SAMs towards social sustainability, including acts of Corporate Social Responsibility for established SAMs (Hilson and Maconachie, 2020), security enforcement in other instances (Finn *et al.*, 2024) and even community development agendas as cited by Hilson (2025). However, most of the SAMs' contribution can be found to be negative, particularly in developing countries. The other argument is that SAMs go into mining as a last resort to fight poverty (Laing and Pinto, 2023), usually the less educated and disadvantaged people end up as SAMs. This leads them to being very irritable, lacking in understanding and prone to violence and other social ills. Lack of education and the desperation prompted by these conditions lead the SAMs to loose morals and contribute negatively towards SS. Thus, the argument can be made that the negative contribution towards social sustainability is a cry for help from the SAMs as they experience a lot of push factors leading to their behaviour. Sadly, this does not negate the fact that they are contributing negatively towards SS.

In the context of Sustainable Development Goals (SDGs), the globe and the Zimbabwean government alike are pushing towards achievement of the SDGs by the year 2030 and among the SDGs are those that speak of SS. The call to create sustainable communities and cities (SDG 11), decent work (SDG 8) and reduced inequalities (SDG 10), among other SDGs, shows a concern to heed SS in industrial practices. The Zimbabwean government has further called for the SAMs to increase their contribution towards the development of the country and communities in which they operate (Marume, 2023).

A heritage-based development model refers to the sustainable approach that utilises a local community's tangible and intangible cultural, historical and natural assets as the foundation for economic growth and development (Ripp and Clifford, 2025). The heritage-based approach, therefore, leverages the IKS within a community to further its development because IKS are parts of the intangible assets available within a community. The heritage-based development model employed by the government leads to a paradigm shift in the approach to education and industry alike. The call to include traditional

methods, cultural dynamics and other forms of IKS in industrial and educational practices leads to a unique opportunity for industry to progress by taking a step back and observing how the community of old made their sustainable living (Ncube *et al.*, 2025). Thus, there is need to try and understand if the inclusion of such IKS in the industrial processes increases the performance of the mining industry. The argument of this study is that the inclusion of IKS in the social sustainability of SAMs improves financial and operational performance of AMs. This argument aligns with the Government of Zimbabwe's thoughts, which also advocates for inclusion of IKS in the heritage-based approach to education and industry (Ndongwe, 2026:3169).

The desire to integrate IKS in the heritage-based approach to development shows potential to benefit significantly from the industry and education approach in developing countries such as Zimbabwe. In this light, this study aims to demonstrate the moderating effect which IKS have on the relationship between social sustainability and performance of artisanal miners in Mashonaland Central in Zimbabwe. The research questions in this regard are as follows:

1. Does social sustainability have a statistically significant positive impact on financial and operational performance of artisanal miners in Bindura, Zimbabwe?
2. Does the inclusion of IKS in social sustainability practices significantly change the relationship between social sustainability and operational and financial performance of artisanal miners in Bindura, Zimbabwe?

In this regard, the study established a hypothesis which are stated as follows:

H0: *IKS has no effect as a moderator on the relationship between social sustainability and performance of artisanal miners in Mashonaland Central in Zimbabwe.*

H1: *Indigenous Knowledge Systems positively moderate the relationship between social sustainability practices and artisanal miners' performance.*

CONCEPTUAL FRAMEWORK

The study formulated a conceptual framework. Figure 1, the conceptual framework, depicts the intention of the study and the variables which the study sought to explore. The study seeks to understand the relationship between SS

and performance of AMs, while considering if indigenous knowledge systems have a bearing on this relationship.

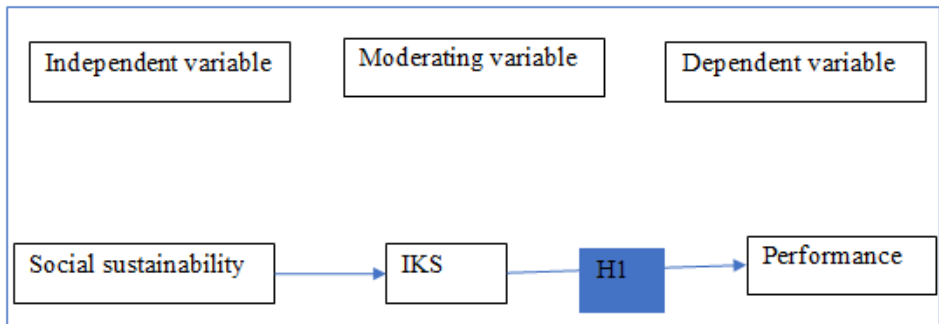


Figure 1: *Conceptual framework* (Researchers’ Conceptualisation, 2026)

LITERATURE REVIEW

The following section shows the literature review conducted in the study. The section shows the theoretical framework of the study, the empirical evidence and the conceptual framework which the study derived. The theory of the study was the Sustainable Development Theory. The main thematic areas in the study are SS, IKS, performance and the relationship between SS, IKS and performance.

THEORETICAL FRAMEWORK

The Sustainable Development Theory was propounded through the works of Brundtland (1987). The Brundtland Commission investigated the needs for sustainability and indicated that they should increase or improve the state of resources to enable current generations to meet their needs and ensure that future generations also meet their needs. Scholars this like Elkington (1997) propounded the triple bottom line (TBL) concept to substantiate and articulate issues of sustainability by introducing the perspective of social, environment and economic aspects of sustainability. The theory has further developed to include considerations of governance in modern Environment, Social and Governance (ESG) issues which form the basis of sustainability in corporate contexts (Zenda *et al.*, 2025). The SS issues are emphasised in the different perspectives of the concepts of sustainability. The key SS issues highlighted in the theory include concerns on community development, corporate social

responsibility, human-wellbeing, human rights, equity, democratic government and democratic civil society (Bostrom, 2012; Missimer and Mesquita, 2021). The following section delves more into the SS issues.

REVIEW OF RELATED LITERATURE

Social sustainability is a factor of sustainability as a whole and comes from the categorisation by Elkington (1997), where he showed the sustainability issues in a TBL of social, economic and environmental sustainability. SS has become a distinct aspect of sustainable development (SD) under the modernised ESG approach (Greenwald, 2021). SS has also been closely associated with Corporate Social Responsibility (CSR) (*ibid.*). SS refers to the identification and management of business impacts, both positive and negative, on people (Foster and Viale, 2020). This extends to the quality of corporate relationships with stakeholders (both internal and external) (*ibid.*). Thus, SS can be viewed as a business license to operate in a community (Meesters *et al.*, 2020). The interconnectedness of society, stakeholders, ethics, human rights, health, welfare and issues of equality/equity shows the vast focus of SS.

In the SDGs context, the major focus on SS includes SDGs on ending poverty, ending hunger, education, equality, sustainable communities, justice and peace, and collaboration with other stakeholders to achieve the SDGs (Zenda *et al.*, 2025). In the context of CSR, SS stands out because CSR is mainly an effort of the organisation to reach out to the community and give back for what they get out of the community. The aspects of the “social conscience” of an entity also come under the SS spectrum, as these show how a business strives to act as a corporate citizen within a social context (Meesters *et al.*, 2021). This implies that the business operates as part and parcel of the community and the business draws on humanistic characteristics. Such an argument was also presented in previous studies (Masuku, 2025). In the measuring of SS, the main thematic issues used include the focus on welfare of employees, welfare of the local community, issues of CSR, ethical issues in the workplace and ethical conduct of business in marketing, and ethical conduct with the local community. In mining, issues of child labour, prostitution and violence are also considered under social sustainability issues.

Indigenous Knowledge Systems refers to the enduring information which societies possess, mainly through their experiences and ways of life (Masunda and Chahwanda, 2025). These IKS predate colonialism and Western-oriented knowledge (Mapara, 2009). The formation of IKS was mainly to address various survival challenges (Mapira and Mazambara, 2013). Therefore, one can understand IKS as the knowledge resulting from adaptation and pressure from challenges. In one of the most eloquent arguments for IKS as a moderator for SS, Mawere (2010) brings forth that IKS can be used to administer peace, harmony and order among people and their physical environment. It is in this peace, harmony and order within the community that one can claim to have a truly sustainable society. The preservation, education and continuation of the practices which bring about peace, harmony and order is what IKS is based on. The continued experience of peace, harmony and order is SS. Therefore, SS is a factor of the practices of IKS and the IKS of a community can significantly influence the SS of the community. The disadvantage of IKS is how they were demonised by the colonial white settlers who associated IKS practices with witchcraft, unholiness and uncleanness (Mapara, 2009). The key elements of IKS were based on spiritual understanding and mutual respect between humanity, flora, fauna and the spiritual realm (Mugambiwa, 2021). The IKS and beliefs were vandalised by the whites and were replaced by religion, especially Christianity. The moral decay witnessed in modern society has been linked to the marginalisation of IKS through colonialism and Christianity (Mawere, 2010; Mapara, 2009).

IKS have various aspects to them, ranging from spiritual issues, social taboos, culture, traditions, norms, education, survival skills and other elements where they exist. IKS also touch on various facets of life, including agriculture, climate, botany, medicines, health, spirituality and governance (Dube and Munsaka, 2018). In agriculture, IKS were used for planning planting dates, harvest times, rainfall patterns and other farming activities (Tenson, 2017). Closely related to agriculture were issues of climate and weather forecasting, which IKS were used extensively for planning activities such as travel schedules (Sithole, 2020). A fascinating example of the use of IKS is when birds were used to foretell rainfall between 2-3 days ahead of time. Once the bird was spotted flying at certain altitudes, it signalled the high probability of rainfall (Mugambiwa and Makhubele, 2021). Such IKS were useful and showed the

connection between nature, animals and humans. The availability of water, healing herbs, medicines, charms for protection and other spiritual energies were well known in botany, medicine and spirituality and these were IKS well protected by *n'anga* (traditional healers/magicians/ spiritual guides) or *svikiro* (spirit medium/intercessor).

Regarding mining activities, literature is scarce on how IKS were used, but it can be established that IKS were used to detect gold belts, to perform mining rituals, to perform alluvial mining (*kuwonga*), to perform open cast mining and even shaft mining (Chipangura, 2023). There is archaeological evidence in Masvingo at the Great Zimbabwe ruins and other ruins in Nyanga, showing mining, gold panning and other mining activities, including spiritually inclined mining activities (Chipangura, 2019). The conservation and security of mines was done through IKS-influenced methods, passed on generations and were well-known to the community in which the mining was taking place (Maunganidze, 2016). Gold smelting skills were not taught in colonial school systems but rather were passed on through IKS. Several rituals were also tied to mining activities and these included beer-brewing festivals (*mapira*) for protection and safe exploration, especially in underground mining (Reniko *et al.*, 2018).

To this day, it is believed in mining communities that unless these rituals are performed, gold will be scarce despite technologies used to try and extract it. Gold is believed to be wealth given by ancestral spirits to people who appease them (Zikhali, 2018). The spiritual connection between minerals and the community is far reaching and very strong, leading to assumptions that the whole process of mining should be done spiritually (Nkomo, 2022). There are assumptions that the downside of the spirituality of gold is how other miners end up using evil spirits (*kuromba makona* or simply *kuromba*) to try and gain an unfair advantage over others in the mining operations (Thornton, 2018). It is also believed that *kuromba makona* involves blood rituals and human sacrifices, leading to the killing and maiming of relatives or other community members. This kind of spiritual access to minerals is undesirable for the community and is often the highlight of the spiritual connection of mining activities. All these spiritual activities are done through IKS, for there is a less academic approach to them and there is also little academic evidence for the case but they remain

topical issues in the community nevertheless. Thus, it becomes difficult to divorce the idea of social sustainability from indigenous knowledge systems because IKS appear to inform much of what SS seeks to achieve.

Performance is a measure of how effectively and efficiently a process achieves its objectives (Colbran *et al.*, 2019). Performance takes various contexts but the main aspects to consider in a business setting are operational performance (OP), financial performance (FP) and Non-Financial Performance (NFP). OP refers to the efficient and effective execution of tasks to achieve the set goals of the business measurable in output, sales volumes and other metrics (Hamman *et al.*, 2013). FP, on the other hand, refers to the effective and efficient conversion of inputs to outputs for an economic gain towards the entity, which is often seen as profit or surplus (Hamman and Schiemann, 2021). NFP refers to the effective and efficient conversion of resources into output to achieve other targets set by the entity which do not necessarily carry a financial value; these include issues of sustainability (environmental performance, social performance, governance performance, CSR and other facets of NFP) (Crucke and Decramer, 2016). Performance, therefore, is usually understood as a measure of achievement against set targets. This can be expressed as a percentage or any other quantifiable metric.

In mining, performance is measured against the output of minerals *vis-à-vis* the inputs used to achieve the mineral output. For AMs of gold, their performance becomes a measure of the gold output against labour, materials and supplies/expenses which will have gone into the gold extraction process (Hilson and Maconachie, 2020). SAMs are fighting poverty through mining, thus there is little concern for profitability, sustainability and other factors of performance (Mkodzongi, 2023). Their main concern is getting enough to survive. This leads to them being short-changed in gold selling and other business aspects of the gold mining process. They sell to the available bidder, not the highest bidder; that is why middlemen take advantage of the SAMs and buy the gold at giveaway prices. Other scholars have generally argued SAMs are uneducated, without much financial knowledge, law and basic mathematics, leading to them being taken advantage of in the business aspect of mining (Stemn *et al.*, 2021). What these factors do to SAMs is that they work interconnectedly to disadvantage the SAMs so that their performance is very low. Their financial

performance is poor, either teetering on break-even or even dwindling into loss (Ngwerume and Muchemwa, 2025). There is a misconception of profit and revenue for the SAMs, leading to them not even understanding if their endeavours are profitable or not. These further strain their financial sustainability and trap them in an endless cycle of poverty and hard work. The NFP is poor as well because most of the time the SAMs do not give much consideration to issues of sustainability; they prioritise revenue (*ibid.*). The financial management (FM) of the SAMs is also poor because when the majority of SAMs they make money, they spend it extravagantly (on alcohol, parties and impulse buying) (Nkomo, 2022). Thus, the financial management, financial performance, financial literacy, financial reporting, strategic management and sustainability performance of SAMs is very low and uninformed, often leading into the poverty trap, failure to grow and a repetitive vicious cycle.

Social sustainability, is recognised as sustainable livelihoods, safe working conditions and/or respect for workers' rights has been found to have a positive relationship with organisational performance. Shumba *et al.* (2025) finds that better SAM performance leads to more sustainable livelihoods for employees, thus indicating a positive relationship. Becker *et al.* (2021) further advances this understanding by propounding that SS issues are required for more productive runs in mines. In large mines, SS has been seen as a driver in enhancing performance (Nyamudzodza *et al.*, 2025). CSR activities fuel the 'social license to operate' for entities, indicating that there is a significant impact of SS on the operations and image of the entities.

The moderating role of IKS in the relationship between SS and performance is not a well-researched area in Zimbabwe. The literature is scarce and there is a dearth in the empirical studies done in Zimbabwe towards understanding the relationship between SS and performance and particularly the moderating role of IKS. The IKS inform SS in African settings. An example of IKS informing SS can be seen through the reliance on IKS for traditional chiefs to make decisions on rulings in customary law in countries like Zimbabwe (Nyahunda, 2024), and the use of totems to promote social relationships and preserve relations in the ChiShona culture in other parts of Zimbabwe (*ibid.*). The inclusion of IKS in SS issues is largely because the African Traditional Systems

(ATS) prioritise harmony between community, environment and humanity. Despite the unavailable literature, there are suggestions that social systems among Africans enhance sustainability and community development (Buthelezi *et al.*, 2024; Mwapaura *et al.*, 2024). Therefore, this study seeks to explore this under-researched area and shed light on the moderating effect of IKS on the relationship between SS and organisational performance in the context of mining entities.

STUDY DESIGN AND METHODOLOGY

The study is guided by the positivist paradigm. The deductive approach was adopted for this study, where the hypothesis was developed and tested through quantitative methods. A quantitative methodology was employed using data obtained from a survey. The study focused on a cross-sectional time horizon. Therefore, information collected was for a particular point in time and not based on a trend analysis. The survey used a Likert-scale questionnaire to collect the data. The target population was unknown at the time of the study because the number of SAMs in Bindura could not be accurately determined. The sample size was determined using the Cochrane's formula for unknown populations at the 5% level of significance, assuming a 95% confidence level (assuming $Z = 1.96$). The following shows the calculation of the sample size.

$N = \text{unknown}$; $Z = 1.96$; $e = 0.05$ (5%), the result is 385 for a sample. Therefore, the study rounded up the sample size to 400 respondents.

The sample was determined to be 400 respondents which the study chose using random sampling in the study area. The study got a response from 372 from the desired 400 respondents ($n=372$), indicating a 93% response rate. Random sampling was done to ensure that the respondents represented the target population well. The randomisation was achieved through visiting the research sites at random times during the day and also randomly asking the participants to answer the questionnaire. The research instrument, developed as a structured questionnaire, used the 7-point Likert scale in its responses. The Likert-scale was designed as 1= Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neutral, 5 = Somewhat agree, 6 = Agree, 7 = Strongly agree. The questions in the questionnaire were derived from the information gleaned from the literature review. The development of the questions was mainly around the themes of the

variables of the study where SS questions included concerns of CSR, ethics, child labour, exploitation of women, social vices and other related issues. The questions on IKS were derived from the literature which showed themes such as rituals, traditions, cultural taboos, superstition and importance of IKS. Performance questions were aimed at understanding the financial and operational performance of the entities through asking about issues like profit, assets and taxation on financial issues and operational efficiency including effective use of resources and governance issues in operational performance. A pilot study on 10 respondents whose responses were analysed for internal consistency as a measure of reliability, was done to ensure the validity and reliability of the research instrument.

The table below shows the Cronbach’s Alpha for the results:

Table 1: Cronbach’s Alpha (Researchers, 2025)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
0.765	0.767	16

Cronbach’s Alpha was used to determine the internal consistency of the responses and the Alpha was found to be 0.767 indicating that there was internal consistency within the research instrument showing reliability of the instrument. The SS scale used showed an Alpha of 0.767 which is acceptable for internal consistency of a research instrument (Adetayo, 2025:13).

The process macro was used to establish the moderating effect of the IKS variable on the regression relationship between SS and the performance of SAMs. The main assumptions made in the data analysis were that the data could be modelled through linear regression. The other assumption was that a significance level of 0.05 was adequate for the study to show basis for significance and rejection criteria for the hypothesis. Furthermore, the other assumptions included the use of Model 1 in the Process macro, bootstrapping using 5 000 samples and the key assumption that the length of the variables was not considered in the application of the Process macro.

FINDINGS

This section addresses the main objective of the study which was to determine if indigenous knowledge systems influence the relationship between social

sustainability and organisational performance of artisanal miners. The section is organised mainly around the theme of understanding whether IKS moderate the relationship between SS and performance of AM in Bindura District. To effectively test the relationship, the study used Hayes Process Macro Model 1 for moderation analysis with SS being the focal predictor (X), performance being the outcome variable (Y) and IKS as the moderator variable (W). The analysis is therefore presented in a logical sequence; first the overall model fit, then the regression coefficients (including the interaction term) and finally the conditional effects showing how the SS to performance relationship changes at different levels of the IKS variable.

Table 2 shows the results from the SPSS test for moderation through the process macro by Andrew Hayes.

Table 2: *Summary of analysis* (Researchers, 2025)

Model	1
Y	Average performance
X	Average social sustainability
W	Average IKS
Sample size	372

Table 2 shows a summary of the analysis which was done. The Process Model 1 for moderation was used, supported by 5 000 bootstrap samples, a 95% confidence level (p-value set at 0.05) and the assumption that large variable names would have no significant impact on the model output. The independent variable X was SS, the Y-variable was performance of SAMs and the moderator variable W was the IKS.

Table 3: *Model summary* (Researchers, 2025)

Outcome variable				Average performance		
Model summary						
R	R-sq	MSE	F	df1	df2	P
0.7184	0.5161	0.7473	130.8163	3.0000	368.0000	0.0000

The table shows the model summary for the regressive relationship between SS and performance. The F value is significantly high at 130.8163, showing that the model can be relied upon. The p-value is below 0.05, indicating that the null hypothesis can be rejected at the 95% level of confidence. The R-squared value (0.5161) shows a strong positive relationship between the variables in the study, where 51% of the changes in performance are influenced by SS (moderated by IKS). Practically this means that the sets of variables used in the moderation framework, especially once interaction is considered, have strong explanatory power for performance outcomes among the sampled miners. These findings correspond with arguments by Chipangura (2019) who also finds that the use of IKS in artisanal mining as a social organisation, had positive impact on the outcomes (operational performance) of the miners. Therefore, this study further strengthens the argument that IKS have a positive moderating effect on the positive relationship between SS and performance.

Table 4: Model (Researcher, 2025)

	Coeff	Se	t	P	LLCI	ULCI
constant	1.3943	0.6125	2.2763	0.0234	0.1898	2.5988
avg_soci	0.1705	0.1492	1.1424	0.2540	-0.1230	0.4639
avg_IKS	-0.0353	0.1374	-0.2571	0.7972	-0.3055	0.2349
Int_1	0.0955	0.0309	3.0936	0.0021	0.0348	0.1563

The above table shows the results from the model with coefficients and the interaction analysis. On the interaction, there was a p-value of 0.0021 , indicating that there is a statistically significant moderating effect on the model. This table presents the key evidence for moderation in the study. The regression results show the interaction term which is crucial in determining the moderation effect of the IKS variable. The interaction term coefficient (Int_1) is positive at 0.0955 and is statistically significant with a p-value of 0.0021 and a 95% confidence interval that does not cross zero (LLCI = 0.0348; ULCI = 0.1563). This forms the central argument for statistical basis that IKS moderates the relationship between SS and performance significantly. The findings show that IKS does not merely correlate with performance but it changes how SS translates into performance because the strength of SS’s impact depends on the

level of IKS. In other studies that focused on IKS and effective sustainable management strategies, it was also found that IKS effectively promotes sustainable management in rural economies (Kumari, 2025). Although Kumari (*ibid.*) did not study AMs as the context, the relationship between IKS and performance was found to be statistically significant and positive just like in this current study.

Table 5 shows the results obtained from the test of the highest order unconditional interactions between the focal predictor and the moderator variable. The results show a high F value, implying that the model is a strong fit. The p-value is below 0.05 (p=0.0021) indicating that the model, with the evidence available, is statistically significant. The moderating effect of IKS is reinforced in this table as the interaction term X*W shows a statistically significant contribution indicated by an R-squared change of 0.0126, F = 905704 and p = 0.0021. Despite the R-squared change being small, the moderation effects are modest in variance terms because they represent a positive change in slope (conditional influence). The importance of this analysis is that it shows that the interaction remains significant and consistent with the coefficient and conditional effects tables.

Table 5: Product terms (Researchers, 2025)

Product term keys					
Int_1:		avg_soci x		avg_IKS	
Test(s) of highest order unconditional interaction(s)					
	R2-chng	F	df1	df2	p
X*W	0.0126	9.5704	1.0000	368.0000	0.0021
Focal predict: avg_soci (X)					
Mod var: avg_IKS (W)					

Table 6 shows the analysis of the results of the study at the mean and at standard deviation (+ and - 1). The tests were made to assess the main effect of the model at different levels. The p-value in all instances remained less than

0.05, and the LLCI and ULCI intervals were above 0. This indicates that IKS has a statistically significant effect on the average performance as a moderator to SS. This implies that there is a significant contribution by IKS to the nature in which SS and performance interact for AMs. The table shows that the effect of SS on performance is statistically significant (all p-values are below 0.05) and the confidence intervals remain above 0. This means that SS positively influences performance at low, average and high levels of IKS, but the magnitude differs across IKS levels. In other words, miners who integrate more IKS into their SS practices benefit more from SS in terms of performance outcomes than miners who have low IKS integration.

Table 6: Conditional Effects (Researchers, 2025)

Conditional effects of the focal predictor at values of the moderator(s)						
avg_IKS	Effect	Se	t	P	LLCI	ULCI
3.2804	0.4838	0.0628	7.6993	0.0000	0.3603	0.6074
4.3634	0.5873	0.0491	11.9693	0.0000	0.4908	0.6838
5.4465	0.6908	0.0557	12.4002	0.0000	0.5812	0.8003

Figure 2 shows the graphical representation of the model. The lower line ($y = 1.28 + 0.48 \cdot x$) shows the regression relationship at SD-1, the middle line ($y = 1.24 + 0.59 \cdot x$) shows the regression relationship at the mean and the upper line ($y = 1.2 + 0.69 \cdot x$) shows the regression relationship at SD+1. The plots show that there is an increasing significance of the model, leading to a strong positive relationship between the variables. The figure is consistent with results in Table 6 are a visual representation of the table showing the slope relating SS to performance through IKS. The slopes show that greater IKS strengthen the SS to performance relationship. Thus, the graphical evidence supports the statistical conclusion that IKS functions as an enabling or intensifying mechanism through which SS practices translate into improved operational and financial performance.

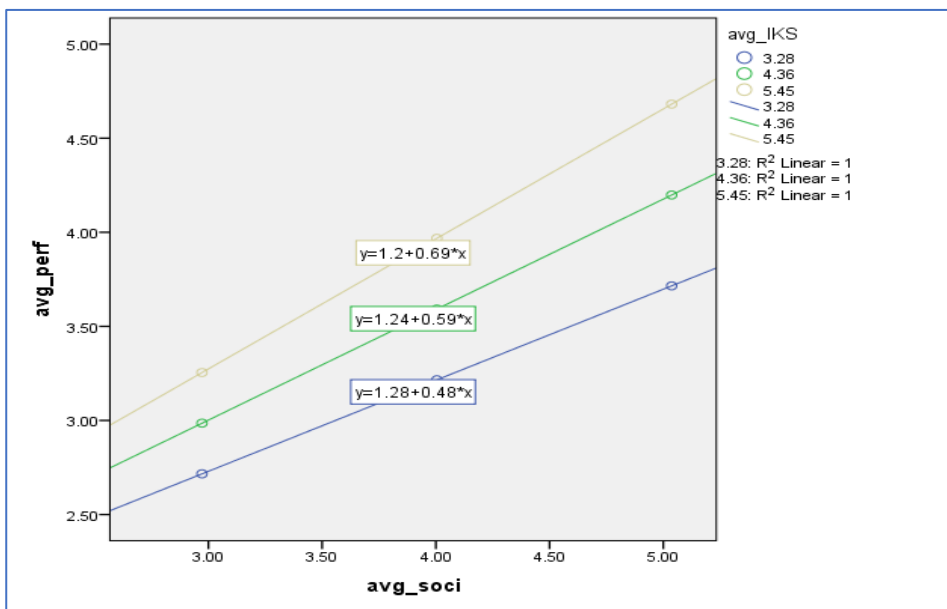


Figure 2: Visual display of conditional effect of the focal predictor (Researchers, 2025)

DISCUSSION

The moderation analysis examined the influence of social sustainability (SS) and performance and whether indigenous knowledge systems (IKS) moderate the relationship between these variables. The first regression model, which included the centred independent variable (SS) and the centred moderator variable (IKS) explained 51.61% of the model, R-squared = 0.5161, $F=130.8$, $p=0.0000$. The second regression model shows a positive 0.01 change in R-squared and a p-value of 0.0021, F-value =9.57. These findings suggest that adoption of IKS methods in SS practices of AMs stands to significantly influence their performance at above 50% of the time this is done. The study found that IKS is a significant moderator in the relationship between SS and performance of SAMs in Mashonaland Central province in Bindura. This finding agrees with previous studies that also found that IKS have a bearing on the performance of miners (Haulle and Poncian, 2025:1). The SS aspects of community engagement, dispute resolution, action against child labour, compliance with government regulations and traditional authorities, and corporate social responsibility (CSR) engagements, should be factored in when

AMs are undertaking their operations. By considering these SS issues and paying attention to rituals, traditional regulations, taboos, superstitions and ancestral spirits as part of IKS inclusion, the mining operations are likely to experience a growth in profit, a decrease in costs, attention to taxation, government financial support and higher mineral output in their operational performance.

CONCLUSIONS AND RECOMMENDATIONS

There is less discussion on the impact of IKS on sustainability issues in the literature discourse; the argument could be made that most of the knowledge on sustainability is being promulgated by Western and colonial masters, thus, their ideology of development is embedded in their approach to knowledge. The evidence from this study shows that there are higher chances of achieving and maintaining sustainability if communities rely on their IKS and merge these with modern knowledge and practices to retain the highest benefit. Achieving SS goes beyond merely what the organisations or SAMs are doing towards the community in which operate. The SS conundrum should go into how SAMs and other entities are contributing towards the cultural practices in the land, the traditions and IKS in the area. Sustainability is beyond the physical realm that we witness; it goes into the spiritual context, which is often demonised and shunned by colonial knowledge and Western ideology. In the African sense, sustainability is the harmony between humans, nature and the spiritual. The argument being that the spiritual is thoroughly understood through IKS. The study concludes that IKS play a significant moderating role in the impact of SS on the performance of SAMs. Therefore, SAMS need to consider IKS in their areas of operations as they seek to improve their mining performance.

REFERENCES

- Adetayo, A. (2025). Understanding Cronbach's Alpha in Social and Management Studies. *Current Science Research Bulletin*, 02(02), 11-16, Ilesa, Nigeria. <https://orcid.org/0000-0002-6870-1212>
- Becker, J. *et al.* (2021). Determinants of Health and Health Needs Assessment of Artisanal and Small-Scale Gold Miners in Kadoma, Zimbabwe: A Mixed Method Approach. *Environmental Research, Environmental Research*, 197, 81-115. <https://doi.org/10.1016/j.envres.2021.111081>

- Boström, M. (2012). A Missing Pillar? Challenges in Theorizing and Practicing Social Sustainability: Introduction to the Special Issue, *Sustainability: Science, Practice and Policy*, 8(1), 3-14, <https://doi.org/10.1080/15487733.2012.11908080>
- Buthelezi, S. C., Ocholla, D. and Dlamini, P. (2024). Strategies for Documenting and Disseminating Indigenous Knowledge at a South African University. *South African Journal of Information Management*, 26(1), 1-13.
- Chipangura, N. (2019). The Archaeology of Contemporary Artisanal Gold Mining at Mutanda Site, Eastern Zimbabwe. *Journal of Community Archaeology and Heritage*, 6, 189-203. <https://doi.org/10.1080/20518196.2019.1611184>
- Chipangura, N. (2023). Decolonising the Archaeology of Indigenous Artisanal Gold Mining in Eastern Zimbabwe. *Journal of Community Archaeology and Heritage*, 10, 215-232. <https://doi.org/10.1080/20518196.2023.2289316>
- Colbran, R. *et al.* (2019). Advancing towards Contemporary Practice: A Systematic Review of Organisational Performance Measures for Non-Acute Health Charities. *BMC Health Services Research*, 19(1), 19-31. <https://doi.org/10.1186/s12913-019-3952-1>.
- Crucke, S. and Decramer, A. (2016). The Development of a Measurement Scale for Organisational Performance of Social Enterprises. *Sustainability Journal*, 8, 1-61. <https://doi.org/10.3390/su8020161>
- Dube, E. and Munsaka, E. (2018). The Contribution of Indigenous Knowledge to Disaster Risk Reduction Activities in Zimbabwe: A Big Call to Practitioners. *Jamba: Journal of Disaster Risk Studies*, 10(1), 10-65. <https://doi.org/10.4102/jamba.v10i1.493>
- Finn, B., Simon, A. and Newell, J. (2024). Decarbonisation and Social Justice: The Case for Artisanal and Small-Scale Mining. *Journal of Economic Research and Social Science*, 117, 33-56. <https://doi.org/10.1016/j.erss.2024.103733>
- Foster, L. and Viale, T. (2020). *Sustainability as a Driver of Organisational Change*, 1-32. Cambridge: Cambridge University Press.
- Funoh, K. N. (2014). The Impacts of Artisanal Mining on Local Livelihoods and the Environment in the Forested Areas of Cameroon. Working Paper No. 150. Centre for International Forestry Research (CIFOR).
- Gibb, H. and O'Leary, K. G. (2014). Mercury Exposure and Health Impacts among Individuals in the Artisanal Small-Scale Gold Mining Community: A Comprehensive Review. *Environmental Health Perspectives*, 122(6), 667-672.

- Gutterman, A. (2023). Organisational Performance and Effectiveness. Available online: <https://doi.org/10.2139/ssrn.4532570>
- Hamman, P. and Schiemann, F. (2021). Organisational Performance as a Set of Four Dimensions: An Empirical Analysis. *Journal of Business Research*, 127(1), 45-65. <https://doi.org/10.1016/j.jbusres.2021.01.012>
- Hamman, P. et al. (2013) Exploring the Dimensions of Organisational Performance. *Organisational Research Methods*, 16(1), 16-83. <https://doi.org/10.1177/1094428112470007>.
- Haulle, E. and Poncain, J. (2025). The Place of Indigenous Knowledge Systems in Mapping and Extraction of Minerals in the Lake Zone in Tanzania. *Journal of African Identities*, 2025, 1-25. <https://doi.org/10.1080/14725843.2025.2518120>
- Hilson, A. (2025). Women in Development Minerals: Artisanal and Small-Scale Mining, Governance and the SDGs. *Environmental Science and Policy*, 2025, 32-75. <https://doi.org/10.1016/j.envsci.2024.1.3980>
- Hilson, G. and Maconachie, R. (2020). Artisanal and Small-Scale Mining and the Sustainable Development Goals: Opportunities and New Directions for Sub-Saharan Africa. *Geoforum* 12(1), 9-31. <https://doi.org/10.1016/j.geoforum.2019.09.006>
- Kumari, U. (2025). Sustainable Management Practices through Indigenous Knowledge Systems: Insights from Rural Economies. *International Journal of Global Humanities and Management Insights*, 2025, 22-75. <https://doi.org/10.63665/ijghmi.v01i01.03>.
- Laing, T. and Pinto, A.N. (2023). Artisanal and Small-Scale Mining and the Low-Carbon Traction. *Environmental Science and Policy*, 149: 210-245.
- Mapara, J. (2009). Indigenous Knowledge Systems in Zimbabwe: Juxtaposing Postcolonial Theory. *The Journal of Pan-African Studies*, 3(1), 139-155.
- Mapira, J. and Mazambara, P. (2013). Indigenous Knowledge Systems and their Implications for Sustainable Development in Zimbabwe. *Journal of Sustainable Development in Africa*, 15(5), 41-90.
- Marume, W. (2023). The Implications of Artisanal Small-Scale Mining and Food Security in Zimbabwe. *Akdeniz Havvazi Ve Afrika Mediniyetleri Dergisi*, 5(2), 1442-1481. <https://doi.org/10.54132/akaf.1394845>.
- Masuku, C. (2025). Empowering Communities through Corporate Social Responsibility: The Role of Zimbabwe Power Company's Public Relations Department in Kariba. *The Dyke*, 181(1), 1-20.

- Masunda, T. and Chahwanda, C. (2025). Rural Community Resilience in Zimbabwe: The Gaps, Myths and Realities. *The Review of Rural Resilience Praxis*, 4(1&2), 13-41. <https://doi.org/10.71458/nsbd3g60>.
- Maunganidze, L. (2016). A Moral Compass that Slipped: Indigenous Knowledge Systems and Rural Development in Zimbabwe. *Cogent Social Sciences*, 13(3), 2-18. <https://doi.org/10.1080/23311886.2016.1266749>.
- Mavhura, E. and Mushure, S. (2019). Forest and Wildlife Resource-Conservation Efforts Based on Indigenous Knowledge: The Case of Nharira Community in Chikomba District, Zimbabwe. *Forest Policy and Economics*, 105, 24-76. <https://doi.org/10.1016/j.forpol.2019.05.019>.
- Mawere, M. (2010). Knowledge Systems' (IKSs) Potential for Establishing a Moral, Virtuous Society: Lessons from Selected IKSs in Zimbabwe and Mozambique. *History, Sociology and Environmental Science*, 31(4), 45-65.
- Meesters, M.*et al.* (2021). The Social License to Operate and the Legitimacy of Resource Extraction. *Current Opinion in Environmental Sustainability*, 49, 7-11.
- Metcalf, S. M. (2008). Identifying Strategies for Effective Artisanal and Small-Scale Gold Mining Interventions in Kadoma-Chakari, Zimbabwe. Unpublished Msc Thesis, 31-54, University of British Columbia.
- Missimer, M., and Mesquita, P. L. (2021). Social Sustainability in Business Organisations: A Research Agenda. *Sustainability*, 14(5), 2608-2614. <https://doi.org/10.3390/su14052608>
- Mkodzongi, G. (2023). Artisanal and Small-Scale Gold Mining and Rural Transformation in Post-Land Reform Zimbabwe: A Broad Overview. *Journal of Rural Studies*, 61(3), 1123-1148. <https://doi.org/10.1016/j.jrurstud.2023.103027>
- Moumin, I. (2024). Organisational Performance: A Comprehensive Literature Review of Modern Models and Approaches. *Emirates Scholar Research Centre*, 28(4), 31-76.
- Mugambiwa, S. S. (2021). Integrating Indigenous Knowledge Systems in Entrepreneurship: A Case of Horticulture Farmers in Mutoko District of Zimbabwe. *Indonesian Journal of Social and Environmental Issues (IJSEI)*, 2(3), 221-226. <https://doi.org/10.47540/ijsei.v2i3.297>.

- Mugambiwa, S. and Makhubele, J. (2021). Indigenous Knowledge Systems Based Climate Governance in Water and Land Resource Management in Rural Zimbabwe. *Journal of Water and Climate Change*, 12(5), 257-289. <https://doi.org/10.2166/wcc.2021.183>
- Muthu, S, S. (2014). Assessing the Environmental Impact of Textile Supply Chain and Its Environmental Impact. *The Textile Institute Book Series, SGS (Hong Kong) Limited*, 109(12), 1-32.
- Mwapaura, K. *et al.* (2024). The Relevance of Indigenous Knowledge Systems in Social Work Education and Practice in Zimbabwe: A Human Rights Perspective. *Journal of Social Development in Africa*, 39(2), 88-113.
- Ncube, I. *et al.* (2025). Government Support for Indigenous Knowledge for Sustainability in Southern Africa. *South African Journal of Information Management*, 27(1), 1-11. <https://doi.org/10.4102/sajim.v27i1.1901>.
- Ndongwe, E. (2026). The Heritage-Based Curriculum (HBC) 2024-2030: Implication for Quality, Inclusive and Competence-Based Education in Zimbabwe. *International Journal of Innovative Science and Research Technology*, 11(1), 3169-3174, <https://doi.org/10.38124/ijisrt/26jan824>
- Ngwerume, T. and Muchemwa, C. (2025). The Role of Artisanal and Small-Scale Mining in Zimbabwe's Economic Transformative Agenda. *RSIS*, 20, 38-44.
- Nkomo, M. (2022). The Anatomy of a Gold-Rush: Politics, Uncertainty and the Organisation of Artisanal Mine Work and Labour in Zimbabwe. *The Extractive Industries and Society*, 11, 101-124. <https://doi.org/10.1016/j.exis.2022.101124>
- Nyahunda, L. (2024). Integration of Indigenous Knowledge Systems (IKS) into Climate Change Mitigation and Adaptation Endeavours: Milestones and Gaps in South Africa and Zimbabwe's Climate Policy Frameworks. *Climatic Change*, 177, 162: 1-16. <https://doi.org/10.1007/s10584-024-03822-2>
- Nyamudzodza, J., Sifile, O. and Mthombeni, A. (2025). Sustainable Management Strategies for Attaining Company's Goals in the Zimbabwean Mining Industry. *Futures: The Zimbabwean Ezekiel Guti University Journal of Leadership, Governance and Development*, 4(1&), 61-102. <https://doi.org/10.71458/07awzh30>

- Reniko, G., Mogomotsi, P. and Mogomotsi, G. (2018). Integration of Indigenous Knowledge Systems in Natural Resources Management in Hurungwe District, Zimbabwe. *International Journal of African Renaissance Studies- Multi-Inter- and Transdisciplinary*, 13, 112-96. <https://doi.org/10.1080/18186874.2018.1475869>.
- Ripp, M. and Clifford, J. (2025). Heritage-Based Urban Development. *Encyclopedia*, 5(2), 82-140. <https://doi.org/10.3390/encyclopedia5020082>
- Risiro, J., Tshuma, D. and Basikiti, A. (2013). Indigenous Knowledge Systems and Environmental Management: A Case Study of Zaka District, Masvingo Province, Zimbabwe. *International Journal of Academic Research in Progressive Education and Development*. 2(1), 18-39.
- Shumba, G., Chikazhe, L. and Jengeta, M. (2025). Government Policies, Human Resource Management and the Performance of Artisanal Small-Scale Mining for the Sustainable Livelihoods of Employees. *Prosperitas*, 12(1), https://doi.org/10.31570/prosp_2025_0121.
- Sithole, P. (2020). Use of Indigenous Knowledge Systems in Crop and Livestock Production and Implications to Social Ecology: A Case Study of Chimanimani District of Zimbabwe. *The Southern African Journal of Environmental Education*, 36, 44-76. <https://doi.org/10.4314/sajee.v36i1.3>
- Stemn, E., Amoh, P. and Joe-Asare, T. (2021). Analysis of Artisanal and Small-Scale Gold Mining Accidents and Fatalities in Ghana. *Resources Policy*, 74, 102-295.
- Tenson, M., (2017). Indigenous Knowledge Systems: A Haven for Sustainable Economic Growth in Zimbabwe. *The Journal of Pan-African Studies*, 10, 172-201.
- Thornton, R. (2018), Artisanal Craft and Expert Knowledge in Africa: The Neglected Role of Specialised and Individualised Knowledge Practices. *Proceedings of the African Futures Conference*, 2: 176-177. <https://doi.org/10.1002/j.2573-508X.2018.tb000064.x>
- Zenda, M., Zhanda, K. and Dzvimbo, M. (2025). Achieving Sustainable Development Goals through Corporate Social Responsibility and Responsiveness in Zimbabwe: Achievements, Challenges and Future Opportunities. *Frontiers in Sustainability*, 6, 1-43. <https://doi.org/10.3389/frsus.2025.1522477>.

Zikhali, W. (2018). Indigenous Knowledge Systems for Development in Nkayi District, Zimbabwe. *Advances in Social Sciences Research Journal*, 5(6), 330-45. <https://doi.org/10.14738/assrj.56.4752>