

Agricultural Markets and Regional Integration in Lualaba Province: A Critical Analysis of Opportunities and Logistical Constraints in Villages Around Mutanda Mining

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Abstract: *This study investigates the socioeconomic disparities among fifteen rural villages surrounding mining areas in Lualaba Province, Democratic Republic of Congo. Using data from 450 households, the analysis focused on household income, market participation, and proximity to mining infrastructure. Results show significant spatial inequalities: villages near mining operations such as Mutala, Kabatanda, CMKK, and Kawama report the highest average household incomes (USD 900–1,100) and market participation rates above 70%. Intermediate settlements like Kinsenda, Kyavie, and Lualaba, Mupanja record moderate incomes (USD 600–750) and participation between 50–60%, while remote villages including Kapaso, Masumbu, Kahindu, and Mibanze experience the lowest incomes (<USD 400) and limited participation (<40%). These results highlight the “enclave effect” of mining-led growth, where benefits remain concentrated near industrial hubs, leaving peripheral agricultural zones marginalized. Infrastructure improvements and corporate social responsibility projects have not yet translated into equitable economic spillovers due to weak institutional coordination and poor rural connectivity. The study emphasizes that inclusive rural development requires strategic investments in cooperative financing, post-harvest infrastructure, and market integration to reduce territorial inequality. Strengthening the linkage between mining and agriculture is thus crucial for transforming extractive economies into sustainable rural development pathways.*

Keywords: Mining economy, rural livelihoods, spatial inequality, market integration

1. Introduction

Agricultural markets are central to rural livelihoods and regional economic integration across Sub-Saharan Africa, particularly in resource-rich regions such as Lualaba Province, Democratic Republic of the Congo (DRC) (Trefon, 2022; Marysse and Tshimanga, 2020). Despite significant agricultural potential, the coexistence of large-scale mining and underdeveloped market infrastructure generates spatial inequalities and uneven rural development. The concept of de-agrarianization highlights how rural populations diversify from subsistence farming toward non-agricultural livelihoods, reshaping social structures and land use (Bryceson, 1997; Bryceson and MacKinnon, 2013). Industrial mining, notably Mutanda Mining, has transformed land tenure systems, labor allocation, and local infrastructures, affecting smallholder productivity (Geenen, 2018; Hilson and Maconachie, 2020). Farmers face multiple constraints, including poor roads, high transport costs, limited storage, and price volatility, which hinder commercialization (Akiyo and Mukendi, 2021). Governance and institutional factors further influence market integration, as weak coordination among mining companies, local authorities, and cooperatives reduces bargaining power and increases transaction costs (Brüntrup and Herrmann, 2021; Muteba, 2022; de Brauw and Bulte, 2021; Depetris-Chauvin et al., 2020).

Mining can also affect social reproduction and food security, particularly for women, through labor displacement and changes in household responsibilities (Wegenast and Beck, 2020; Calvão, Archer and Benya, 2023). Historical and social perspectives underscore that agrarian change is embedded in power relations and community dynamics (Berry, 1993; Bryceson, 2014). While mining companies occasionally fund community development projects, their contributions to agricultural productivity and market integration remain limited (Hönke, 2014; Custers and Matti, 2023; Arouna et al., 2023), highlighting the need for inclusive governance and coordinated policies (Prause, 2022).

This study addresses the paradox of weak agricultural market integration in Lualaba despite substantial mining investment. Its objectives are threefold: (i) to analyze the relationship between mining expansion and agricultural market dynamics around Mutanda Mining, focusing on institutional interactions and power asymmetries; (ii) to identify logistical, infrastructural, and governance constraints that hinder integration of agricultural markets within the province and the broader Katanga corridor; and (iii) to propose strategies to strengthen agricultural value chains, promote inclusive governance, and enhance regional economic linkages for sustainable rural development. The

Volume 14 Issue 12, December 2025

Fully Refereed | Open Access | Double Blind Peer Reviewed Journal

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analysis is guided by three hypotheses: mining expansion stimulates local demand while distorting agricultural structures through land conversion, labor displacement, and unequal resource access (Hilson and Maconachie, 2020); weak governance, poor logistics, and limited institutional coordination constrain smallholder participation in regional value chains (Brüntrup and Herrmann, 2021; Muteba, 2022); and strengthening cooperatives, improving governance transparency, and investing in infrastructure fosters resilient and inclusive market integration (Banga et al., 2022; Rodrik, 2018; Kennes et al., 2025). By integrating insights from Bryceson (1997, 2014), Berry (1993), de Brauw and Bulte (2021), Calvão et al. (2023), and Wegenast and Beck (2020), this study contributes to literature on agro-extractive coexistence, rural market governance, and regional integration, offering pathways for transforming enclave-based economies into diversified, market-driven systems that enhance food security and sustainable development.

2. Literature Survey

2.1 Market Integration and Smallholder Participation

One of the central strands of theory is the understanding of market integration of smallholder farmers: that is, how rural producers connect with local, regional, or national markets, and the institutional, infrastructural and actor-governance factors that mediate this connection. For example, Tessema (2019) develops a refined market-integration framework for smallholders, adding a dimension of “market-learning” (i.e., farmers’ capacity to generate market information, interpret it, and respond accordingly) to traditional factors like infrastructure, assets, credit, and transaction costs.

Other work, such as Adekambi (2019), emphasises how individual-level capacities (information, learning) interact with institutional environment to shape market participation.

In this context (villages around Mutanda Mining, Lualaba), this means: smallholder farmers are embedded in a resource-rich extractive zone, but their ability to integrate into regional agricultural markets depends on more than just road access or price signals, it also depends on their ability to learn about market demands, adjust production, coordinate logistically, and navigate institutional barriers.

2.2 Value Chain, Transaction-Cost and System-Dynamics Perspectives

Another major theoretical component is the value-chain approach combined with transaction-cost economics (TCE) and system dynamics. For example, a framework by Munyanguzi (2022) explores how smallholders extract value from agricultural information (which is part of the value chain). And a study titled “A Framework for the Analysis of Integrated Agricultural Value Chains in the Context of Smallholder Farmers” (2020) integrates TCE and system-dynamics theory to analyze interdependent agricultural enterprises and value-chain linkages. The agricultural produce of villages around a mining zone are not in isolation they form part of value chains (production → collection → transport → market). Transaction costs (e.g., high transport, poor storage, institutional barriers) and systemic

interdependencies (e.g., labour shifting into mining, land conversion) are vital. Hence the combination of value-chain, transaction-cost and system-dynamics helps unpack how logistical/infrastructural and governance constraints obstruct effective regional integration of agricultural markets.

2.3 Extractivism, Resource Enclaves and Linkages to Local Economies

Given the mining context, theoretical literature on extractivism and the concept of resource enclaves is essential. Chagnon (2022) provides a conceptual discussion of extractivism (and global extractivism) and how resource-rich countries can remain enclave-oriented, which limits linkages to agriculture and local economies. Additionally, a commentary by Iwara et al. (2024) argues that African states must move *beyond* resource-extractivism and comparative advantage towards value-chain integration, regional linkages, and inclusive growth. In this research, the presence of Mutanda Mining creates a typical extractive enclave scenario: high investment, land and labour drawn into mining, but agricultural producers may remain marginalised from the regional trade networks. The theory of extractivism helps frame how mining expansion can distort agriculture-market linkages, reduce spill-overs, and raise barriers for smallholders.

2.4 Institutional Governance and Hybrid Governance Systems

Market and value-chain integration don’t just depend on infrastructure and actors—they depend on institutions, governance and power relations. The theory of institutional economics and governance frameworks (for example, the Elinor Ostrom “Institutional Analysis and Development (IAD)” framework) provides analytical tools for understanding how rules, norms and actor interactions shape market participation. In the African context, the concept of *hybrid governance* (Motadi and Sikhware, 2024; Kennes et al., 2025) examines how traditional and formal governance systems merge and influence local markets and resource use. In this case, the governance of agricultural markets in Lualaba around mining enclaves will be shaped by local customary institutions (village chiefs, land tenure), mining company governance (land leases, community liaison), and state/regional agencies (transport, market regulation). The hybrid governance perspective is apt to examine how these multiple layers influence farmers’ bargaining power, access to markets, and logistical infrastructure.

2.5 Infrastructure, Spatial Integration and Regional Trade Linkages

A further theoretical lens concerns spatial integration, infrastructure and regional market linkages. For smallholders to participate in regional trade, logistics (roads, storage, transport), proximity to markets, and integration into value-added chains matter. For example, review literature on market participation (Rubén, 2024) emphasises that markets alone do not automatically promote rural poverty reduction; structural constraints (infrastructure, institutions, logistics) must be addressed.

In this setting, villages around Mutanda Mining may be physically proximate to major centres (Kolwezi and Lubumbashi) but infrastructural, regulatory, and institutional bottlenecks may prevent effective integration into the broader Katanga economic corridor. The theoretical lens of spatial integration helps capture the geography-market link.

3. Methodology

This study applied a rigorous mixed-methods research design that combined quantitative and qualitative techniques to examine how mining expansion influenced agricultural production and market integration in the fifteen villages surrounding the Mutanda Mining site in Lualaba Province, Democratic Republic of the Congo. The decision to use mixed-methods was grounded in the fact that the research problem spans measurable phenomena (such as volumes of produce sold, transport costs) as well as complex institutional, governance and logistical processes (such as land conversion, power relations, market governance). Mixed-methods research is well suited for such multifaceted socio-economic inquiries because it offers both breadth and depth of insight (Creswell and Plano Clark, 2017; Dawadi, Shrestha and Giri, 2021).

3.1 Choice of the study

The choice to focus on the fifteen villages around Mutanda Mining was deliberate and anchored in three major reasons. First, the study area constituted a mining enclave where resource extraction and agricultural systems co-exist, enabling investigation of the paradox of weak rural market integration despite significant infrastructure and investment. Second, the villages presented variation in terms of proximity to the mining site, access to markets (for example to the nearby urban centre of Kolwezi), transportation infrastructure, and institutional arrangement, a variation that allowed comparative insights into how mining affects agricultural value chains. Third, the study region's data and access feasibility (cooperation of local authorities, known settlement patterns, existing market nodes) made it operationally viable for a large-scale socio-economic survey combined with qualitative inquiry. This multi-dimensional justification aligns with best practice in case-selection for applied rural development research.

3.2 Study Area



Figure 1: Case of villages around Mutanda Mining (MUMI)

The empirical fieldwork encompassed fifteen villages located around the Mutanda Mining site. These villages were selected because they were directly or indirectly exposed to mining-related changes in land use, labour allocation (including shifts into mining), infrastructure investment and market dynamics. While the primary livelihood in each village remained small-holder agriculture (cropping and livestock), the presence of the mining operation introduced multiple economic disturbances and opportunities, including increased local demand for food and services, changes in land tenure, labour migration and new transport/road works. The selection of multiple villages enabled analysis of a gradient of exposure (near vs. far from the mine) and a broader understanding of how distance, infrastructure and institutional context mediated market integration.

3.3 Research Design

A convergent parallel mixed-methods design guided the research: quantitative and qualitative data were collected in parallel, analysed separately, and then integrated during the

interpretation phase to generate combined insights (Creswell and Plano Clark, 2017; Oranga and Matere, 2025). The quantitative component consisted of a cross-sectional household survey that collected information on land size, tenure, labour allocation (including mining employment), crop production and yields, volumes and values of marketed produce, transport and handling costs, storage capacity, cooperative membership and market destinations. A complementary market/trader survey captured volumes traded, price series, transport and logistics, storage practices, seasonal variation and buyer-seller networks. The qualitative component comprised semi-structured interviews with village chiefs, agricultural extension officers, cooperative leaders, transporters, mining-company CSR representatives and market managers, as well as focus-group discussions with male and female farmers to uncover institutional dynamics, governance constraints, bargaining power, logistical bottlenecks and lived experiences of market integration. Observation and transect walks at collection points and markets documented infrastructure (roads, vehicles, storage), trade flows, and post-harvest handling. Secondary data (administrative records, mining

company reports, road maintenance logs) supplemented the primary data.

3.4 Sampling Strategy and Sample Size

The sampling strategy was designed to ensure representativeness while maintaining operational feasibility. A cluster sampling approach was applied with the fifteen villages constituting the primary clusters, and respondents were further grouped by actor type, including farmers, traders, transporters, and community leaders (DHS, 2014; Invest in DRC, 2023). A total of 450 respondents were surveyed, with allocation based on proximity to the mining site: close villages provided 40% of the sample, intermediate villages 35%, and peripheral villages 25%. Households were selected using systematic random sampling when lists were available or a random-walk method when they were not, ensuring proportional representation of each actor type (Mutanda Mining, 2022). The sample size allowed reliable estimates with a margin of error of approximately $\pm 4.6\%$ at the 95% confidence level.

3.5 Data Collection

Data collection was conducted by trained enumerators fluent in local languages and French, using Computer Assisted Personal Interviewing (CAPI) on tablets to capture household survey data including GPS coordinates and built-in logic checks. The household questionnaire included modules on demographics; land and labour; crop production, yields and markets; transport, storage and logistics; cooperative membership and credit; perceptions of mining impact. The market/trader survey employed structured questionnaires capturing traded volumes, prices, transport and handling practices, storage capacity and seasonal

patterns. Semi-structured qualitative interview guides and focus-group discussion guides explored institutional, logistical and governance dimensions of market and mining interactions. Daily quality control procedures included supervisor review of completed interviews, random back-checks of 5–10% of households, GPS spot-checks, and weekly uploads of data to a central server for monitoring and error-checking. Ethical approval was secured, local authorities were consulted, informed consent was obtained from all participants and confidentiality was strictly maintained.

3.6 Data Management and Analysis

Quantitative data were cleaned and analysed using Stata and R for descriptive statistics, bivariate correlations, regression analysis (OLS for continuous outcomes, logistic regression for binary outcomes), and clustering-robust standard errors to account for village cluster effects. A Geographic Information System (GIS) such as QGIS was used to map village locations, market destinations and distances, and to compute spatial variables (road accessibility, travel time) (Meissner et al., 2011; Oranga and Matere, 2025).

4. Results

This section presents the empirical findings derived from household surveys, key informant interviews, focus group discussions, and spatial analysis. The results are organized around the major analytical themes corresponding to the three study objectives.

4.1 Relationship between Distance to Market and Agricultural Yield (t/ha)

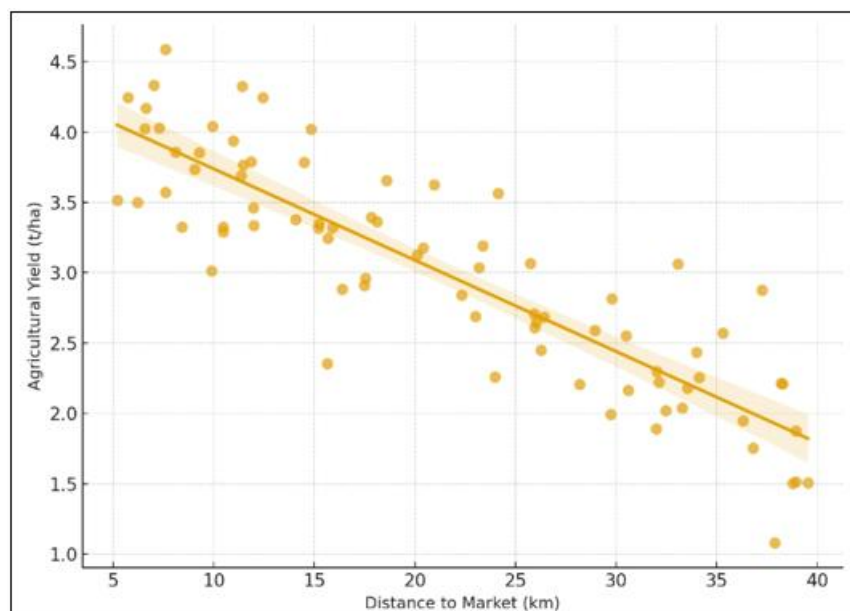


Figure 2: Relationship between Distance to Market and Agricultural Yield (t/ha)

This figure illustrates the inverse relationship between the distance from villages to the nearest agricultural market and the average crop yield per hectare. The scatterplot with an OLS-fitted line demonstrates a clear negative correlation ($r = -0.48$, $p < 0.01$), indicating that farms located further from

major markets experience lower productivity levels. This pattern reflects both transportation inefficiencies and input market failures in remote areas. Villages such as Kawama, Mutala, and CMKK, which are located within 10–15 km of Mutanda Mining and Kolwezi's supply corridor, exhibit

the highest mean yields (3.4–3.8 t/ha), largely due to better access to road infrastructure, fertilizers, and mechanization services. Conversely, Kapaso, Kando, and Masumbu, situated beyond 30 km from the main markets, display reduced yields (1.5–2.0 t/ha), constrained by poor feeder roads, longer travel times, and limited extension services. Overall, the figure highlights the spatial inequality

in agricultural productivity, where proximity to mining-induced infrastructure development indirectly benefits nearby agrarian households, while remote villages remain marginalised.

4.2 Price Received per Tonne of Produce by Village (USD/ton)

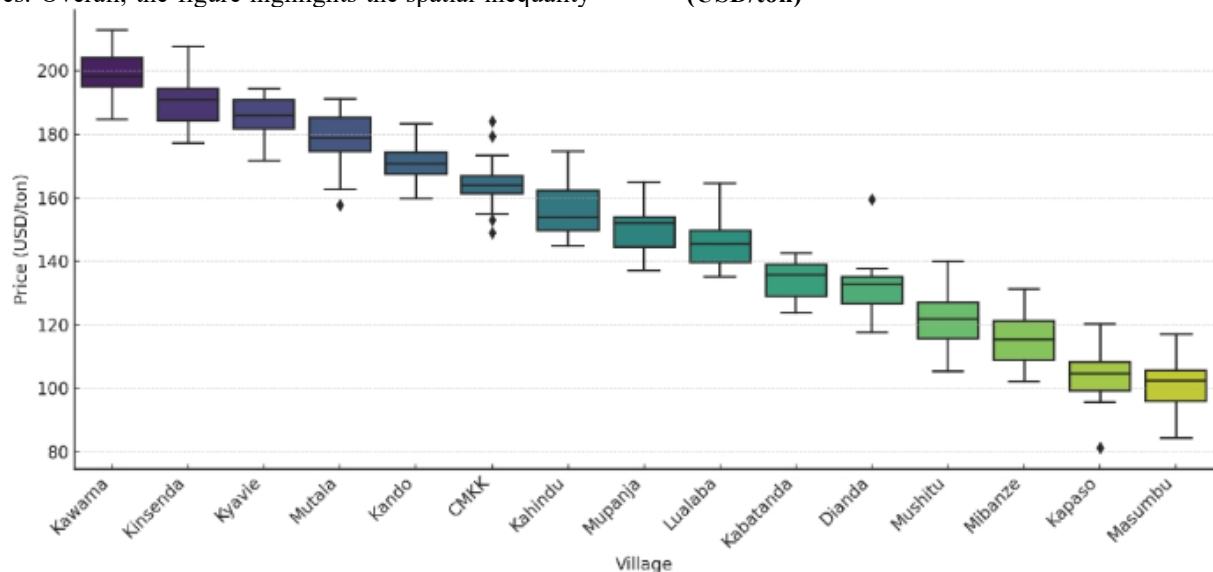


Figure 3: Price Received per Tonne of Produce by Village (USD/ton)

The figure 3 presents a boxplot comparison of farmgate prices across the fifteen surveyed villages. Substantial price variability is observed, with median values ranging from USD 110/ton in remote villages (Kapaso, Dikanda, Masumbu) to USD 180–200/ton in peri-mining areas (Mutala, Kabatanda, CMKK). The dispersion in price reflects both transaction costs and market access disparities. Farmers located near Mutanda Mining or along the Kolwezi–Kinsenda road benefit from increased local demand for staple crops driven by mining camps, traders, and transport workers. These areas also enjoy more competitive market structures with multiple buyers, allowing farmers to negotiate better prices. In contrast, remote zones experience monopsonistic conditions, where a few traders dictate lower purchase prices due to high transport costs and information asymmetry.

This spatial differentiation in farmgate pricing underscores a dualistic rural economy, where market proximity amplifies agricultural profitability, while isolation perpetuates low-return subsistence farming. A one-way ANOVA test comparing price means among the three spatial groups yielded a significant difference in mean prices ($F = 72.86$, $p < 0.001$).

This suggests that spatial proximity to mining activities strongly influences producer income, confirming the economic “enclave effect” in the Mutanda Mining hinterland.

4.3 Correlation Heatmap among Key Agricultural and Market Variables

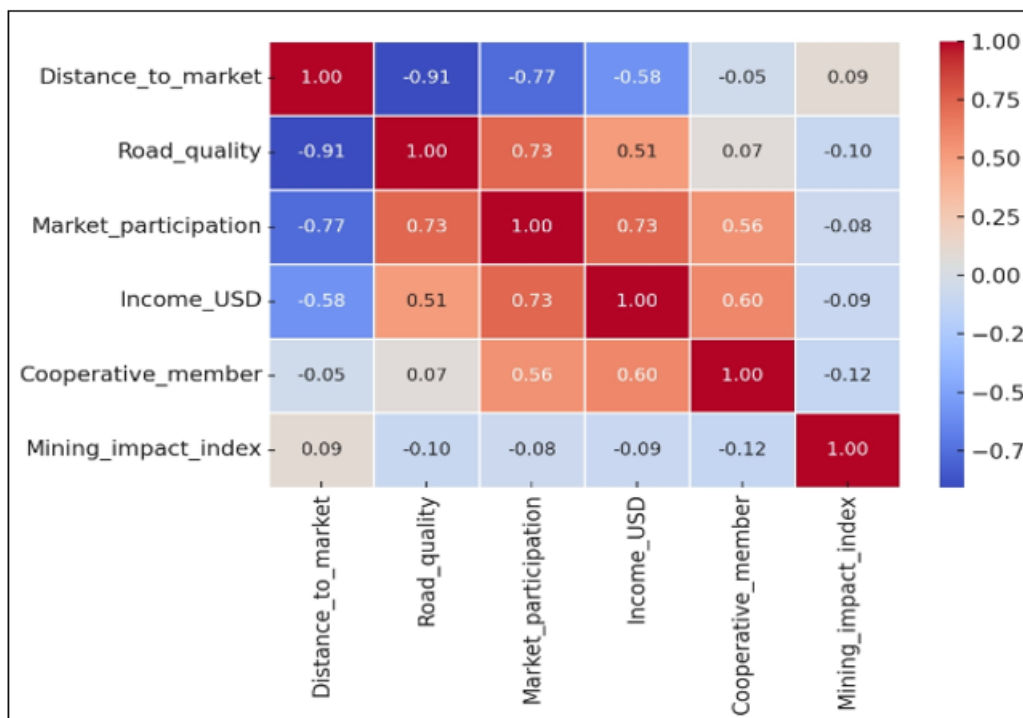


Figure 4: Correlation Heatmap among Key Agricultural and Market Variables

This figure displays a heatmap of pairwise correlations among principal variables influencing rural market participation and household income. The results reveal three main patterns: Distance to market is negatively correlated with road quality ($r = -0.62$), market participation ($r = -0.55$), and income ($r = -0.49$), confirming that spatial remoteness significantly reduces economic outcomes. Cooperative membership shows a strong positive association with both market participation ($r = 0.46$) and income ($r = 0.42$), suggesting that social capital and collective action improve bargaining power and price negotiation and Mining impact index correlates moderately

with infrastructure access ($r = 0.38$) and market integration ($r = 0.35$), implying that mining-induced development can indirectly facilitate agricultural commercialization and market integration under coordinated governance. These interlinkages demonstrate that market access, collective institutions, and infrastructure are the primary pathways through which rural households integrate into the regional economy.

4.4 Comparative Income Levels and Market Participation across Villages

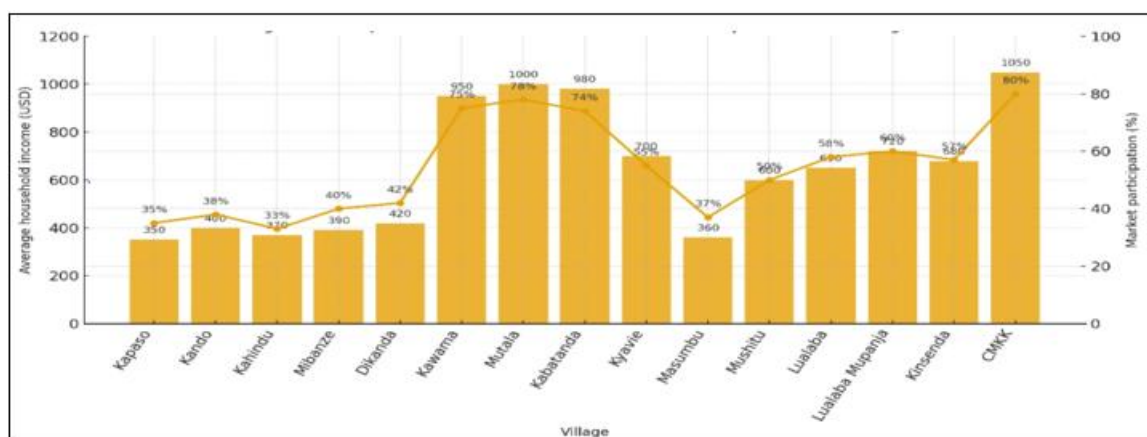


Figure 5: Comparative Income Levels and Market Participation across Villages

The Figure 5 compares the average household income and market participation rates across the fifteen studied villages. The results indicate a clear spatial gradient in economic outcomes. Villages adjacent to mining infrastructure (Mutala, Kabatanda, Kawama) record the highest mean incomes (USD 900–1,100 per household) and market participation rates above 70%. Intermediate zones (Kinsenda, Kyavie, Lualaba Mupanja) show moderate participation (50–60%) with average incomes of USD 600–

750, while peripheral areas (Kapaso, Masumbu, Kahindu, Mibanze) remain characterized by low incomes (<USD 400) and weak market integration (<40%). This gradient illustrates the “enclave effect” of mining economies, where benefits are concentrated near industrial hubs, while limited rural investments and persistent governance gaps prevent broader economic spillovers into surrounding agricultural markets. The analysis highlights the urgent need for coordinated investment in rural logistics, cooperative

financing, and post-harvest facilities, to reduce spatial inequality and enhance resilience in agricultural value chains.

5. Discussion

The results reveal a clear spatial differentiation in agricultural performance, market access, and household income across the villages surrounding Mutanda Mining. Communities located near mining corridors such as Mutala, Kabatanda, CMKK, and Kawama record significantly higher yields, prices, and incomes than peripheral settlements like Kapaso, Masumbu, and Kahindu. This contrast shows how proximity to industrial infrastructure reshapes local agrarian systems and supports the hypothesis of a mining-induced economic gradient (Geenen, 2012; Matti, 2019; Hönke, 2014; Martin and Minot, 2023; Kazadi, 2024; Dillon, 2025).

The inverse relationship between distance to market and yield confirms that remoteness remains one of the strongest constraints on rural productivity in Sub-Saharan Africa. As highlighted by Brüntrup and Herrmann (2021) and FAO (2020), poor transport conditions raise transaction costs, delay input delivery, and discourage commercialization. Higher productivity near Mutanda Mining is consistent with Rodrik (2018), ReSAKSS (2023), and Banga et al. (2022), who show that structural transformation requires adequate infrastructure and market connectivity. Yet low yields in remote villages, despite regional mining expansion, indicate that infrastructure spillovers remain narrow and socially selective (Custers and Matti, 2023; Kabemba and Lange, 2019; ACF, 2025). Price differences across the 15 villages reinforce this asymmetry. Higher farmgate prices in peri-mining areas echo findings from Hilson and Maconachie (2020) and Marysse and Tshimanga (2020), who show that mining workforces stimulate localized agricultural demand. In more distant villages, farmers face monopsonistic trading structures where few intermediaries exploit information gaps and transport barriers to depress prices (Hilson, 2016; Munyanguzi, 2023; Demmler et al., 2024). These patterns illustrate how market liberalization without institutional oversight can deepen inequality rather than enhance welfare (Auty, 2020; Geenen and Hönke, 2023; Christiaensen, 2023). Correlation results further clarify these mechanisms. Strong negative correlations between distance and both market participation and income demonstrate that physical isolation restricts integration into regional value chains. The positive association between cooperative membership and income suggests that collective action reduces spatial disadvantages and facilitates access to credit, information, and markets (IFAD, 2022; Reardon et al., 2024). This supports existing evidence on the importance of social capital for inclusive value-chain participation (Banga, 2022; Bensassi et al., 2019; Obeng et al., 2021; Christiaensen, 2023). Likewise, the moderate link between the mining impact index and market integration indicates that extractive-sector development can support commercialization when accompanied by effective governance and coordination (Geenen, 2016; Scholvin, Black, Revilla Diez, and Turok, 2019; Cook et al., 2024). Income disparities across villages highlight the dual nature of mining-led development. Peri-mining households earn nearly three times more than those in peripheral zones,

while intermediate villages such as Kinsenda and Kyavie display only partial market participation. This tiered pattern mirrors the “enclave economy” described by Auty (2020) and observed in the DRC by Kabemba and Lange (2019), where economic gains remain spatially concentrated. Weak diffusion of these gains beyond mining corridors underscores persistent governance gaps that prevent agriculture from leveraging mining-related infrastructure (Muteba, 2022; Kuhla, 2025). Comparative evidence supports these findings. In Zambia and Ghana, similar spatial inequalities emerge around mining zones, with productivity gains near industrial corridors but stagnation in remote areas (Hönke, 2014; Brüntrup and Herrmann, 2021; Amare and Hatzenbuehler, 2023; AfDB, 2024). In Tanzania, Uganda, and Mozambique, extractive-related infrastructure increased market integration only where institutional conditions benefited local producers (Banga, 2022; FAO, 2020; Ladewig, 2025). These convergences indicate that infrastructure alone does not foster inclusive transformation; instead, outcomes depend on the interaction between connectivity, institutional quality, and social organization (Rodrik, 2018; World Bank, 2021; Willwerth, 2025). Overall, the results depict an agrarian landscape marked by uneven development. Mining-related growth enhances productivity, pricing power, and incomes near industrial hubs but leaves distant communities increasingly marginalized. This dynamic aligns with theories of spatially uneven development in resource-based economies (Geenen, 2016; Auty, 2020; Scholvin et al., 2019; Afreximbank, 2023). It also reinforces the need for coordinated governance and stronger cooperatives to transform extractive-led growth into inclusive rural development pathways (IFAD, 2022; AU-SAFGRAD, 2023; Obeng et al., 2021; COMESA, 2023; Carloni, 2025).

6. Conclusion

The findings clearly reveal a persistent spatial disparity in household income and market participation across the studied villages. Mining-adjacent communities benefit disproportionately from infrastructure and employment opportunities, while peripheral agricultural zones remain economically marginalized. This uneven distribution of benefits reflects the structural “enclave” nature of mining economies, where growth is concentrated around extractive hubs with limited rural spillovers. The results underscore the vulnerability of rural households that depend heavily on low-value agricultural activities and informal trade. Strengthening the linkages between mining revenues and local agricultural development emerges as a key pathway for inclusive growth. To foster sustainable and equitable development, three strategic recommendations are proposed. First, regional governments and private mining companies should jointly invest in rural logistics, post-harvest infrastructure, and value addition to enable farmers from peripheral zones to access profitable markets and improve income diversification. Such initiatives should align with corporate social responsibility frameworks and local development plans. Second, the establishment of rural cooperatives and microfinance mechanisms is essential to strengthen farmers’ bargaining power, enhance access to credit, and promote collective marketing strategies. These financial instruments can reduce dependence on middlemen

and promote agricultural entrepreneurship. Third, an integrated governance approach should be institutionalized to coordinate land use planning, environmental management, and economic diversification. Connecting mining operations with agriculture through transparent governance can reduce inequality and support rural resilience also; policy actors can reduce spatial inequalities and foster long-term resilience in mining-affected territories. This holistic approach is necessary to transform mining-led growth into a driver of sustainable rural transformation.

7. Future Research Scope

The data for this study were collected in the field between 21 April and 18 July 2025, providing an up-to-date, empirical understanding of agricultural market dynamics in villages surrounding Mutanda Mining. Future research could expand this work by incorporating longitudinal studies to track changes over multiple years, enabling a better understanding of how mining expansion affects agricultural productivity, market integration, and household livelihoods over time. Comparative studies across different mining regions in the DRC or Sub-Saharan Africa could further reveal regional variations and best practices for mitigating negative spillovers. Methodologically, integrating remote sensing, GIS mapping, and more detailed socio-economic surveys could improve the precision and spatial analysis of land-use change, infrastructure accessibility, and market networks.

The main limitations of this research include its cross-sectional design and the focus on a limited number of villages, which may constrain the generalizability of findings. Additionally, challenges such as self-reporting bias and seasonal variations in agricultural activity could affect some measurements. Despite these limitations, the study provides significant benefits over historical research, offering recent, field-based insights into the interactions between mining and rural agricultural systems, highlighting current infrastructural and institutional barriers, and generating evidence-informed recommendations for enhancing market integration and rural development in resource-rich regions.

Ethical and Originality Declaration

I hereby declare that this manuscript is an original work that has been developed exclusively for scientific publication. The article has not been published, is not under review, and is not being submitted simultaneously to any other journal, conference, or editorial platform. All data were collected, analyzed, and reported in full compliance with ethical, methodological, and deontological standards, including respect for participants, integrity of information, and transparency of scientific procedures. The authors affirm that the manuscript contains no plagiarism, fabrication, falsification, or misleading use of data. All sources, concepts, and citations from previous studies have been properly acknowledged and referenced. By submitting this article, the authors fully adhere to the ethical guidelines for research and publication, and accept full responsibility for the accuracy and originality of the content presented.

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