



LIVELIHOOD DIVERSIFICATION CHALLENGES AND ECONOMIC RESILIENCE AMONG YOUTH DIGGERS IN ARTISANAL DIAMOND MINING COMMUNITIES OF KONO DISTRICT, SIERRA LEONE

Emmanuel Conteh,

Kalie Marahⁱ

Community Development Studies,
Milton Margai Technical University,
Sierra Leone

Abstract:

Artisanal and small-scale mining (ASM) offers significant employment opportunities for young people in resource-dependent economies, but its role in sustainable economic resilience is not clear. This study examines the impact of livelihood diversification challenges on the economic resilience of youth diggers in Sierra Leone's artisanal diamond mining communities in Kono District, using the Sustainable Livelihoods Framework and the Capability Approach. It also explores the potential mediating role of access to finance, skills and training, institutional support and livelihood diversification. A structured survey of 250 youth diggers (18-35 years) was used to collect data, which were analysed using multiple regression and bootstrapped mediation with 5,000 resamples. The measures were highly reliable and valid, with Cronbach's alpha ranging from .82 to .90, AVE values ranging from .64 to .77, and limited common method bias (Harman's single-factor variance = 32.6%). Economic resilience was significantly lower with livelihood diversification challenges ($\beta = -.41, p < .001$), while access to finance, skills and training, and institutional support were all significantly positive ($\beta = .21-.25, p < .001$). Participation in alternative livelihood activities, however, did not significantly predict resilience, nor did it mediate the relationships tested. The results suggest that resilience is more about having meaningful access to financial, human and institutional resources than diversification and thus priorities for youth livelihood policies in ASM communities.

JEL: D2, D6, Q2, O15, Q5

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ⁱ Correspondence: email kaliemarah2566@gmail.com

1. Introduction

Youth employment is one of the most urgent structural issues in low- and middle-income economies. Many young people are not moving into stable, productive, and secure jobs, but rather into informal, low-productivity and precarious work, often as a default rather than a choice (Krauss *et al.*, 2022). This informality is often intertwined with reliance on natural-resource-based livelihoods - agriculture, fishing, pastoralism and extraction - which are sources of income volatility for households while also offering an entry point into economic life. This tension is stark: informal, resource-based livelihoods are at once essential to household survival and inadequate for long-term economic security, as evidenced in reports of rural households having to choose between physical distancing and outright hunger (Krauss *et al.*, 2022) or of daily economic life being a matter of "*coping with informality, risk, and insecurity*" (Gutierrez *et al.*, 2026). Rural wellbeing scholarship now sees this as a structural issue in food and livelihood systems, rather than a frictional one, and as such, a policy issue that needs to be addressed (Woodhill *et al.*, 2022).

This is especially true for communities that depend on a limited natural-resource base. Households that rely heavily on a single resource system, such as a fishery, a rangeland, or a mineral deposit, are exposed to multiple risks related to environmental change, price fluctuations, and resource depletion. Livelihood diversification, defined as the development of a more diversified portfolio of livelihood activities, is a concept that has been extensively theorized as the key adaptive strategy to this exposure (Jackson *et al.*, 2025; Taylor *et al.*, 2021). However, the empirical evidence on the benefits of diversification for resilience is far from unanimous. For example, in small-scale fisheries, the link between asset wealth, diversification and adaptive capacity is found to be complex and context-dependent, not always positive (Taylor *et al.*, 2021; Bassett *et al.*, 2022); and in crop diversification, the income benefits are shown to be highly dependent on the mix of activities undertaken and the resources available to the households (Islam *et al.*, 2024). Diversification, that is, is not a resilience mechanism that happens automatically, but rather seems to be contingent on the content of the diversification and the resources available for it.

Artisanal and small-scale mining (ASM) is firmly in this context, and has an additional layer of complexity. ASM is now recognized as an important source of rural employment, and in many mineral-rich areas, the primary source of employment after agriculture, and it is a source of employment for young people who have limited opportunities to enter economic life (Hilson & Osei, 2014). ASM is not simply a legacy of the past; recent scholarship has challenged the notion of African youth as being "stuck" in a state of waitthood, revealing that their involvement in ASM is driven by a range of motivations and strategic considerations, even in the face of limited opportunities (Arthur-Holmes & Yeboah, 2025). Meanwhile, ASM's structural characteristics - its labor-intensive nature, lack of regulation, vulnerability to occupational hazards, and, most importantly, its reliance on a dwindling and volatile mineral resource make it a precarious basis for long-term economic security at best. The manual, low-capital labor

that historically employed many young diggers is being squeezed out as easily accessible deposits are depleted or displaced by mechanized extraction, and a transition to a new livelihood is not necessarily a seamless one (Mabe *et al.*, 2021; Maconachie & Hilson, 2011). In principle, diversification out of mining is the adaptive strategy that the wider resilience literature would recommend, but in practice, it requires financial, skill and institutional resources that are often lacking in mining communities.

Sierra Leone's Kono District is a case in point in this regard. For decades, the rural economy of Kono has been defined by alluvial diamond mining, and mining and farming livelihoods have historically not been mutually exclusive (Maconachie, 2007). During the post-conflict era, diamonds have played a significant role in local development discussions and in national governance reform, and scholars have documented how artisanal mining has been incorporated into and at times undermined by evolving governance arrangements (Maconachie, 2008, 2020). In more recent times, as the alluvial deposits become increasingly "worked out" and mining is increasingly mechanized, Kono's mining communities have been described as being "stuck in transition": neither firmly anchored in mining nor firmly anchored in alternative livelihoods, but caught between a shrinking resource base and underdeveloped pathways out (Maconachie & Conteh, 2025). This work, which draws on 20 years of field research in Kono, offers a rich qualitative description of the constraints on livelihood diversification in the district, including land access, capital constraints, and policy neglect (Maconachie, 2011; Maconachie & Conteh, 2025).

This literature has not yet measured the relationship at the level of individual young diggers: how the diversification challenges they face relate, in measurable terms, to their economic resilience, and whether the resources most frequently proposed as solutions finance, skills, institutional support work by enabling diversification, or by strengthening resilience in other ways. This gap is a multi-faceted one with four dimensions. In terms of content, the level of qualitative and policy-based research on the mining-livelihood nexus in Kono has not yet been paralleled by survey-based research that can be used to test these relationships with a large sample of youth diggers. Empirically, the wider ASM-youth literature - concentrated heavily on Ghana - relies predominantly on qualitative and ethnographic methods (Arthur-Holmes & Yeboah, 2025; Hilson & Osei, 2014), leaving open how far its insights travel to a quantitatively specified model in a different national and mineral context. In theory, the Sustainable Livelihoods Framework is often used as a structuring language in ASM research, but is less often used as a testable structural model in which specific capital-type resources, diversification and resilience are connected by measurable pathways. Methodologically, this qualitative focus has resulted in a lack of empirical differentiation between two policy-relevant scenarios: access to finance, skills, and institutional support can increase resilience either by allowing diggers to diversify their livelihood portfolios (a mediated pathway) or by directly strengthening resilience, without necessarily leading to diversification. The difference is important for policy because livelihood transition programming in the ASM sector is often based on the implicit premise that increasing

diversification activity is the resilience-building mechanism, which has rarely been directly tested against the alternative that resource access is more important than diversification activity.

The current study aims to fill these gaps by conducting a quantitative, theory-based study of 250 youth diggers aged 18-35 in artisanal diamond mining communities in Kono District. The study is based on the Sustainable Livelihoods Framework and draws on the Capability Approach, and explores the relationship between livelihood diversification challenges and economic resilience, and whether this relationship is mediated by livelihood diversification itself, while theoretically justifying access to finance, skills/training access, and institutional support as explanatory factors. The analysis is guided by three research questions. What are the livelihood diversification challenges, and how do they relate to economic resilience among youth diggers in Kono District? Second, does livelihood diversification act as a mediator in this relationship? Third, what is the relationship between access to finance, skills/training access, and institutional support and livelihood diversification, and with economic resilience, controlling for the challenges of livelihood diversification? In answering these questions, the study makes four contributions that are developed fully in Section 7: it extends the Sustainable Livelihoods Framework by empirically distinguishing mediated from direct pathways linking capital-type resources to resilience; it provides quantitative evidence on youth diggers in a diamond-mining context that has so far been examined almost exclusively through qualitative methods; it demonstrates a regression-based approach to testing livelihood-resilience relationships that is transferable to other ASM settings; and it offers evidence-based guidance for the design of youth livelihood transition policy in Sierra Leone and comparable resource-dependent economies. The rest of the paper is organized as follows. The theoretical framework and hypotheses are developed in Section 2. The relevant literature is critically reviewed in Section 3. The methodology is described in Section 4, which covers sampling, measurement and analytical approach. The results are presented in Section 5, the theoretical and empirical implications are discussed in Section 6, the contributions of the study are outlined in Section 7, the policy implications are discussed in Section 8, and the limitations and directions for future research are discussed in Section 9.

2. Theoretical Framework and Hypothesis Development

2.1 The Sustainable Livelihoods Framework

The Sustainable Livelihoods Framework (SLF), developed by Chambers and Conway (1992) and developed by Scoones (1998), and the UK Department for International Development (DFID, 1999), is the foundation of this study. A livelihood is defined as a set of capabilities, assets and activities that enable a means of living and a livelihood is considered sustainable if it is able to withstand and recover from shocks and stresses and to maintain or improve its underlying capabilities and assets, both now and in the future (Chambers & Conway, 1992). At the heart of the SLF is the idea that livelihood strategies

are influenced by the five types of capital (human, financial, social, physical, and natural) that are interrelated, as well as a broader vulnerability context of shocks, trends and seasonality, and are mediated by changing structures and processes, including government policies, markets and institutions (Scoones, 1998). In this definition, livelihood outcomes are not only a result of risk exposure, but also the capital assets that an individual or household can access, and the institutional context that enables the transformation of those assets into livelihood strategies.

The SLF is well adapted to the Kono context, as artisanal diamond mining is, in the framework's own words, a livelihood strategy that is heavily dependent on a single, finite natural capital, and is practiced by young people who often have little financial, human, and institutional capital to rely on. The focus of the framework on capital diversity as a determinant of livelihood strategy choice offers a theoretical basis for considering access to finance (financial capital), skills/training access (human capital), and institutional support (a proxy for the transforming structures and processes that turn assets into livelihood strategies) as explanatory factors for livelihood diversification and economic resilience. Meanwhile, the SLF has been the target of a long-standing critique that is directly relevant to its application here. The framework, as De Haan & Zoomers (2005) point out, is under-theorized in its focus on institutions, and it fails to address the political and social relations that determine who in practice gains access to capital assets, which is not just a matter of asset stocks but of power, negotiation and social relations that the standard SLF diagram treats as a relatively thin institutional "box". This critique is relevant to artisanal diamond mining communities where access to land, mining plots, and networks of dealers is often negotiated and mediated by chieftaincy structures, patronage and negotiated authority, rather than open markets (Maconachie, 2008). A second, related limitation is that the SLF's pentagon of capitals is analytically useful, but may lead to the implicit assumption that diversification is always a good thing, that is, that a broader portfolio of activities is always resilience-enhancing, when in fact the quality, viability, and capital-intensity of the activities entered into may be as important as the number of activities (Ellis, 2000). This study does not assume that this is the case, but rather poses it as an empirical question; hence the reason for modelling livelihood diversification as a hypothesized mediating mechanism to be tested rather than assumed.

2.2 The Capability Approach as a complementary perspective

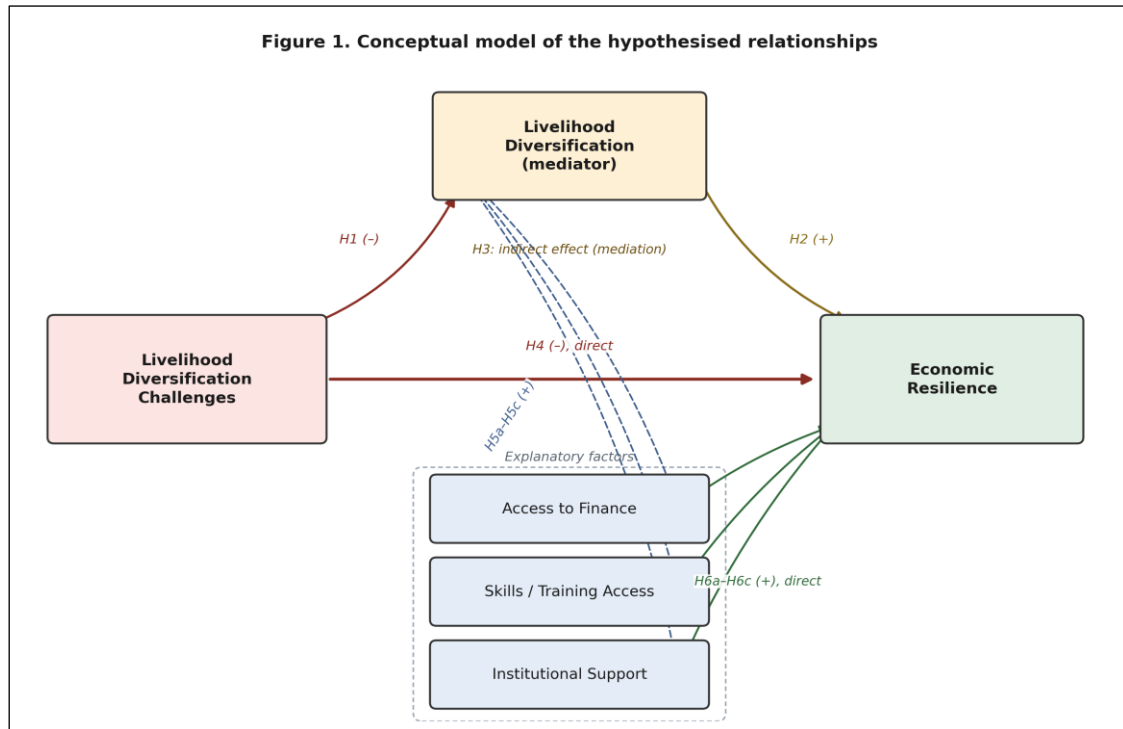
The Capability Approach (Sen, 1999) provides an alternative perspective to the SLF, which emphasizes what people can do and be given the resources they have. Sen (1999) makes a distinction between resources (or "commodities"), the capabilities they enable (the real freedoms a person has to realize valued functionings), and functionings themselves (the beings and doings a person actually realizes). The Capability Approach takes a different perspective on livelihood diversification problems when applied to youth diggers in Kono, viewing it not as a lack of alternative livelihoods, but as a limitation of the set of livelihood functionings that youth are practically able to exercise, even if some livelihoods exist in name. Limited access to finance, skills, education and

institutional support function, in Sen's (1999) terms, as constraints on the "conversion factors" that determine whether a given resource can actually be turned into a valued functioning: a young digger with access to a small loan but no relevant skills or market information may be no more able to convert that capital into a viable alternative livelihood than a digger with skills but no capital. This is analytically helpful for the present study in explaining why access to finance, skills, and institutional support are considered separate but related explanatory factors, rather than interchangeable proxies for a single underlying "resource" construct: each refers to a different conversion factor that can either increase or decrease the capacity to diversify.

The Capability Approach has its own limitations, and they should not be ignored. Sen (1999) intentionally does not provide a definitive list of capabilities that are important, but rather leaves the approach as a normatively open and empirically underspecified one, which is good for cross-context applicability, but bad for operationalization in a structured survey instrument, where researchers have to make judgements about which functionings to use as proxies for capability expansion. That operationalization is done indirectly in this study: access to finance, skills/training, and institutional support are proxies for the conversion factors Sen identifies, and economic resilience is treated as a downstream indicator of increased capacity to resist and respond to livelihood shocks, not as a measure of capability in the Sennian sense. The Capability Approach is not being tested as a structural model here, but rather as an interpretive lens to explain why access to resources is important, to illuminate the mechanism by which finance, skills and institutional support could work.

2.3 Conceptual model and hypothesis development

Integrating these two perspectives, the study's conceptual model positions livelihood diversification challenges as the principal explanatory variable and economic resilience as the main outcome variable, with livelihood diversification specified as a hypothesized mediating mechanism, and access to finance, skills/training access, and institutional support specified as explanatory factors that may shape both diversification and resilience. The full pathway structure is summarized in Figure 1 and developed into ten directional hypotheses below.



In SLF terms, livelihood diversification challenges (including limited access to capital, land, skills and markets for alternative livelihoods) constitute a limited vulnerability context that should reduce the capacity of a young digger to diversify their livelihood portfolio. When these difficulties are significant, the SLF suggests that people stay in their current (mining) approach even when it is fragile, because they lack the resources and institutions to try something different (Shonhe *et al.*, 2022; Mabe *et al.*, 2021). This yields the first hypothesis:

H1. Livelihood diversification problems are negatively related to livelihood diversification of youth diggers.

When diversification does happen, it is considered the main adaptive strategy that resource-dependent households use to cope with income volatility and shocks (Jackson *et al.*, 2025; Ellis & Sijtsma, 2023). In principle, a more diversified livelihood portfolio should help to lessen the vulnerability of a young digger to the ups and downs of a single, diminishing resource, and enhance their ability to withstand and rebound from livelihood shocks:

H2. Livelihood diversification is positively associated with economic resilience among youth diggers.

Combined, H1 and H2 suggest an indirect mechanism by which diversification pressures reduce resilience, by first reducing diversification itself.

H3. Livelihood diversification mediates the negative relationship between livelihood diversification challenges and economic resilience.

Livelihood diversification challenges can also have direct impacts on resilience, even if they do not involve livelihood diversification (e.g., by directly increasing income volatility, psychological insecurity, or exposure to shocks from continued reliance on a single, diminishing livelihood source) (Maconachie & Conteh, 2025):

H4. Economic resilience among youth diggers is negatively and directly related to livelihood diversification challenges.

In the SLF, financial, human and institutional capital are theorized as the resources that will decide whether diversification challenges can be overcome or not, while in the Capability Approach they are reframed as conversion factors. Access to finance is the source of capital required to start alternative livelihoods; access to skills and training is the source of human capital and technical competence required to pursue viable alternatives; and access to institutional support - from local government, mining authorities or community-based organizations - is the source of transforming structures and processes required to convert individual effort into sustained livelihood change (Maconachie & Hilson, 2011; Hilson & Osei, 2014). Each should, therefore, be designed to increase the practical capacity of a young digger to diversify:

H5a. There is a positive relationship between access to finance and livelihood diversification. **H5b.** Access to skills/training is positively related to livelihood diversification. **H5c.** Livelihood diversification is positively related to institutional support.

Finally, the model includes direct links between each of the explanatory factors and economic resilience, reflecting the possibility that these factors contribute to resilience in ways other than diversification, such as by providing a financial buffer, transferable competence, or a support network that can be mobilized directly when facing shocks.

H6a. There is a direct and positive relationship between access to finance and economic resilience.

H6b. Access to skills/training is directly and positively related to economic resilience.

H6c. Economic resilience is directly and positively related to institutional support.

H1–H6c operationalize the proposition that economic resilience of youth diggers is influenced by the severity of the diversification challenges they encounter, the resources they have to address these challenges, and - the central theoretical question this study is designed to adjudicate - whether these forces operate primarily by enabling diversification itself, or act on resilience directly.

3. Literature Review

3.1 Artisanal diamond mining and youth livelihoods

The sustained field programme of Maconachie and collaborators has been the most detailed account available of the intersection of mining and rural livelihoods in Kono District, and has shaped research on the subject disproportionately, with two decades of research (Maconachie, 2007, 2008, 2011, 2020; Maconachie & Conteh, 2025). This work has evolved from the historical entanglement of 'farming miners' and 'mining farmers' (Maconachie, 2007) to the impact of post-conflict governance reforms on access to diamond wealth (Maconachie, 2008) and, most recently, to characterizing the mining communities of Kono as 'stuck in transition' between a diminishing resource base and underdeveloped alternatives (Maconachie & Conteh, 2025). It is a strength of its central theme, depth: findings are based on sustained, multi-sited fieldwork, not single cross-sectional snapshots. The methodological limitation of its central focus, for the purposes of the present study, is not substantive, but rather the evidence base is almost entirely qualitative and interpretive, based on interviews, focus groups, and historical analysis. This makes it particularly appropriate for explaining mechanisms and context but not particularly appropriate for establishing the relative strength of competing explanatory pathways, or for testing whether the relationships it describes qualitatively - between mechanization, diminishing access, and livelihood insecurity - are of magnitude and consistency that would be considered robust across a wider sample of individual diggers. The quantitative design of the present study is designed to supplement, rather than replace, this qualitative foundation.

There is also a parallel and largely independent literature on youth engagement in ASM in other parts of West Africa, with a strong focus on the galamsey sector in Ghana. This literature has been useful in debunking deficit-based approaches to African youth as being passively stuck in "waithood" and demonstrating instead that youth participation in ASM is a strategic agency, albeit constrained (Arthur-Holmes & Yeboah, 2025). (Hilson and Osei, 2014) build on this by claiming that ASM is a real (albeit imperfect) transitional solution to the youth unemployment problem in sub-Saharan Africa, taking in not only unskilled workers but also graduates and displaced formal-sector workers. Some of the few quantitative data in this area come from Mabe *et al.* (2021), who document the coping mechanisms of small-scale miners in Ghana after displacement, but do not address how diversification challenges work when there is no displacement, as is the case for most youth diggers in Kono, where the process is gradual resource depletion and mechanization. Another implicit limitation of the Ghana-centred literature is that galamsey's institutional and regulatory context is very different from Sierra Leone's diamond governance context, which has a unique institutional backdrop due to the Diamond Area Community Development Fund and the periodic mining bans in Sierra Leone (Maconachie, 2008, 2020). The results from Ghana are thus only partially transferred to Sierra Leone, highlighting the importance of context-specific quantitative evidence.

3.2 Livelihood diversification

The general livelihoods literature considers diversification as the main livelihood strategy used by natural-resource-dependent households to cope with risk, but the empirical link between diversification and resilience is far from clear, as it is often assumed to be a policy solution. (Jackson *et al.*, 2025) report on livelihood diversification patterns by farming systems in the Eastern Gangetic Plains, and show that livelihood diversification is not uniform across households of different means, but rather systematic in relation to underlying asset endowments. Similarly, in small-scale fisheries, Taylor *et al.* (2021) report that the link between asset wealth, diversification, and adaptive capacity is not linear and is not always positive; and Bassett *et al.* (2022) demonstrate that vulnerability and resilience of small-scale fishery supply chains are as much a function of structural position in the chain as of diversification itself. (Islam *et al.*, 2024) provide a more direct test of the impact of crop diversification on farmer income in the Rajshahi division of Bangladesh, which shows that the impact of crop diversification on farmer income depends on the crops being diversified and the resource base that households can contribute to the diversification - a result that warns against using the term "crop diversification" as a single homogeneous construct with a uniform resilience-enhancing effect. Combined, this literature indicates that the link between diversification and resilience is not as straightforward as is sometimes suggested in policy debates: diversification may be beneficial under certain resource and asset conditions, but not under others, and the benefits of diversification may be more strongly linked to the quality and viability of the activities diversified into than to the number of activities diversified. This conditionality is one of the main reasons why diversification is treated as a mediating mechanism in the present study, as opposed to being assumed to be a good for resilience.

3.3 Economic resilience in resource-dependent communities

The concept and measurement of economic resilience have been approached and quantified in very different ways in the natural-resource-dependent livelihoods literature, which is another methodological gap. (Dixon *et al.*, 2021) model resilience in Asian agrifood systems mainly in terms of system-level indicators of shock absorption and recovery, whereas (Favretto & Stringer, 2024) create a more actor-centred framing of climate-resilient development that is sensitive to the actors' resilience being measured and the measure itself. While (Rusere *et al.*, 2025) focus on coping strategies at the household level during the COVID-19 lockdown in rural South Africa, treating resilience largely as the successful use of coping strategies in the immediate aftermath of a shock, (Tarekegn *et al.*, 2026) operationalize vulnerability, the conceptual counterpart of resilience, by using composite district-level indices that combine exposure, sensitivity and adaptive capacity. This diversity of measurement approaches is particularly relevant to ASM livelihoods research, as the majority of the measurement development has been in agricultural or fishery livelihoods settings, and it is unclear whether the findings from these contexts can be applied to artisanal mining populations, which face a single

depleting resource, occupational hazard profile, and informality, compared to farming or fishery households. The present study directly fills this gap by creating and psychometrically testing a multi-item economic resilience scale specifically for the youth-digger population, which is reported in Section 5.

3.4 Access to finance, skills and institutional support

Financial exclusion is a key factor that is broadly recognized as limiting livelihood diversification in ASM communities, although there are few empirical tests of the link between financial exclusion and resilience outcomes, rather than descriptive accounts of financial exclusion. (Maconachie and Hilson, 2011) contend that formalization initiatives aimed at "safeguarding livelihoods" in West African ASM have often worsened poverty, partly because they have not been linked to any significant improvements in miners' access to credit or other sources of capital. This is in line with the Sustainable Livelihoods Framework, which places financial capital as a precondition for livelihoods strategy change, but the direction and relative strength of the impact of finance (net of skills and institutional factors) has been little studied statistically in a mining-specific youth population. Although skills and training are central to the Capability Approach's account of conversion factors, the literature on ASM does not provide as much empirical attention to this theme as is given to finance, and where it is discussed, it is often as part of a wider formalization or diversification programming (Hilson & Osei, 2014). Institutional support (local government, mining authorities, and community organizations) is the least consistently operationalised of the three explanatory factors in previous studies, and is more frequently described qualitatively as "weak governance" or "policy neglect" (Maconachie, 2020; Obie *et al.*, 2026) than measured as a multi-item construct that can be included in a single statistical model with finance and skills. (Obie *et al.*, 2026) are closest, connecting sustainable mining governance and social capital transformation to community-level resilience outcomes, but they do so at the community level, rather than at the individual level, and they do not address how institutional support is perceived and experienced by individual young diggers themselves.

3.5 Livelihood transitions and synthesis of gaps

There is a smaller literature that focuses more directly on livelihood transitions out of resource dependence. For subsistence farming communities, (Choquette-Levy *et al.*, 2025) model the process of retrenchment, defined as withdrawal from a primary livelihood activity in the face of climate-driven risk, and for peri-urban livelihoods around Kigali, (Baffoe *et al.*, 2025) document the socioeconomic consequences of land expropriation, which can result in loss of livelihoods but also, in some instances, unexpected diversification. These studies are useful in showing that livelihood transitions are not necessarily smooth and fully voluntary, as (Maconachie & Conteh, 2025) describe the Kono diggers' situation as being "stuck in transition", but neither study looks at a transition process triggered by resource depletion in an extractive livelihood specifically,

nor does either provide a quantitative test of the mechanisms (diversification, finance, skills, institutions) by which transitions succeed or stall.

In this literature, five gaps are identified that coalesce into the research problem of this study. First, the empirical evidence on the mining-livelihood nexus is rich but overwhelmingly qualitative, and the magnitude and relative strength of the relationships proposed by this nexus have not been tested. Second, the broader ASM-youth literature is geographically limited to Ghana and is not extensively quantified in Sierra Leone's unique diamond-mining and post-conflict governance environment. Third, the diversification-resilience relationship observed for agricultural and fishery livelihoods seems to be conditional and not universal, but this conditionality has not been evaluated for artisanal mining. Fourth, there is no validated instrument specific to ASM youth populations to measure economic resilience, and the literature on economic resilience has been inconsistent in its measurement. Fifth and most importantly for policy, finance, skills and institutional support have been much talked about as an enabler of diversification, but rarely tested against the alternative that it acts directly on resilience. This study is explicitly designed to adjudicate this alternative.

4. Methodology

4.1 Research design and setting

The study used a quantitative, cross-sectional survey design to test the hypothesized relationships between livelihood diversification challenges, livelihood diversification, access to finance, skills/training access, institutional support and economic resilience among youth diggers. The cross-sectional design is suitable for the study's main purpose, which is to determine the strength and nature of the relationship between these constructs at one time, but the limitations of causal inference are directly addressed in Section 9. The data collection was conducted in the artisanal diamond mining communities of Kono District, eastern Sierra Leone, which has long been known as the epicentre of the country's alluvial diamond sector and the main location of the qualitative fieldwork tradition that underpins much of the theoretical work in the study (Maconachie & Conteh, 2025; Maconachie, 2007). As the artisanal digging is geographically concentrated, as described in this literature, sampling was done in active mining areas in chiefdoms that have had a long history of alluvial diamond mining, such as Gbense, Nimikoro and Tankoro.

4.2 Population, sampling and sample size justification

The target population consisted of youth diggers aged 18-35 years who were involved in artisanal diamond digging in Kono District during the time of data collection. Prospective respondents outside the specified age range were excluded, as were individuals who were not directly involved in the mining process but rather had ancillary roles related to mining (such as dealing, brokering, or site supervision). This was done to isolate a population with a relatively homogeneous occupational exposure to the livelihood

challenges under study. Since there is no formal register of the informal artisanal diggers, a probability sampling frame was not possible, and a multi-stage sampling approach was used, with the first stage being purposive sampling of active mining sites in the selected chiefdoms based on known concentrations of digging activity, and the second stage being systematic sampling of eligible diggers encountered at each site until the required sample size was achieved. This is in line with the typical surveying of informal, geographically dispersed occupational populations in the ASM literature (Mabe *et al.*, 2021).

The a priori statistical power analysis was used to justify the target and achieved sample size of 250, rather than the more common, but statistically arbitrary, ten times rule. The minimum sample sizes for detecting a medium effect size (Cohen's $f^2 = .15$) with $\alpha = .05$ and power = .80 are 114 for the full regression model (nine predictors: four substantive explanatory constructs, one mediator, and four control variables) and 166 for a smaller effect ($f^2 = .10$) under the same criteria. The minimum for the core theoretical predictors ($k = 4$) is 85. The sample size of 250 is well powered for hypothesis testing for both medium and small-to-medium effect sizes, with post-hoc power of .997 and .955, respectively, at the full nine-predictor model, and well above all three thresholds.

4.3 Designing questionnaires and measures

The questionnaire was designed to operationalize the six constructs in the conceptual model: livelihood diversification challenges, access to finance, skills/training access, institutional support, livelihood diversification, and economic resilience. No psychometrically validated multi-item scales specific to artisanal mining livelihoods were identified in the published literature for these constructs, so items were researcher-developed, with content for the constructs drawn from the Sustainable Livelihoods Framework and Capability Approach for construct definition and from the qualitative literature on Kono's mining-livelihood nexus (Maconachie, 2007, 2008, 2011, 2020) for context-appropriate item content. This approach was in line with the recommended practice for constructs that did not have a context-specific instrument: items were written to reflect the theoretical definition of each construct, face and content validated, and pre-tested for appropriateness for a predominantly non-formally-educated respondent population (see Table 1 for the education profile of the achieved sample) and for oral, enumerator-administered delivery in a mining-site setting.

Livelihood diversification challenges (five items) reflected perceived constraints on engaging in income-generating activities other than artisanal mining, such as limited access to alternative livelihood markets, land and capital. Access to finance (four items) was perceived as access to savings, credit, and formal and informal financial services. Skills/training access (four items) measured perceived access to vocational, technical or entrepreneurial training for livelihoods other than digging. Institutional support (four items) measured perceived support from government, mining authorities and community-based organizations for livelihood diversification. Economic resilience (five items) was the respondents' perceived ability to absorb, adapt to, and recover from income shocks to livelihoods. Each of the 18 items in these four multi-item constructs was

rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), and the scores for each construct were calculated as the average of the items. Livelihood diversification was hypothesized to be a mediating factor between the two variables, and was operationalized as a single-item measure of the level of respondents' involvement in alternative (non-mining) livelihood activities, scored from 1 (very low) to 5 (very high); this single-item operationalization was a deliberate simplification appropriate to a context where enumerating a full portfolio of intermittent informal activities in a structured interview is difficult, but it is also a genuine measurement limitation that is returned to in Section 9. Demographic and occupational control variables included were age of the respondents, gender, highest education, years of mining, and illustrative monthly mining income.

4.4 Data collection procedure and ethical considerations

Structured, enumerator-administered interviews were used to collect data as this was the most appropriate method for the variation in literacy levels among the respondents (Table 1) and to ensure that the information was as accurate as possible in the field. The enumerators were briefed on the content of the questionnaire and the interview protocol before data collection. The study protocol adhered to standard ethical research guidelines: participation was voluntary, informed consent was obtained from each respondent before the interview, respondents were informed that they could withdraw at any time without penalty, and individual responses were reported anonymously or in de-identified form. There was no financial or material reward for participation, to reduce the pressure to participate.

4.5 Analytical strategy

Prior to analysis, data were checked for missing values, duplicate respondent records, and out-of-range responses; the resulting data set had no missing values, no duplicate respondent records, and no values outside the range of possible responses. Multivariate outliers were examined for the construct-level composite scores and continuous control variables, and no cases were found to be greater than the chi-square critical value at $p < .001$. Internal consistency reliability was calculated for each multi-item construct with Cronbach's alpha. Construct validity was evaluated using exploratory factor analysis (principal axis factoring, promax rotation), sampling-adequacy checks (Kaiser-Meyer-Olkin, Bartlett's test of sphericity), convergent validity was examined through average variance extracted (AVE) and composite reliability, and discriminant validity was examined using the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio of correlations. Given the self-reported cross-sectional survey design, the issue of common method bias was evaluated using Harman's single-factor test.

The choice of hypothesis testing was made deliberately and not by default, and was justified on four grounds: the use of hierarchical multiple regression instead of partial least squares structural equation modelling (PLS-SEM). First, the measurement model (Section 5.2) showed that each multi-item construct was unidimensional, reliable,

and psychometrically sound as a summated composite, and that a regression-based approach is not significantly inferior in relative terms to a full latent-variable specification, but is more transparent in terms of interpretation. Second, the study's main objective is the testing of a limited number of a priori hypotheses about direct and indirect effects, not the estimation of a more elaborate nomological network of formative indicators or higher-order constructs, where regression-based path analysis is common and well established. Third, the a priori power analysis (Section 4.2) showed that the achieved sample size was sufficient for OLS-based inference, so that the robustness of PLS-SEM in small samples was not a major factor in this case. Fourth, standardized regression coefficients are more easily understood by the policy and development-practice audiences this study seeks to inform than variance-based composite loadings. The indirect-effect (a x b path) approach was tested for mediation, and bias-uncorrected percentile confidence intervals were calculated from 5,000 bootstrap resamples, which is recommended for mediation testing, irrespective of the structural modelling approach used. Multicollinearity was evaluated by variance inflation factors (VIF), effect sizes were calculated as Cohen's f^2 for each substantive predictor, and predictive relevance was evaluated by the Stone-Geisser Q^2 statistic, which is a regression-based analogue to the statistic conventionally reported in PLS-SEM. All analyses were performed using Python (NumPy, pandas, SciPy, statsmodels, scikit-learn, factor_analyzer, pingouin).

5. Results

5.1 Respondent characteristics

The achieved sample comprised 250 youth diggers (Table 1). Respondents were predominantly male (72.8%), with a mean age of 26.79 years (SD = 5.31, range 18-35). Educational attainment was concentrated at the lower end of the formal schooling spectrum: 16.8% had no formal schooling beyond primary level, 43.6% had completed junior secondary school, 27.6% had completed senior secondary school, and 12.0% had some tertiary education. Respondents reported a mean of 4.94 years (SD = 1.99, range 1-11) engaged in artisanal mining, and a mean illustrative monthly mining income of SLE 1,243.01 (SD = 483.58, range SLE 250-2,385). Mean self-reported engagement in alternative livelihood activities was 2.90 (SD = 1.25) on the five-point scale, indicating a moderate but highly variable level of diversification activity across the sample.

Table 1: Respondent Characteristics (N = 250)

Characteristic	n / M	% / SD
Age (years)	26.79	SD = 5.31; range 18-35
Gender: Male	182	72.8%
Gender: Female	68	27.2%
Education: None/Primary	42	16.8%
Education: Junior Secondary School	109	43.6%
Education: Senior Secondary School	69	27.6%
Education: Tertiary	30	12.0%
Years engaged in mining	4.94	SD = 1.99; range 1-11

Monthly mining income (SLE)	1,243.01	SD = 483.58; range 250-2,385
Alternative livelihood activity level (1-5)	2.90	SD = 1.25

5.2 Measurement model: reliability and validity

All four multi-item constructs demonstrated strong internal consistency reliability (Table 2): livelihood diversification challenges ($\alpha = .895$), access to finance ($\alpha = .823$), skills/training access ($\alpha = .869$), institutional support ($\alpha = .898$), and economic resilience ($\alpha = .871$), all comfortably exceeding the conventional .70 threshold. Item-total correlations ranged from .608 to .798 across all twenty-two items, with no item showing a weak ($< .40$) association with its own construct.

Table 2: Descriptive Statistics, Reliability, and Convergent Validity

Construct	Items	M	SD	Skew	Kurtosis	Alpha	AVE	CR
Livelihood Diversification Challenges	5	3.134	0.769	-0.050	-0.286	.895	.698	.920
Access to Finance	4	2.864	0.673	-0.105	-0.406	.823	.643	.878
Skills/Training Access	4	2.804	0.749	0.161	-0.135	.869	.713	.908
Institutional Support	4	2.721	0.809	0.127	-0.671	.898	.766	.929
Economic Resilience	5	3.312	0.713	-0.137	0.040	.871	.640	.898

Note: Alpha = Cronbach's alpha; AVE = average variance extracted; CR = composite reliability. N = 250.

Sampling adequacy for factor analysis was excellent (Kaiser-Meyer-Olkin measure = .896; Bartlett's test of sphericity $\chi^2(231) = 2994.70$, $p < .001$). Exploratory factor analysis using principal axis factoring with promax rotation extracted five factors with eigenvalues exceeding 1.0, jointly accounting for 70.09% of total variance (Table 3). The rotated factor solution recovered the hypothesized five-construct structure cleanly: every item loaded most strongly on its intended factor (loadings ranging from .687 to .921), with the smallest gap between an item's primary and secondary loading being .587 and the median gap exceeding .75, indicating minimal cross-loading.

Table 3: Exploratory Factor Analysis: Rotated Factor Loadings (Principal Axis, Promax)

Item	LDC	INS	FIN	SKL	RES
LDC1	0.862	-0.007	-0.127	-0.025	0.125
LDC2	0.782	0.005	-0.044	0.030	-0.078
LDC3	0.805	-0.007	0.045	-0.034	-0.058
LDC4	0.847	-0.024	0.085	-0.094	0.036
LDC5	0.878	0.032	0.009	0.121	-0.037
FIN1	0.006	0.019	0.832	0.003	-0.028
FIN2	-0.073	-0.034	0.808	-0.036	0.038
FIN3	-0.021	-0.016	0.752	-0.024	0.039
FIN4	0.057	0.022	0.814	0.073	-0.023
SKL1	0.024	0.057	0.028	0.865	-0.029
SKL2	-0.053	-0.055	0.008	0.808	0.032
SKL3	-0.040	-0.001	-0.037	0.853	-0.018
SKL4	0.066	-0.015	0.023	0.849	0.032
INS1	0.003	0.877	-0.034	-0.002	0.019
INS2	0.013	0.898	-0.096	0.019	0.010

INS3	-0.061	0.869	-0.002	-0.046	-0.023
INS4	0.048	0.855	0.133	0.022	-0.003
RES1	-0.101	0.045	0.004	0.054	0.687
RES2	0.053	0.049	0.094	-0.069	0.814
RES3	0.108	-0.054	-0.005	0.005	0.921
RES4	-0.036	-0.028	0.045	0.007	0.773
RES5	-0.103	0.013	-0.117	0.034	0.785

Note: Extraction method: principal axis factoring; rotation: promax. KMO = .896; Bartlett's chi-square(231) = 2994.70, $p < .001$. Cumulative variance explained = 70.09%. Loadings $\geq |.40|$ considered salient; bold loadings indicate the intended construct assignment.

Convergent validity was further supported by average variance extracted (AVE) values of .698 (livelihood diversification challenges), .643 (access to finance), .713 (skills/training access), .766 (institutional support), and .640 (economic resilience), all exceeding the .50 threshold, with composite reliability ranging from .878 to .929 across constructs (Table 2). Discriminant validity was supported by both criteria applied (Table 4). Under the Fornell-Larcker criterion, the square root of AVE for each construct (.800-.875) exceeded its correlation with every other construct in the model. Under the more stringent HTMT criterion, all ratios fell well below the conservative .85 threshold, with the highest observed value (.662, between livelihood diversification challenges and economic resilience) still comfortably within acceptable bounds.

Table 4: Discriminant Validity: Fornell-Larcker Criterion and HTMT Ratios

Construct	LDC	FIN	SKL	INS	RES
LDC	[0.835]	-0.339	-0.365	-0.106	-0.584
FIN	0.395	[0.802]	0.216	0.084	0.419
SKL	0.415	0.256	[0.844]	0.033	0.409
INS	0.119	0.098	0.038	[0.875]	0.319
RES	0.662	0.493	0.470	0.362	[0.800]

Note: Diagonal values in brackets are the square root of AVE. Values above the diagonal are inter-construct correlations (Fornell-Larcker criterion: discriminant validity is supported where the diagonal exceeds all off-diagonal values in its row/column). Values below the diagonal are HTMT ratios (discriminant validity is supported where HTMT $< .85$).

Common method bias was assessed via Harman's single-factor test: an unrotated single-factor solution accounted for 32.55% of total variance, well below the 50% threshold conventionally taken to indicate a serious common method bias concern, suggesting that shared method variance is unlikely to account for the pattern of relationships reported below.

5.3 Correlations and multicollinearity

Table 5 reports inter-construct correlations. Livelihood diversification challenges correlated negatively with access to finance ($r = -.339$, $p < .001$), skills/training access ($r = -.365$, $p < .001$), and economic resilience ($r = -.584$, $p < .001$), and was not significantly correlated with institutional support ($r = -.107$, $p = .093$). Access to finance, skills/training

access, and institutional support each correlated positively with economic resilience ($r = .419, .409$, and $.319$ respectively, all $p < .001$) and weakly but positively with one another ($r = .033-.216$). Notably, livelihood diversification (the single-item alternative-activity measure) was not significantly correlated with any other construct in the model, including livelihood diversification challenges ($r = .006$, $p = .930$), access to finance ($r = -.038$, $p = .552$), skills/training access ($r = -.018$, $p = .779$), institutional support ($r = -.029$, $p = .651$), or economic resilience ($r = -.095$, $p = .135$). This pattern - foreshadowing the regression and mediation results below - indicates that the level of engagement in alternative livelihood activities, as measured here, functioned essentially independently of the theorized explanatory and outcome constructs. Variance inflation factors for all predictors in the regression models ranged from 1.01 to 1.32, well below conventional thresholds (5 or 10) for concern, indicating that multicollinearity does not threaten the interpretability of the regression coefficients reported below.

Table 5: Inter-Construct Correlations

Construct	1	2	3	4	5	6
1. Livelihood Diversification Challenges	-					
2. Access to Finance	-.34***	-				
3. Skills/Training Access	-.37***	.22***	-			
4. Institutional Support	-.11	.08	.03	-		
5. Livelihood Diversification	.01	-.04	-.02	-.03	-	
6. Economic Resilience	-.58***	.42***	.41***	.32***	-.09	-

Note: *** $p < .001$. $N = 250$.

5.4 Hypothesis testing: regression and mediation results

Two hierarchical regression models were estimated (Table 6). Model 1 tested livelihood diversification (the mediator) as a function of livelihood diversification challenges, access to finance, skills/training access, institutional support, and controls; this model was not statistically significant overall ($R^2 = .026$, adjusted $R^2 = -.006$, $F(8, 241) = 0.818$, $p = .587$), and none of the four substantive predictors approached significance (all $|\beta| \leq .027$, all $p \geq .70$). Only respondent age showed a marginal association with diversification ($\beta = -.142$, $p = .029$), suggesting slightly lower alternative-activity engagement among older diggers within the sampled age range.

Model 2 tested economic resilience as a function of livelihood diversification challenges, livelihood diversification, access to finance, skills/training access, institutional support, and controls. This model was highly significant overall ($R^2 = .502$, adjusted $R^2 = .483$, $F(9, 240) = 26.893$, $p < .001$), explaining approximately half of the variance in economic resilience. Livelihood diversification challenges exerted a strong, significant negative effect ($\beta = -.414$, $SE = .052$, $t = -7.92$, $p < .001$, 95% CI $[-.517, -.311]$), the largest effect size in the model (Cohen's $f^2 = .261$, a medium effect). Access to finance ($\beta = .208$, $SE = .049$, $t = 4.25$, $p < .001$, 95% CI $[.112, .305]$, $f^2 = .075$), skills/training access ($\beta = .206$, $SE = .049$, $t = 4.18$, $p < .001$, 95% CI $[.109, .303]$, $f^2 = .073$), and institutional support ($\beta = .248$, $SE = .046$, $t = 5.36$, $p < .001$, 95% CI $[.157, .339]$, $f^2 = .120$) each exerted

significant, independent positive direct effects, all in the small-to-medium range. Livelihood diversification itself was not a significant predictor of economic resilience once these other paths were accounted for ($\beta = -.077$, $SE = .046$, $t = -1.68$, $p = .095$, 95% CI $[-.168, .014]$, $f^2 = .012$, negligible), and its point estimate ran contrary to the hypothesized direction. A supplementary model omitting the mediator (Model 2b) produced an almost identical fit ($R^2 = .496$, adjusted $R^2 = .480$), confirming that livelihood diversification contributed negligibly to the model's explanatory power. Ten-fold cross-validation of Model 2 yielded a mean out-of-sample R^2 of .457 ($SD = .128$) against an in-sample R^2 of .502, indicating that the model retains substantial predictive relevance for economic resilience beyond the estimation sample.

Table 6: Hierarchical Regression Results (Standardized Coefficients)

Predictor	Model 1: Livelihood Diversification (M) beta (SE)	Model 2: Economic Resilience (Y) beta (SE)	Model 2b: Economic Resilience, no mediator beta (SE)
Livelihood Diversification Challenges	.012 (.073)	-.414*** (.052)	-.415*** (.052)
Livelihood Diversification (mediator)	-	-.077+ (.046)	-
Access to Finance	-.027 (.068)	.208*** (.049)	.210*** (.049)
Skills/Training Access	-.013 (.069)	.206*** (.049)	.207*** (.050)
Institutional Support	-.019 (.064)	.248*** (.046)	.249*** (.046)
Age	-.142* (.065)	-.029 (.047)	-.018 (.046)
Education	.018 (.064)	.015 (.046)	.014 (.046)
Years mining	-.053 (.064)	.036 (.046)	.040 (.046)
Gender (Female = 1)	.053 (.145)	.076 (.104)	.072 (.104)
R²	.026	.502	.496
Adjusted R²	-.006	.483	.480
F	0.818	26.893***	29.681***
df	8, 241	9, 240	8, 241

Note: + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. Standard errors in parentheses. All predictors standardized (z-scores). N = 250.

Bootstrapped mediation analysis (5,000 resamples, percentile 95% confidence intervals) tested the indirect effect of each substantive predictor on economic resilience through livelihood diversification (Table 7). None of the four indirect effects were significant: livelihood diversification challenges (indirect effect = $-.001$, 95% CI $[-.015, .012]$), access to finance (indirect effect = $.002$, 95% CI $[-.009, .017]$), skills/training access (indirect effect = $.001$, 95% CI $[-.013, .016]$), and institutional support (indirect effect = $.002$, 95% CI $[-.010, .016]$) all produced confidence intervals comfortably spanning zero. In every case, the corresponding direct effect remained significant and of similar magnitude to its total effect, confirming that the relationships between livelihood diversification challenges, access to finance, skills/training access, and institutional support on the one hand, and

economic resilience on the other, operate directly rather than through the hypothesized diversification pathway.

Table 7: Bootstrapped Mediation Analysis (5,000 Resamples, Percentile 95% CI)

Pathway (X -> Diversification -> Resilience)	a	b	Indirect (a x b)	95% CI	Direct (c')	95% CI	Sig.
Livelihood Diversification Challenges	.012	-.077	-.001	[-.015,.012]	-.414***	[-.509,-.319]	No
Access to Finance	-.027	-.077	.002	[-.009,.017]	.208***	[.108,.306]	No
Skills/Training Access	-.013	-.077	.001	[-.013,.016]	.206***	[.110,.304]	No
Institutional Support	-.019	-.077	.002	[-.010,.016]	.248***	[.149,.346]	No

Note: *** $p < .001$. Indirect effects are considered significant where the 95% bootstrap confidence interval excludes zero. None of the four indirect effects reached significance.

Table 8 summarizes hypothesis testing outcomes. Of the ten hypotheses tested, four were supported (H4, H6a, H6b, H6c) and six were not supported (H1, H2, H3, H5a, H5b, H5c). The pattern is not one of scattered or inconsistent non-support, however, but a coherent structural finding: every hypothesis specifying a direct effect on economic resilience was supported, while every hypothesis routed through livelihood diversification - whether as an outcome of the explanatory factors (H1, H5a-c) or as a predictor of resilience and mediator of the challenges-resilience relationship (H2, H3) - was not. This pattern is interpreted theoretically in Section 6.

Table 8: Summary of Hypothesis Testing

Hypothesis	Path	Result
H1	Diversification challenges (-) -> Livelihood diversification	Not supported
H2	Livelihood diversification (+) -> Economic resilience	Not supported
H3	Livelihood diversification mediates challenges -> resilience	Not supported
H4	Diversification challenges (-) -> Economic resilience, direct	Supported
H5a	Access to finance (+) -> Livelihood diversification	Not supported
H5b	Skills/training access (+) -> Livelihood diversification	Not supported
H5c	Institutional support (+) -> Livelihood diversification	Not supported
H6a	Access to finance (+) -> Economic resilience, direct	Supported
H6b	Skills/training access (+) -> Economic resilience, direct	Supported
H6c	Institutional support (+) -> Economic resilience, direct	Supported

6. Discussion

6.1 The direct burden of diversification challenges

The study's most consistent and strongest result is the direct negative relationship between livelihood diversification challenges and economic resilience (H4; $\beta = -.414$),

which is consistent with and reinforces the qualitative picture found in the Kono literature. The results presented here quantify the resilience cost of being "stuck in transition" as described by (Maconachie & Conteh, 2025) between a dwindling resource and an underdeveloped alternative. The finding adds to this qualitative account the evidence that the relationship is robustly present at the level of individual perception in a large sample, and that the magnitude ($f^2 = .261$) is the largest of all three resource-access factors, and the highest of all the factors identified in this study, making diversification challenges the single strongest correlate of economic resilience. This is broadly in line with the characterization of a constrained vulnerability context as one that directly undermines livelihood outcomes (Scoones, 1998), and it extends the SLF by showing that this corrosive effect does not necessarily have to occur through the pathway of reducing diversification (the pathway the SLF's diagrammatic logic might most naturally suggest).

6.3 Resource access as an indirect resilience mechanism through diversification

Access to finance, skills/training access and institutional support all had significant, independent and comparably sized direct effects on economic resilience (H6a-c supported), which is consistent with the SLF's core proposition that financial, human and institutional capital shape livelihood outcomes (Scoones, 1998; Chambers & Conway, 1992) and with the Capability Approach's account of these resources as conversion factors that expand what young people are practically able to achieve (Sen, 1999). This result also supports (Maconachie and Hilson's, 2011) assertion that ASM formalization initiatives that ignore access to capital tend to exacerbate poverty, and Hilson and Osei's (2014) more general claim that meaningful poverty alleviation for ASM-dependent youth requires deliberate investment in these very resource areas. The largest effect was found for institutional support ($f^2 = .120$), which aligns with (Obie *et al.*, 2026) community-level results that governance quality and social capital transformation are important for resilience in mining contexts, bringing that community-level evidence to the level of individual perception.

Theoretically interesting is not that these resources are important, but how they seem to be important. Access to finance, skills, and institutional support were hypothesized (H5a-c) to operate substantially by enabling diversification - the pathway most consistent with a literal reading of the SLF's capital-to-strategy logic. None of the three predicted diversification, however (all non-significant, Table 6), and none had a significant indirect effect via diversification (Table 7). This implies that these resources contribute to resilience in ways other than by increasing the number or level of alternative livelihood activities that a young digger engages in – likely by providing a direct financial cushion against income shocks, transferable competence that enhances bargaining power and adaptability within mining, or a support network that can be accessed during acute stress, regardless of whether the young digger has formally entered into a second livelihood activity. This is in line with the Capability Approach's focus on expanded capability – the actual freedom to act in response to adverse events – rather than on any specific observed functioning, like participating in a specific alternative activity (Sen,

1999): a digger with strong institutional support may be more resilient because that support provides a usable safety net, even if it is never translated into visible diversification behavior.

6.3 Why diversification did not function as hypothesized

The lack of any significant relationship between livelihood diversification (as measured here) and either its hypothesized antecedents or economic resilience is the most theoretically significant finding of the study, and should not be interpreted as a null finding. There are three possible explanations, none mutually exclusive.

The first is a measurement-related one. The difficulty of enumerating a full and intermittent informal-activity portfolio in a structured interview (Section 4.3) meant that livelihood diversification was operationalized as a single item measure of the level of engagement in alternative activities, but this measure does not differentiate between a young digger who has taken up a marginal, low-return subsistence activity and one who has established a genuinely viable secondary income source. This is the difference that (Islam *et al.*, 2024) demonstrate to be important for whether diversification increases farmer income, and which (Taylor *et al.*, 2021) and (Bassett *et al.*, 2022) also find to be important for the diversification-resilience relationship in fisheries: it is not diversification per se, but the quality, capital-intensity, and viability of what is diversified into that appears to matter. A coarse activity-level measure may simply not be able to capture a relationship that a more detailed, activity-quality-sensitive measure would capture.

The second explanation is more directly theoretical, and relates to a limitation of the Sustainable Livelihoods Framework mentioned in Section 2: de Haan and Zoomers (2005) warn against using diversification as a straightforward positive strategy, since the politics and quality of access that determine whether a particular diversification strategy is viable can be lost in the framework's capital-to-strategy logic. The present results confirm that warning empirically. For many diggers who try to diversify in Kono, as (Maconachie & Conteh, 2025) argue, the shift to more alternative activities does not necessarily mean more resilience, but rather the same resource constraints, but applied to a second precarious activity. On this reading, diversification is not a resilience-building strategy in and of itself, but rather a symptom of the same underlying resource scarcity that also limits resilience directly, which is why it has no relationship with the explanatory factors (finance, skills, and institutional support do not readily translate into more diversification, because the diversification available to under-resourced diggers is itself low-value).

The third explanation is that conditions of security and constraint may be more important in shaping the resilience of youth diggers in Kono than the concrete behavioral strategies that are often the focus of diversification-focused development programming. If economic resilience, as defined here, reflects a more general ability to absorb and recover from shocks, as closer to (Sen's, 1999) definition of capability than to any specific set of activities observed at the time of interview, then it is reasonable to assume that this

capacity is more closely linked to the availability or lack of available resources and binding constraints than to the particular set of activities that a young person may have assembled at the time of interview. This would suggest that livelihood transition policy for youth diggers should be assessed not just on the extent to which it is seen to increase the number of activities youth report doing, but on the extent to which it measurably decreases the challenges they face and increases the resources they actually have - a distinction that was elaborated into policy guidance in Section 8.

6.5 The reasons why young people stay in mining

Together, these results provide a partial explanation for the continued participation of young diggers in artisanal mining in Kono, despite its precarity. It is not that they don't know about or care about alternatives, but rather that the level of diversification activity they reported ($M = 2.90$ on a five-point scale) was moderate. Instead, the results indicate that more of something else is not, in itself, a resilience-enhancing strategy for the resource conditions most commonly experienced by diggers. Continued mining activity may therefore be a rational response to the relative lack of viable, resource-based alternatives, rather than a lack of diversification effort, as (Arthur-Holmes and Yeboah, 2025) warn against assuming continued ASM activity is a sign of passivity. On this account, the problem of sustainable livelihood transition in Kono is not a diversification deficit, but a resource deficit: young diggers are actually constrained in their capacity to diversify in a meaningful way, and, more importantly, in their capacity to withstand livelihood shocks, and it is the latter, resource-driven pathway, and not diversification activity itself, that this study's evidence points to as doing the empirical work.

7. Theoretical, Empirical, Methodological, and Practical Contributions

This study has four unique contributions. It theoretically builds on the Sustainable Livelihoods Framework by empirically separating two pathways through which capital-type resources are generally believed to influence livelihood outcomes: through livelihood diversification and through strengthening livelihood resilience directly; and demonstrates that the latter pathway does the empirical work for youth diggers in Kono. This further develops the SLF's capital-to-strategy-to-outcome logic for resource-dependent, extraction-based livelihoods specifically, and provides empirical support for (de Haan and Zoomers', 2005) caution on assuming that diversification is an inherently resilience-enhancing strategy. It also illustrates the usefulness of the SLF combined with the Capability Approach: viewing finance, skills and institutional support as conversion factors, rather than simply as inputs to a diversification pipeline, better predicts a pattern where these resources are important for resilience even if they are not converted to additional observed activities.

Empirically, the study offers the first quantitative, survey-based evidence on the relationship between livelihood diversification challenges and economic resilience among youth diggers in Sierra Leone's artisanal diamond sector, which has been studied

almost exclusively using qualitative and ethnographic approaches to date (Maconachie & Conteh, 2025; Maconachie, 2007, 2011). It thus adds to this qualitative tradition quantitative estimates of the relative strength of the relationships it describes, and brings the wider ASM-youth literature, which has been largely focused on the galamsey sector in Ghana (Arthur-Holmes & Yeboah, 2025; Hilson & Osei, 2014), to a unique national, mineral and institutional context.

Methodologically, the study provides a transferable analytical approach to test livelihood-resilience relationships in ASM settings, using a validated multi-item measurement, hierarchical regression and bootstrapped mediation, which provides a quantitative alternative to the qualitative and case-study methods that have been the predominant approaches in this literature so far. It also demonstrates the importance of explicitly testing the mediation role of diversification, a design decision that was important in this study and one that other researchers in similar resource-dependent livelihood contexts may want to consider rather than overlook.

In practice, the results shift the focus from diversification-promotion programming, which assumes that activity expansion is the path to change, to direct resource-access interventions, such as financial inclusion, skills and vocational training, and institutional support, as levers to increase economic resilience among youth diggers. The distinction has real implications for the prioritization and assessment of livelihood interventions in Kono and similar ASM contexts by government institutions, local councils, mining authorities, financial institutions, NGOs and youth and community-based organizations, as discussed in the following section.

8. Policy Implications

The results indicate that livelihood transition interventions for youth diggers in Kono District will be more effective if they are designed and evaluated with the aim of directly improving access to resources and resilience outcomes, rather than the number of diversification activities. The empirical results lead to three sets of recommendations.

First, financial inclusion interventions (savings and credit programmes, village savings and loan associations, and partnerships between community organizations and formal financial institutions) are not just about increasing the number of alternative activities diggers engage in, but are a direct intervention in their own right to build resilience. Financial institutions and development partners working in Kono should be mindful of the resilience value of financial access and consider offering appropriately designed micro-savings and credit products to youth diggers without requiring them to stop or decrease their mining activity.

Second, the strong direct link between access to skills/training and resilience reinforces the need to continue investing in vocational and entrepreneurial training programmes, but the results of the study highlight the need to be careful not to judge these programmes based on whether participants report taking up more alternative livelihood activities. Instead, apprenticeship programmes, technical and vocational

training, and financial literacy programmes should be assessed in relation to outcomes that are relevant to resilience – income stability, shock-coping capacity, perceived security – because it is possible that skills contribute to resilience through enhancing bargaining power, adaptability, and option value, even if they are not directly adopted as a second livelihood activity.

Third, the relatively high direct impact of institutional support on resilience (the highest of the three explanatory factors) suggests that local governance and institutional engagement is an underutilized policy lever. The pathway could be enhanced by more regular interaction with digger communities in Kono, including clear communication on policy and land-use decisions in the mining sector, effective dispute-resolution processes, and active collaboration with community-based and youth groups already working in mining communities. Institutional support is not dependent on diversification in these outcomes, so the resilience benefit does not have to wait for, or depend on, the success of parallel livelihood-diversification programming.

Finally, where agricultural diversification and other alternative-livelihood programming are being continued (as they should be, given the finite nature of alluvial diamond deposits), the findings indicate that programming and evaluation should be based on the viability and capital-intensity of the activities being promoted, rather than simply the number of activities. On the basis of this study's evidence, a programme that supports a small number of diggers to set up a viable, market-oriented alternative enterprise is more likely to have an impact on resilience than a programme that encourages diversification broadly without addressing the fundamental resource constraints that determine whether any given alternative enterprise is viable. The most policy-relevant conclusion of this study is that diversification support should not be considered a standalone policy, but rather a complement to, or a follow-on to, direct investment in finance, skills and institutional support.

9. Conclusion, Limitations, and Future Research

This study explored the relationship between livelihood diversification challenges and economic resilience among 250 youth diggers in the artisanal diamond-mining communities of Kono District, Sierra Leone, and tested livelihood diversification as a hypothesized mediating mechanism between access to finance, skills/training access, and institutional support, and economic resilience. Livelihood diversification problems were a strong negative direct predictor of economic resilience, while access to finance, skills/training access and institutional support had significant positive direct effects, independent of each other. In contrast to the central mediation hypothesis of the study, livelihood diversification (as measured by the extent of involvement in alternative livelihood activities) was not related to the hypothesized antecedents of livelihood diversification and was not found to mediate any of the tested relationships, nor was it related to economic resilience. The overall pattern suggests that the level of economic resilience of youth diggers in Kono is directly related to the constraints they experience

and the resources at their disposal, and not to the amount of livelihood diversification activity they undertake per se, which extends the Sustainable Livelihoods Framework and has clear implications for the design and evaluation of livelihood-transition policy in artisanal mining communities.

The following limitations should be taken into account when interpreting these conclusions. The cross-sectional design only allows for associations at one time and does not allow for causal direction or for reverse or reciprocal relationships between the constructs of the study; for example, a digger who feels economically resilient may feel less challenged by diversification, and not the other way around. Despite the comforting finding of the Harman's single factor test, all measures were self-reported, and this type of survey data is subject to method-related bias. The sample was sufficiently powered and representative of multiple active mining sites, but was geographically limited to specific chiefdoms in Kono District and may not be fully representative of other artisanal diamond mining communities in Sierra Leone, or of artisanal mining of other minerals or in other national contexts. The multi-stage, site-based sampling approach required because of the lack of a formal digger registry is consistent with the usual sampling method used for hard-to-reach informal populations, but cannot ensure the same representativeness as full probability sampling. Most importantly for the central finding of the study, livelihood diversification was defined as a single item measure of activity level, which as discussed in Section 6.3 may not be sensitive enough to the quality, income adequacy, or viability of the activities diggers engage in, and a null relationship with this measure should be interpreted as evidence about the specific construct as measured, rather than as a definitive statement that diversification does not matter for resilience in this population.

These limitations should be directly addressed in future research. The causal and temporal structure of these relationships could be tested more directly than a cross-sectional design allows by using longitudinal designs, following diggers over time as their mining conditions and diversification opportunities change. Comparative research in the mining communities, both within Sierra Leone and with other African economies where ASM is practiced, would help to determine the extent to which the results reported here are specific to the diamond sector in Kono or more general characteristics of ASM-based youth livelihoods. Mixed-methods designs that combine structured survey measurement with qualitative or ethnographic research on the nature and viability of diggers' diversification activities would assist in resolving the measurement and theoretical explanations presented in Section 6.3 for why diversification did not work as hypothesized in this study. Finally, research that compares current and former artisanal miners, including those who have successfully transitioned to alternative livelihoods, would be a valuable complement to the current cross-sectional snapshot, helping to shed light on the resource conditions and activity types that actually distinguish successful livelihood transitions from the "stuck in transition" pattern that this and previous research has documented in Kono District.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Author(s)

Emmanue Conteh, PhD (University of Reading, UK) in Livelihoods (Int. and Rural Development): sound knowledge in livelihoods and sustainable development, rural development, policy implementation and management, intellectual leadership and comprehensive understanding of agriculture policies, strategies, institutions, and regulations; 10 years + professional working experience in rural development and food security projects. Strong knowledge of (agro-) economic policy issues facing transition economies and emerging markets; Experienced in developing alternative agricultural value chains development, rural businesses, marketing and re-organization including stand-by management.

Kalie Marah. I am currently pursuing a Master's in Management, specializing in Finance, at Universitas Muhammadiyah Yogyakarta (UMY), following Bachelor's degrees in Tourism Management from Limkokwing University of Creative Technology and a Bachelor's of Education (B.Ed) in Community Development Studies/Agriculture from Milton Margai Technical University. My academic and professional interests focus on finance, sustainable tourism, rural livelihoods, community development, agricultural development, environmental sustainability, and socio-economic development. He has professional experience in teaching, examination administration, banking, community mobilization, advocacy, and community liaison activities in Sierra Leone. My research experience includes bibliometric systematic reviews and quantitative economic analysis, using Scopus, SmartPLS, RStudio (Bibliometrix), VOSviewer, and ARDL Bounds Testing. He has co-authored research on local politics and cultural practices in environmental and disaster management and foreign direct investment and economic growth in Sierra Leone. He has also demonstrated leadership through various community and student-union positions, including President of the National Union of Koinadugu and Falaba Students.

References

- Arthur-Holmes, F., & Yeboah, T.N. (2025). Reconceptualizing the youth and waithood notions: African youth agency and rural livelihoods in artisanal and small-scale mining. *Journal of Rural Studies*, 113, 103513. <https://doi.org/10.1016/j.jrurstud.2024.103513>
- Baffoe, G., Manirakiza, V., & Uwayezu, E. (2025). Two sides of the coin: Unveiling the socioeconomic impacts of land expropriation on Kigali residents. *Urban Forum*, 36(1). <https://doi.org/10.1007/s12132-024-09516-3>
- Bassett, H.R., Sharan, S., Suri, S.K., Advani, S., & Giordano, C. (2022). A comparative study of small-scale fishery supply chains' vulnerability and resilience to COVID-19. *Maritime Studies*, 21(2). <https://doi.org/10.1007/s40152-021-00231-4>
- Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century* (IDS Discussion Paper 296). Institute of Development Studies.
- Choquette-Levy, N., Ghimire, D., Oppenheimer, M., & Ghimire, R. (2025). Retrenchment under climate-driven risks in subsistence farming communities. *Population and Environment*, 47(2). <https://doi.org/10.1007/s11111-025-00493-8>
- de Haan, L., & Zoomers, A. (2005). Exploring the frontier of livelihoods research. *Development and Change*, 36(1), 27-47. <https://doi.org/10.1111/j.0012-155X.2005.00401.x>
- DFID. (1999). *Sustainable livelihoods guidance sheets*. Department for International Development.
- Dixon, J.M., Weerahewa, J., Hellin, J., Rola-Rubzen, M.F., Huang, J., Kumar, S., Das, A., Qureshi, M.E., Krupnik, T.J., Shideed, K., Jat, M.L., Prasad, P.V.V., Yadav, S., Irshad, A., Asanaliyev, A., Abugaliev, A., Karimov, A., Bhattarai, B., Balgos, C.Q., ... Timsina, J. (2021). Response and resilience of Asian agrifood systems to COVID-19: An assessment across twenty-five countries and four regional farming and food systems. *Agricultural Systems*, 193. <https://doi.org/10.1016/j.agsy.2021.103168>
- Ellis, F. (2000). *Rural livelihoods and diversity in developing countries*. Oxford University Press. Retrieved from https://academic.oup.com/book/51946?_cf_chl=tk=e8TwINd3kLUaNi4bE_ZVTVOiQLMLnB.WEyV0s6pQMCY-1788899122-1.0.1.1-hEKdWh5Zr6B1l18SCVQ.vhvpQCu8FqpP2x73vv7PyGg
- Favretto, N., & Stringer, L.C. (2024). Climate resilient development in vulnerable geographies. *Mitigation and Adaptation Strategies for Global Change*, 29(8). <https://doi.org/10.1007/s11027-024-10187-5>
- Gutierrez, E.D.U., Dressler, W.H., Brown, T., Glover, D., Wilmsen, B., Limsa, M., Cañete, R., Agravio, R., Pido, M., & Divinagracia, D. (2026). Hanapbuhay: Coping with informality, risk, and insecurity in a Philippine rice farming village. *Critical Asian Studies*, 58(2). <https://doi.org/10.1080/14672715.2025.2601952>

- Hilson, G., & Osei, L. (2014). Tackling youth unemployment in sub-Saharan Africa: Is there a role for artisanal and small-scale mining? *Futures*, 62, 83-94. <https://doi.org/10.1016/j.futures.2014.05.004>
- Islam, M.S., Jahan, H., Ema, N.S., & Ahmed, M.R. (2024). Determinants of crop diversification and its impact on farmers' income: A case study in Rangpur District, Bangladesh. *JSFA Reports*, 4(10). <https://doi.org/10.1002/jsf2.216>
- Jackson, T.M., Nandi, R., Jannat, A., Ghosh, A., Hajra, D.K., Mitra, B., Rashid, M.M., Bista, S., Chaudhary, A., Timsina, P., Karki, E., Chakma, K.R., Rana, G., & Kishore, A. (2025). Patterns of livelihood diversification in farming systems of the Eastern Gangetic Plains. *Agricultural Systems*, 227, 104346. <https://doi.org/10.1016/j.agsy.2025.104346>
- Krauss, J.E., Artur, L., Brockington, D., Castro, E., Fernando, J., Fisher, J., Kingman, A., Moises, H.M., Mlambo, A., Nuvunga, M., Pritchard, R., Ribeiro, N., Ryan, C.M., Tembe, J., & Zimudzi, C. (2022). 'To prevent this disease, we have to stay at home, but if we stay at home, we die of hunger' - Livelihoods, vulnerability and coping with Covid-19 in rural Mozambique. *World Development*, 151, 105757. <https://doi.org/10.1016/j.worlddev.2021.105757>
- Mabe, F.N., Owusu-Sekyere, E., & Adeosun, O.T. (2021). Livelihood coping strategies among displaced small-scale miners in Ghana. *Resources Policy*, 74, 102291. <https://doi.org/10.1016/j.resourpol.2021.102291>
- Maconachie, R. (2007). 'Farming miners' or 'mining farmers'? Diamond mining and rural development in post-conflict Sierra Leone. *Journal of Rural Studies*, 23(3), 367-380. <https://doi.org/10.1016/j.jrurstud.2007.01.003>
- Maconachie, R. (2008). Diamonds, governance and 'local' development in post-conflict Sierra Leone: Lessons for artisanal and small-scale mining in Sub-Saharan Africa? *Resources Policy*, 34(1-2), 71-79. <https://doi.org/10.1016/j.resourpol.2008.05.006>
- Maconachie, R. (2011). Re-agrarianising livelihoods in post-conflict Sierra Leone? Mineral wealth and rural change in artisanal and small-scale mining communities. *Journal of International Development*, 23(8), 1054-1067. <https://doi.org/10.1002/jid.1831>
- Maconachie, R. (2020). Artisanal mining policy reforms, informality and challenges to the sustainable development goals in Sierra Leone. *Environmental Science & Policy*, 116, 38-46. <https://doi.org/10.1016/j.envsci.2020.10.011>
- Maconachie, R., & Conteh, F.M. (2025). Stuck in transition? Artisanal mining, livelihood diversification and rural change in Sierra Leone. *The Extractive Industries and Society*, 22, 101604. <https://doi.org/10.1016/j.exis.2024.101604>
- Maconachie, R., & Hilson, G. (2011). Safeguarding livelihoods or exacerbating poverty? Artisanal mining and formalization in West Africa. *Natural Resources Forum*, 35(4), 293-303. <https://doi.org/10.1111/j.1477-8947.2011.01397.x>
- Obie, M., Jabar, A.S., & Tunda, A. (2026). Sustainable mining governance, social capital transformation, and community resilience in Indonesia's nickel frontiers. *International Journal of Sustainable Development and Planning*, 21(6). <https://doi.org/10.18280/ijstdp.210619>

- Rusere, F., Hunter, L., Collinson, M., & Twine, W. (2025). Resilience and coping strategies in rural South Africa during the COVID-19 lockdown: A study of livelihoods, food security, and socioeconomic determinants. *Human Ecology*, 53(2). <https://doi.org/10.1007/s10745-025-00603-y>
- Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis* (IDS Working Paper 72). Institute of Development Studies.
- Sen, A. (1999). *Development as freedom*. Oxford University Press.
- Tarekegn, G.B., Goshu, K.G., Enyew, F.B., Hama, S., Umer, Y., Marti-Cardona, B., Sahani, J., Cheneka, B.R., Endris, H.S., Gebre, S.L., Shenga, Z.D., Dadi, D.K., Kovats, S., Jahan, Y., & Debele, S.E. (2026). Rural livelihood vulnerability to climate variability: A district-level assessment in Ethiopia. *Science of the Total Environment*, 1035, 181865. <https://doi.org/10.1016/j.scitotenv.2026.181865>
- Taylor, S.F.W., Aswani, S., Jiddawi, N., Coupland, J., James, P.A.S., Kelly, S., Kizenga, H., Roberts, M., & Popova, E. (2021). The complex relationship between asset wealth, adaptation, and diversification in tropical fisheries. *Ocean and Coastal Management*, 212, 105808. <https://doi.org/10.1016/j.ocecoaman.2021.105808>
- Woodhill, J., Kishore, A., Njuki, J., Jones, K., & Hasnain, S. (2022). Food systems and rural wellbeing: Challenges and opportunities. *Food Security*, 14(5). <https://doi.org/10.1007/s12571-021-01217-0>