

How does small-scale mining stabilize rural livelihoods in Sub-Saharan Africa? the case of Mozambique

Article

Published Version

Creative Commons: Attribution 4.0 (CC-BY)

Open Access

Hilson, G., Laing, T., Hilson, A., Arnall, A. ORCID: <https://orcid.org/0000-0001-6218-5926> and Mondlane, S. (2025) How does small-scale mining stabilize rural livelihoods in Sub-Saharan Africa? the case of Mozambique. *World Development*, 185. 106761. ISSN 0305-750X doi: <https://doi.org/10.1016/j.worlddev.2024.106761> Available at <https://centaur.reading.ac.uk/118576/>

It is advisable to refer to the publisher's version if you intend to cite from the work. See [Guidance on citing](#).

To link to this article DOI: <http://dx.doi.org/10.1016/j.worlddev.2024.106761>

Publisher: Elsevier

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in the [End User Agreement](#).

www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online



Regular Research Article

How Does Small-Scale Mining Stabilize Rural Livelihoods in Sub-Saharan Africa? The Case of Mozambique

Gavin Hilson^{a,*}, Tim Laing^b, Abigail Hilson^c, Alex Arnall^d, Salvador Mondlane^e^a Surrey Business School, University of Surrey, Guildford, United Kingdom^b Brighton Business School, University of Brighton, Mithras House, Brighton, United Kingdom^c Kent Business School, University of Kent, Canterbury, Kent, United Kingdom^d School of Agriculture, Policy and Development, University of Reading, Reading, United Kingdom^e Departamento de Geologia, Faculdade de Ciências, Universidade Eduardo Mondlane, Maputo, Mozambique

ARTICLE INFO

Keywords:

Artisanal and small-scale mining (ASM)

Mozambique

Poverty

Livelihoods

ABSTRACT

This paper examines the linkages between subsistence farming and artisanal and small-scale mining (ASM) – low-tech, labor-intensive mineral extraction and processing – in sub-Saharan Africa, focusing on the case of Mozambique. While the body of literature on this subject is burgeoning, it is comprised mostly of conceptual pieces and country case studies that rely heavily on qualitative data. Focusing on Manica Province, long an epicentre of small-scale gold mining activity in Mozambique, the paper showcases the value of including complementary quantitative data in analyses of ASM-farming linkages in rural sub-Saharan Africa. In particular, quantitative data that provide detail on the demographical composition of communities engaged in both ASM and agriculture, and which shed light on the spending patterns of households involved, could go a long way toward enriching dialogues on this subject, and, in the process, yield more effective (and, indeed, representative) rural development and poverty alleviation strategies in the region. The data gathered in Manica Province provide a more nuanced picture of how the ages and educational levels of household heads, and the sizes of their families, shape views on ASM and agriculture in gold-rich sections of Mozambique. Studies exploring the linkages between ASM and agriculture in sub-Saharan Africa that feature *both* qualitative and quantitative data provide greater clarity on the role each activity could play in tackling some of the region's broader development challenges, including food insecurity and (building) community resilience.

1. Introduction

Over the past two decades, a sizable body of literature (e.g. [Maconachie and Binns, 2007](#); [Hilson, 2009](#); [Pijpers, 2014](#)) has emerged that draws attention to the links between subsistence farming and artisanal and small-scale mining (ASM) – low-tech, labor-intensive mineral extraction and processing – in sub-Saharan Africa. The consensus among scholars who have contributed to this discussion is that the two activities dovetail one another, at times interconnectedly across seasons, throughout sub-Saharan Africa; that due to diminished prices for cash crops and crucial inputs such as fertilizers no longer being subsidized by the state, agriculture is not as viable, economically, as it once was; and that in light of this, ASM, *not* farming, has become a primary source of income for tens of millions of the region's rural households ([Bryceson, 2002](#); [Maconachie, 2011](#)). Some scholars have concluded, on the

balance of the evidence, that, moving forward, host African governments must make formalization of, and support for, ASM more of a focal point in their national economic growth and rural poverty alleviation strategies ([Banchirigah and Hilson, 2010](#)).

Government officials and, to some extent, donors, have routinely acknowledged over the years the connections between ASM and agriculture in sub-Saharan Africa but have resisted lobbying for greater inclusion of the former in broader economic development policy architecture. They have been reluctant to take action because most (*i. e.* > 95 percent) of the region's ASM operations are unlicensed, and are therefore challenging to connect with, regulate and monitor. This is despite there being plausible explanations for this phenomenon, most prominently: 1) the bureaucratic procedures that must be navigated to lodge applications for ASM licenses and permits; 2) exorbitant payments that must typically be made to obtain them; and 3) an acute shortage of

* Corresponding author.

E-mail address: g.m.hilson@surrey.ac.uk (G. Hilson).<https://doi.org/10.1016/j.worlddev.2024.106761>

Accepted 11 August 2024

0305-750X/© 2024 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

mineralized land (the result of governments having demarcated most of their territory as concessions to mineral exploration and mining companies) on which to work. Individuals who covet ASM licenses and permits thus have little incentive to dialogue with regulators for the purposes of registering claims and operating legally (ILO, 1999; Hilson and Potter, 2005; Van Bockstael, 2014; Spiegel, 2015).

While donors have pledged hundreds of millions of dollars to support ASM in sub-Saharan Africa over the years, very little of this has been used to tackle these root causes of the sector's informality. Most support earmarked for ASM in the region has rather taken the form of technical and/or financial assistance packages implemented specifically for individuals in possession of a license and the requisite permits, which donors and private sector partners assume – in most instances, incorrectly – can be easily obtained. For there to be any chance of building the momentum needed in sub-Saharan Africa to facilitate implementation of more inclusive and *appropriate* rural development policies and strategies for ASM, the narrative on the sector's role and economic importance more generally must change. But without a deepened analysis of the connections ASM has with agriculture, an improved understanding of what implications this may have for community wellbeing and rural development, and a broader appreciation of the sector's growing economic importance in the region overall, this is unlikely to happen. New dynamic storylines about ASM's livelihoods “dimension” that speak to broader international development concerns and priorities are desperately needed.

The aim of this paper is to contribute to this debate by sharing fresh insights on the galvanizing ASM-farming phenomenon in rural sub-Saharan Africa. It *locates* ASM within the broader literature on the livelihood portfolios of the region's farm-dependent families by taking the discussion one step further: arguing that the linkages between these two activities stabilize rural households, economically, in a variety of ways. The paper begins, in Section 2, by revisiting elements of the growing ASM-farming debate in sub-Saharan Africa in greater detail, after which, a conceptual model is developed to help articulate more clearly how synergies between the two activities impact households across the region. Using this conceptual model as guidance, Section 3 and Section 4 zoom in on the case of Mozambique, the location of one of the more sizable and dynamic gold panning sectors in sub-Saharan Africa, to nuance the region's emerging ASM-farming nexus further. The case draws on a dataset of 200 individual farming miners/mining farmers¹ interviewed in Manica Province, long one of the country's major small-scale gold-producing hubs. Section 5 reflects more broadly on the implications of these findings, particularly for scholarship that examines, and policymaking and planning around climate change, food security and rural livelihoods, issues which, in sub-Saharan Africa, have gained considerable attention since the launch of the UN Sustainable Development Goals (SDGs), 2015.

The paper introduces quantitative data to a debate on an issue – *i.e.* ASM-farm linkages in sub-Saharan Africa – that has principally been examined, conceptually and qualitatively, using testimonials. Quantitative data offer granular detail that potentially provide a foundation for fresh storylines on how ASM assists hundreds of thousands of rural African households, economically.

2. Farming-ASM linkages and rural livelihood diversification in sub-Saharan Africa

The subject of farm–nonfarm linkages in sub-Saharan Africa began attracting scholarly attention in the 1980s. Most of the work produced was conceptual and/or made the case that more productive agricultural

¹ The labels “farming-miners” and “mining-farmers” introduced by Maco-nachie and Binns (2007) resonates powerfully here. As both activities are, indeed, interconnected, it is almost impossible to categorize individuals as one or the other.

capacity provides a foundation for larger, more profitable, harvests, which, in turn, stimulates growth in the nonfarm economy. Results from surveys were used by scholars such as Haggblade et al. (1988), Haggblade et al. (1989), Delgado et al. (1994) and Hopkins et al. (1994) to argue that in sub-Saharan Africa, subsistence agriculture, due to its demand for labor-intensive goods and services, catalyzes linkages to, and creates multipliers within, the nonfarm economy. The prevailing view at the time was that agriculture was *the* dominant economic activity in rural sub-Saharan Africa, and that increased crop production stimulates growth in the nonfarm segments of the economy it is connected to (Haggblade and Liedholm, 1991). Although Haggblade et al. (1989) rightly acknowledged at the time that “piecing together an accurate picture” of the nonfarm economy in sub-Saharan Africa using “disparate evidence” retrieved from a series of small business surveys, enterprise counts, household censuses and industry cases was challenging, there was broad agreement that it accounted for between 30 and 50 percent of the income generated by the region's rural households (p. 1174).

In the earliest works on farm–nonfarm linkages in sub-Saharan Africa, ASM was almost entirely absent. This is no surprise because scholarly coverage of ASM itself was sporadic at the time; the material that had been published mostly showcased mine production levels, technology use and needs at sites, and the types of minerals being extracted on an artisanal and small scale more generally (see e.g. Carman, 1985, 1987; Stewart, 1989; Legge, 1990). In the rare instance where an association between ASM and farming was made (e.g. Wels, 1982; Noetstaller, 1987), it was little more than a brief reference to the two activities being interconnected across seasons.

The ASM sector continued to be overlooked in assessments of farm–nonfarm linkages in sub-Saharan Africa well into the 1990s, by which time the theme of “livelihoods” had taken center stage on the international development agenda. “Sustainable Livelihoods” (or “sustainable rural livelihoods”) was coined by Chambers and Conway (1991) and subsequently championed as an all-encompassing theme to guide community development strategies. An embodiment of key development themes and subjects, including capabilities, equity, assets, poverty alleviation and living standards (Chambers and Conway, 1991; Carswell, 1997; Scoones, 1998), Sustainable Livelihoods resonated powerfully at the time with donors, who seemed enamoured with its simplicity and breadth. Few organizations were more convinced about the concept's utility, however, than the UK Department for International Development (DFID). Following years of engagement and consultation with experts at the Institute for Development Studies, Overseas Development Institute, and the NGOs Care International and OXFAM, DFID unveiled its Sustainable Livelihoods Framework. The move was rationalized in the organization's White Paper, *Eliminating World Poverty: A Challenge for the 21st Century*, which stresses the need for “a dynamic balance between policies and actions which promote sustainable livelihoods, human development and the better management of the natural and physical environment” (DFID, 1997, p. 22). DFID, along with the abovementioned organizations and the United Nations Development Program (UNDP), were instrumental in popularizing the theme of Sustainable Livelihoods in the 1990s (Carney, 1999; Ashley and Carney, 1999; Solesbury, 2003).²

A buoyant discussion on Sustainable Livelihoods, which drew

² A comprehensive critique of the Sustainable Livelihoods Framework is beyond the scope of this paper. It is worth mentioning, however, that despite being extremely popular with donors, the Sustainable Livelihoods Framework likely had its share of detractors. Scoones (2009) provides a comprehensive explanation why: how, despite the excitement among donors of making approaches with livelihoods as their focal points “central to their programming,” doing so has proved difficult “to translate into practice, with inherited organisational forms, disciplinary biases and funding structures constructed around other assumptions and ways of thinking” (p. 172).

attention to rural households and their vulnerability, helped to rejuvenate the debate on farm–nonfarm linkages in sub-Saharan Africa. Researchers who spearheaded the contemporary and indeed, more nuanced, analysis of this subject undoubtedly drew inspiration from the dialogue on Sustainable Livelihoods that proliferated in the 1990s. This group of scholars (e.g. Barrett et al., 2001a; Block and Webb, 2001) further illuminated the circumstances facing the region’s agriculture-dependent households, paying special attention to how movement into the nonfarm economy – or “livelihood diversification” – helps rural families buffer against economic “shocks” and “stresses,” as well as disaggregated the *push* and *pull* factors fuelling it. While the thinking towards the end of the 1980s was that “nonfarm earnings help stabilize household income over the calendar year and provide security in lean crop years” (Haggblade et al. 1989, p. 1177), a decade later, there was growing agreement among scholars that, “Despite the persistent image of [sub-Saharan] Africa as a continent of “subsistence farmers,” nonfarm sources may already account for as much as 40–45% of average household income and seem to be growing in importance” (Barrett et al. 2001b, p. 316). Much of this – and ultimately, the *push* dimension of this rural livelihood diversification – was attributable to structural adjustment,³ which, as a number of commentators (Sarris and Shams, 1991; Ellis, 1998, 2000a; Bryceson, 2002; Ponte, 2002; Ellis et al. 2003) explain, adversely impacted subsistence and smallholder agriculture in the region. Under adjustment, state parastatals and agricultural marketing boards were dismantled; prices on farm inputs increased; subsidies on fertilizers and herbicides were removed; and complementary state provision of crucial services such as education and health were scaled back on account of budgetary slashes. Livelihood diversification – most visibly, amongst the extreme poor – was inevitable, entailing a pursuit of “diverse alternatives for income generation [that] can make the difference between minimally viable livelihoods and destitution” (Ellis, 2000b, p. 299). Significantly, explained Bryceson (1999), the changes ushered in by structural adjustment in sub-Saharan Africa “Precipitated a large-scale search for new, more remunerative activities outside agriculture” (p. 173).

The ASM sector was not one of the “remunerative activities outside agriculture” initially referred to by scholars in their analyses of rural livelihood diversification in the region. It did, however, appear on the radar of certain development agencies in the late-1990s and early-2000s, most notably the United Nations and DFID. Seemingly inspired by the utility and practicality of Sustainable Livelihoods approaches, officials at the former, through its Department of Economic and Social Affairs, launched the US\$280,000 *Poverty Eradication and Sustainable Livelihoods: Focusing on Artisanal Mining Communities* Project in 1999. Fieldwork for this project, which sought to establish links between poverty and ASM, broaden understanding of the role Sustainable Livelihoods could play in alleviating hardship within the sector’s workforce, and identify ways to make its operations more viable, was carried out in Ghana, Guinea, Ethiopia and Mali (UNDESA, 2003). The latter funded an ASM “Livelihoods Study,” fieldwork for which was undertaken in Ghana, Tanzania and Zambia, between 2003 and 2007. Its objective was “to understand the challenges faced by the ASM communities and then help to devise policy initiatives to increase the security and well being of these people,” and to then use this information to “Develop an effective

³ Comprehensive loan packages administered by the World Bank and International Monetary Fund to poor countries, beginning in the 1970s and 1980s. In exchange for funds, borrowing governments were asked to make sweeping economic changes, including modifying their public spending priorities, tax reforms, financial liberalization, implementing competitive exchange rates, liberalizing their trade policies, increasing foreign direct investment, privatizing state assets, and deregulating industry (Crisp and Kelly, 1999).

and practical model policy framework into a fully implemented and tested scheme of assistance to the ASM sector” (D’Souza, 2003).⁴ But as was the case with most technical assistance implemented for ASM in sub-Saharan Africa at this time, these projects were carried out autonomously, *outside* of the broader rural economic development and poverty alleviation policy architecture in which the sector barely featured. Beyond their initial phases of funding, therefore, neither had much of an impact, developmentally.

There has since been a series of publications that have showcased the linkages between ASM and agriculture in sub-Saharan Africa. As indicated, many of these pieces are conceptual, highlighting the interconnections between the two activities (e.g. Hilson, 2009; Ofofu et al., 2020). Others, however, have attempted to nuance these dynamics further, sharing insights on the motivations behind why individuals engaged in agriculture choose to “branch out” into ASM, as well as where earnings generated in the latter are being spent to support the former. The movement of farm-dependent households into ASM in the region has been mostly conceptualized as “distress-push” diversification, or fuelled by financial precarity (Hilson, 2016). There is, of course, a corresponding gradient, as analysis of the body of work produced to date on this subject reveals that some individuals’ situations are far worse than others’, although all cases reinforce claims made by scholars over the years that ASM is largely a “poverty-driven activity” (see e.g. Barry, 1996; Hentschel et al., 2002; Buxton, 2013). At the one extreme, there are people who are in the most desperate of situations, a case in point being Finishi Village in Malawi (see Kamlongera, 2011), where due to chronic economic hardship, the bulk of residents engage in the mining of blue agate on a small scale, full-time. These individuals no longer view agriculture as a viable primary income-earning activity; their harvests are not productive because of erratic rainfall and costly fertilizers, which has led them to reorient their agricultural practices to supply food for their households. From the evidence, ASM seems to have brought some financial stability to families residing in Finishi Village, the sector’s wide appeal the result of it being the only viable source of income locally. Similar observations were made by Hilson and Garforth (2012) in Ghana and Mali, where in communities such as East Akim (Eastern Region) in the former, and Sebekale and Bougoudalé (Yanfolila Cercle, Sikasso Region) in the latter, families engage in small-scale gold mining to generate the income needed to purchase pesticides, fertilizers and other crucial farm inputs required to stabilize crop production for household consumption and, where possible, to generate surplus for sale at local markets.

At the other extreme, there are cases where, for both individuals and families, ASM is a part of a diversified livelihoods portfolio that can reorient markedly and recalibrate, depending on the circumstances. Scholars have, over the years, shared various ideas and anecdotes which, when analyzed together, support the idea that ASM is a crucial prong in hundreds of thousands of the region’s rural livelihood portfolios. Drawing on experiences from the likes of Tanzania, the Congo Basin, Ghana, Guinea and Sierra Leone (e.g. Fisher et al., 2009; Maconachie, 2011; Osumanu, 2020; Mabe et al., 2021; Bansah et al., 2023), they have argued that as a key component of diversified livelihood portfolios, ASM helps to buffer against shocks and stresses. In these cases, individuals also prioritize more heavily work linked to ASM, an activity that they routinely move in and out of; they are, therefore, comfortable relying more heavily on ASM for their incomes when circumstances *suddenly* make farming unviable. But unlike the cases of Finishi Village, East Akim, Sebekale and Bougoudalé, this type of “distress-push” movement, despite also being fueled by poverty, involves individuals who *already* have their footprints in ASM. Concise examples include the linkages between rice farming and artisanal diamond digging in Liberia (Hilson

⁴ See “Procurement Department Contracts Issued February 2003,” https://web.archive.nationalarchives.gov.uk/ukgwa/20040119034029/http://www.dfid.gov.uk:80/Contracts/files/contracts_2003feb.htm (Accessed 13 January 2023).

and Van Bockstael, 2012), and the even more diverse livelihood portfolios comprising diamond digging, gold panning and various agricultural activities, in neighbouring Sierra Leone (Maconachie, 2011), activities engaged in simultaneously by different family members, whose movements across each became exceptionally clear during the West African Ebola crisis (Maconachie and Hilson, 2018). The ability of many of these individuals to turn, rather seamlessly, to ASM for income was made possible by the efforts of their ancestors, extended families having located work and establishing a presence in the sector, or a combination of the two. In some countries, such as Ghana and Mali, where gold panning and associated overland trade had flourished for centuries before colonial rule (Dumett, 1999; Davignon, 2018), what today may appear to be a fast emerging ASM-farming connection is, in fact, deeply-rooted.

To summarize, in sub-Saharan Africa, ASM features heavily in distress-push diversification pursued by the region's farm-dependent families. This includes, at the one extreme, parties which have minimal experience in ASM but nevertheless decide to pursue work here because there are few viable alternative income-earning opportunities, and at the other extreme, individuals who have previously pursued employment in the sector, as it is a part of their livelihoods portfolios but do so now more pronouncedly. The functions of ASM in distress-type diversification pursued by farm-based households across sub-Saharan Africa, however, are by no means recent developments, which raises a very important question: namely, why were these dynamics not taken into account during the design phases of the region's broader development architecture and individual countries' rural poverty-alleviation plans and programs? A likely explanation is that ASM's economic importance in sub-Saharan Africa was largely unrealized at the time. As indicated, structural adjustment lending has had crippling effects on the region's subsistence and smallholder farming economy. The mass movement/pronounced shifts into ASM these changes would induce, therefore, were only beginning to take shape or in some cases, had not yet galvanized, when the likes of the New Partnership for Africa's Development (NEPAD)⁵ and various countries' Poverty Reduction Strategy Papers (PRSPs)⁶ were being designed and implemented. Nevertheless, the failure of governments across sub-Saharan Africa to acknowledge, comprehensively, the growing importance of ASM – in particular, the very visible role it plays in distress-push diversification associated with farming – has proved to be a major oversight. It has led to the design of most of the region's economic development policy architecture being informed by the idea that a supported agricultural sector, and little more, is *the* solution to the region's rural poverty problem (Banchirigah and Hilson, 2010).

Work which showcases the link between ASM and subsistence agriculture in sub-Saharan Africa often examines this phenomenon retrospectively. While the messages it conveys, using excerpts from testimonials reinforced with supplementary qualitative data, are powerful and certainly resonate with donors and host governments, at the same time, they have failed to usher in policies which more accurately reflect ASM's economic role in the region. More dynamic storylines, informed by fresh data that provide more granular detail on ASM's

⁵ In 2001, the New Partnership for Africa's Development (NEPAD) was adopted by African Heads of State and Government. It was ratified by the African Union (AU) in 2002 to "address Africa's development problems within a new paradigm." See "New Partnership for Africa's Development" (NEPAD), www.un.org/development/desa/socialperspectiveondevelopment/issues/new-partnership-for-africas-development-nepad.html (Accessed 3 July 2023).

⁶ In 1999, in response to mounting criticisms of the conditionalities they attached to their structural adjustment loans, the International Monetary Fund and the World Bank launched the PRSP project. Conceived by national government officials who are tasked with detailing macroeconomic goals, spending targets and social development priorities over a three-year period, PRSPs were trumpeted by the International Finance Institutions as being comprehensive and "country-driven" (Craig and Porter, 2003; Fraser, 2005).

connections with agriculture in sub-Saharan Africa, however, could go a long way toward facilitating this sector receiving the spotlight it deserves in the broader rural economic development and poverty alleviation agenda and policy architecture in place in the region. The remainder of the paper sheds light on how, using findings from recent research carried out in Manica Province in Mozambique. The work undertaken illuminates more clearly the impact ASM-farm linkages have had on individual households in Manica Province. It combines quantitative and qualitative data with a view toward formulating a more powerful narrative: specifically, the idea that rural farm families' engagement in ASM helps to bring some stability to their households.

The next section of the paper details the methodology adopted for the Mozambique research, as well as outlines the conceptual model developed to analyze the data gathered.

3. Study location and methodology

3.1. The context

Mozambique was selected as a case study to explore further the linkages between farming and ASM in sub-Saharan Africa because of the widely-reported connections between the two sectors in the country (see e.g. Mondlane and Shoko, 2003; Dondeyne et al., 2009; Dondeyne and Ndunguru, 2014). More than 75 percent of Mozambique's population engages in farming in some capacity (Balchin et al., 2017). Most of this activity, however, is reliant on rain-fed production systems with few inputs (seeds, fertilizers), and not particularly well-connected to markets and financial services. The country's smallholder system, therefore, is extremely informal, comprised mostly of family-owned plots that are, on average, 1.4 ha in size (FAO, 2022). Not surprisingly, farm production here is highly-susceptible to shocks and stresses linked to climatic events: Mozambique, due to its low adaptive capacity, is one of the most vulnerable countries in sub-Saharan Africa to extreme weather events. Since 1990, the lives of more than 11 million Mozambicans have been affected by flooding, which has damaged 180,000 ha of crops and has resulted in the loss of at least 40,000 cattle. As Mozambique is coastal, it is routinely battered by cyclones and heavy downpours during its rainy season, which, along with being downstream of nine major river basins on the continent, causes intense flooding. Droughts, which occur in the country every four – five years and have caused widespread famine, have proved even more devastating for the country's farm-based families. They have impacted the livelihoods of more than 17 million Mozambicans since 1984 (Mondlane, 2004; Forecast Based Financing, 2019; World Bank, 2021; ACAPS, 2023).

A precarious smallholder farming sector may explain why, in many rural sections of Mozambique, an increasing number of people engage simultaneously in ASM. The linkages between the two activities have been extremely visible since the launch of the country's Structural Adjustment Program in 1986, which, as Mondlane and Shoko (2003) explain, along with the end of the country's civil war in 1992 and an extended period of drought between 1990 and 1993, "prompted many retrenched workers and peasants to pan gold in many provinces of Mozambique" (p. 246). The authors reported at the time that most ASM activity in the country is carried out "during the non-agricultural season, or when agricultural yields are poor as a result of rampant drought or flooding" (p. 255).

In certain locations, including Manica Province (Central Mozambique), ASM takes place throughout the year (Dreschler, 2001). Data retrieved from a baseline study conducted in 1999 by the Directorate of Mines (DNM) with funding from the World Bank revealed that there were at least 20,000 gold panners in Manica Province, a sizable percentage of whom were reportedly using earnings from their work to supplement income generated from and/or support agriculture. Census data collected in 2021 and released in 2023 by the country's National Institute of Statistics (the Instituto Nacional de Estatística or INE) indicate that in Manica Province, there are just under 100,000 people

involved in some type of economic activity linked to ASM. Although Manica has long been Mozambique's agricultural breadbasket, its gold panning economy has expanded so rapidly over the past two decades that it has cemented itself, alongside farming, as one of the province's main sources of employment (Drace et al., 2012; Hilson et al., 2021a). What remains unclear, however, is where each of these activities features in the livelihood portfolios of those who engage in both simultaneously. Knowledge of these details has important implications for policy, particularly planning linked to rural poverty alleviation and community development. As is the case with most analysis on ASM-farming in sub-Saharan Africa, the body of work produced on this subject in the context of Central Mozambique is largely conceptual, offering very few clues on the precise roles played by each activity in the livelihoods of families.

What is known is that Manica Province boasts some of Mozambique's most fertile lands and therefore has enormous agricultural potential. The lengthy list of crops cultivated here include lychee nuts, local vegetables (cucumber, cabbage, lettuce and tomato), "export vegetables" (baby corn, chillies and broccoli), mango, avocado and macadamia. Civil war between the FRELIMO government and the rebel group RENAMO between 1977 and 1992 and, subsequently, excessive state intervention and private sector control of farms, however, has prevented Manica Province's smallholders from realizing their full productive potential. Since country independence, the state has elected to pursue a "dual agricultural strategy," promoting large modern industrial-scale farms on the one hand and supporting peasant-run plots on the other hand. A combination of sporadic donor investment and government support, few paved roads to access larger markets, high transport costs and low yields, have crippled the latter. Most plots found here are family farms that are 1–3 ha in size; modern agricultural inputs such as fertilizers, irrigation technology and machines are virtually absent from these plots. The families working these farms are rather reliant on rudimentary implements such as shovels and hoes but these confine them to precariously low levels of crop production. They are, therefore, typically forced to sell produce locally at depressed prices (Simmons, 1978; Smart and Hanlon, 2014a, b; USAID, 2017).

What is also known is that as a result of this bleak agricultural situation, many of Manica Province's residents engage in gold panning. Mondlane and Shoko (2003) were among the first to point out how, in Central Mozambique, earnings from ASM are pooled with those generated from agriculture. Dondeyne et al. (2009) later explored this phenomenon in greater depth, observing that those engaged in ASM gained as much as 2–3 g of gold daily, the sale of which yielded earnings well above the international poverty line. The authors further reported that these earnings were "much higher than any alternatives agriculture or tourism could currently offer" (p. 49): how, in Manica, miners reported generating revenue that was four times as much as farmers earned from sales of cash crops in neighbouring Zambezia Province. Follow-up work carried out by Dondeyne and Ndunguru (2014) confirmed that many residents in Manica were using proceeds from sales of the gold they were extracting to buy seeds and fertilizers for their farms; build better houses and buy cattle; and even purchase automobiles, which has facilitated transport to the town, where produce can be sold more profitably.

After years of relative neglect of the sector, the Government of Mozambique has started to bring many areas where ASM is conducted under legal regulation. As a starting point, officials have actively encouraged operators to form associations and apply for a mining pass (or *Senha Mineira*) to access "designated areas" the government has put aside for artisanal mining. In sub-Saharan Africa, associations and co-operatives have long been advocated as crucial building blocks of ASM formalization strategies; they are viewed by policymakers as organic organizational structures through which individuals and groups can be engaged and mobilized (Noestaller, 1987; Siwale, 2018). In the case of Mozambique, moves to encourage the formation of ASM associations commenced in the early-1990s, when the government established the Mining Development Fund (FFM) to support operators. The problem,

however, was, as Nopeia et al. (2022) explain, that "the FFM focused exclusively on registered mining associations, which were (and still are) a minority in the artisanal mining community in Mozambique, rather than assisting all artisanal operators, particularly those operating in an informal environment" (p. 3).

All ASM activities in Mozambique are regulated by the Mining Law (Law 20/2014, 18 August 2014). Chapter V of the law is devoted entirely to ASM, in which two regimes are identified. These are as follows: 1) the *Certificado Mineiro* for Small-Scale Mining (Section I), and 2) the aforementioned *Senha Mineira* for Artisanal Mining (Section II). On 31 December 2015, the government passed Decree 31/2015, which approved the Regulation of Mining Act and its Annexes. The Regulation also defines "Artisanal Mining" and "Small-Scale Mining" separately (N.º 3, Article 116.º and Cfr. N.º 4, Article 98.º, respectively); its Chapter III is dedicated to the *Certificado Mineiro* and *Senha Mineira*. Since the dissolution of the FFM, the National Institute of Mines (INAMI) and the National Directorate of Geology and Mines (DNGM), both of which fall under the Ministry of Mineral Resources and Energy, have been tasked with assessing applications for, and the awarding of, these licenses.

The Government of Mozambique continues to encourage ASM operators to form associations. In order to be registered as an association, the law requires that there must be at least 10 members (although it is common for there to be as many as 200 miners and workers working together) who normally divide earnings amongst themselves (typically, by sharing the ore they mine). Each association has a chairperson, secretary and treasurer; while recognized by law, these associations are not required to pay taxes, unlike ASM cooperatives. According to the latest data, there are 86 ASM associations registered in Mozambique. Legislation does not demand that artisanal operators in possession of a *Senha Mineira* be affiliated with an association but if mining individually, they, too, are confined to working in designated areas (University of Zambezi and Mining Development Fund, 2012; Tychsen et al., 2022). The Minister of Mineral Resources and Energy is authorized to identify, modify and terminate designated areas, and has the power to grant the mining pass (*Senha Mineira*) – tenable for a period of five years – required to access them. People have, however, reported that obtaining this mining pass can be challenging due to a lack of technical support, shortage of credit and bureaucratic hurdles. There is also widespread concern about the viability of designated areas, including sections of the study locations visited in Manica Province: they are being delineated without any geological assessment of the terrain, and of what has been identified and subsequently "blocked out," most contain extremely low levels of gold (University of Zambezi and Mining Development Fund, 2012; Hilson et al., 2021; Tychsen et al., 2022).⁷

Many people who mine gold on an artisanal and small scale in Manica also engage in agriculture. In Mozambique, the state owns all land, access to which is governed by the Land Law of 1997. This landmark piece of legislation is unique because it "embraces customary African law in its innovative land tenure strategy" while "giving substantial control to local authorities in the delimitation and allocation of land use rights, the resolution of disputes, and the subsequent management of resources" (Burr, 2005, p. 961). The law also facilitates "negotiated private sector access to customarily acquired land," which has, in some instances, culminated in "agreements benefitting local

⁷ In Mozambique, ASM associations are best described as *existing* between the "formal" and "informal" economies. The clearest indication of this position is that despite being registered and recognized under Mozambican law, these associations are heavily managed and governed within the paralegal structures of local leaders. Some associations possess a mining pass (*Senha Mineira*) and therefore, their members are authorized to use it to access a designated area. In other instances, individuals who are not affiliated with any association are in possession of these mining passes. They typically hire their own diggers who, despite not having their own permits, are authorized to access a designated area provided that they are associated with a holder of a mining pass.

people,” and permits individuals with customary rights to “take their land out of customary jurisdiction” (Tanner, 2010, p. 107). In the study locations visited in Manica Province, most of the people who farm hold customary rights to the lands they are working.

Manica Province, like most areas of sub-Saharan Africa where ASM and farming are reportedly interconnected, is heterogenous demographically: the importance attached to each activity could vary among the different groups of people found here. Which individuals, however, value ASM more than farming and *vice versa*, and where does each feature in their livelihood portfolios? To help bridge this gap, semi-structured interviews were carried out with 200 artisanal miners randomly selected from across the four main ASM sites (Bandire, Mimosa, Munhena and Tsetsera) in Manica District and Sussundenga District, the two major gold-producing areas in Manica Province (Figure 1), and where associations were established and registered during the first decade of this century. Each miner was asked questions about ASM and farm-related work. Interviews, which were conducted between May and October 2019, yielded both quantitative and qualitative data. This information is analyzed in the discussion that follows.

The sample included members from miners’ associations in Tsetsera

and Mimosa, as well as those working informally – and autonomously – in small groups (up to five individuals) without legal access to designated areas (*i.e.* those who are not in possession of a *Senha Mineira*). All of the interviewees were male, drawn from different levels of the production chain. They included individuals working as diggers and haulers working under license holders (individuals in possession of a *Senha Mineira*) or group leaders, and people engaged in the processing of gold (*i.e.*, individuals carrying out grinding, milling, sieving, and amalgamation of concentrate by adding 1:1 portions of mercury and burning the gold sponge in order to liberate gold from mercury). Men mainly engage in ASM activities in Manica Province, although, similar to other areas of sub-Saharan Africa (see e.g. Arthur-Holmes and Abrefa Busia, 2020, 2022; Traoré et al., 2024), in Manica Province, there are numerous women at sites but most assist with gold panning or are involved in ancillary trades and services such as food provision and the supply of various items such as clothing and equipment (Buss et al., 2021; Ruth-erford and Chemane-Chilemba, 2020).

The sample was assembled through a combination of random, purposive and opportunistic selection, guided by the expertise of the interviewers. The aim was to produce a mix (albeit, not statistically

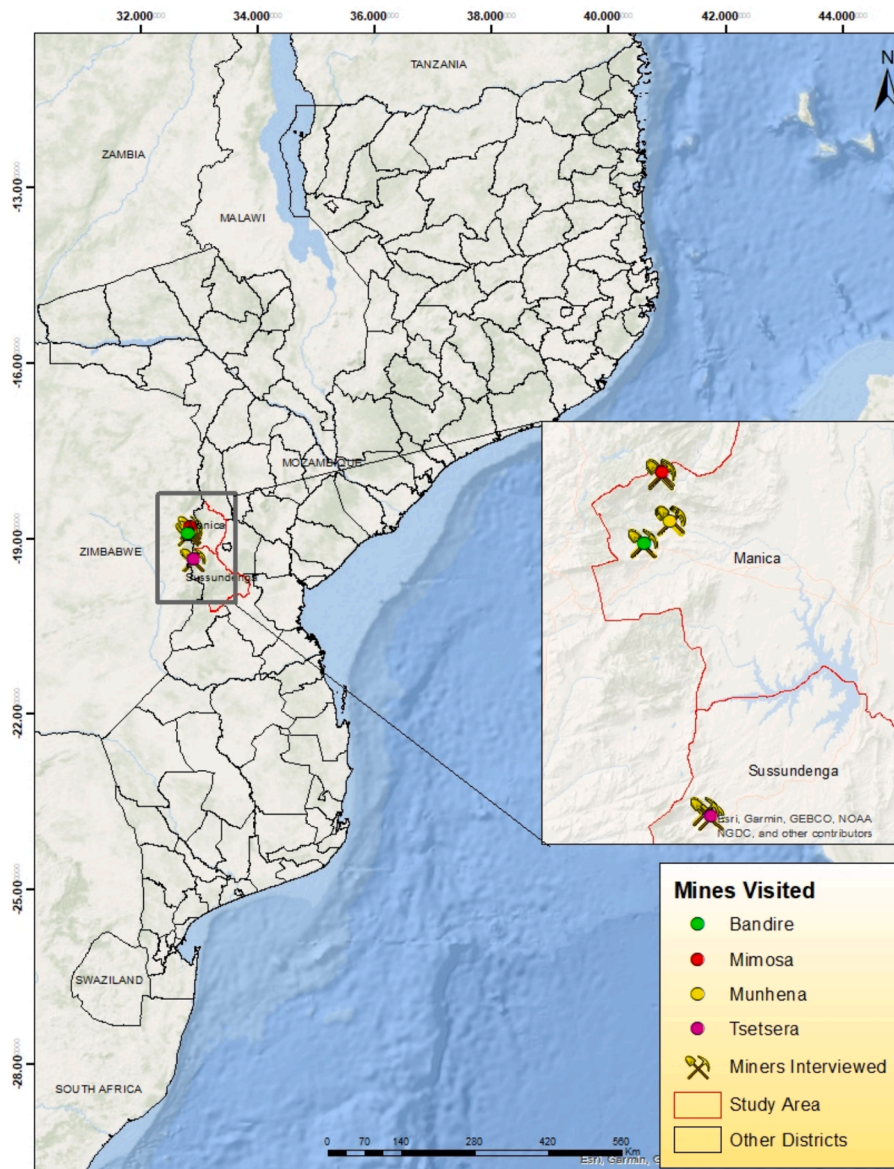


Figure 1. Location of study sites.

rigorous due to the lack of information on the population) of characteristics, regional distributions and roles in the production chain. A conceptual model was developed to help articulate the roles played by ASM and farming in the lives of Manica Province's residents. The resulting quantitative data, along with complementary qualitative research findings gathered from semi-structured interviews, offer a clearer picture of the interconnections between agriculture and ASM in Manica Province. These insights are crucial to designing more appropriate rural development policy strategies in which the roles played by both activities are reflected more accurately.

3.2. Conceptual model

As indicated, to date, the bulk of scholarly work that has reported on, and/or examined the linkages between, farming and ASM in sub-Saharan Africa has been conceptual; where data have been used to contextualize this phenomenon, analysis has been mostly qualitative. A similar approach was taken with the research carried out in Manica Province, although in a bid to generate more granular details capable of shedding even further light on trends and developments, complementary quantitative data were also gathered from interviewees. These data were fed into a conceptual model, the design of which was informed by the literature, with the supposition that ASM and farming *are*, indeed, interconnected, throughout sub-Saharan Africa (Figure 2).

The model is based on a number of key assumptions, each of which is also reinforced by ideas and points raised in the literature on, and hypotheses formulated about, ASM-farming linkages in sub-Saharan Africa. The first is that the decision made by households to engage in both activities is deliberate. Diversified income portfolios, it is maintained here, are a means by which families satisfy a suite of needs, including food supply, housing, education (for children) and health services. Consistent with reports that ASM-farming communities in sub-Saharan Africa are, demographically, heterogenous in their makeup, it was assumed that needs and more broadly, spending priorities, vary from household-to-household, governed by factors such as age, the size of the family, the level of education of residents, and personal preferences. For example, if families were large, it was predetermined that the household likely covets far greater supplies of food; conversely, it was assumed that if the household consists of younger, single, individual(s), there may be a preference for income-in-hand. It was assumed that larger households are more likely to combine mining and various farming activities (especially subsistence); smaller households are likely to focus more on income-generating activities, whether just mining or a combination of activities (ASM and cash-crop farming or subsistence agriculture).

Second, it is likely that *specific* household needs are being satisfied by ASM – that earnings from working in this sector are used to pay for

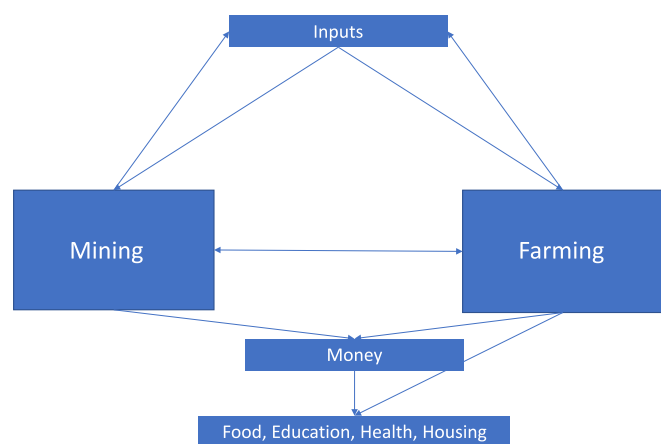


Figure 2. Conceptual model developed to articulate the interconnections between mining and farming.

particular goods and services. The same applies to the food crops that are being cultivated to meet the nutritional needs of individuals, or the cash crops they may harvest specifically for sale in local markets, earnings from which, in turn, are used to finance the purchase of other goods and services. Production from farming and ASM is inherently unpredictable, with realized output from both dependent upon factors external to households, such as crop failure and the erratic occurrence of gold, which may mean that earnings from one “replaces” the other when it comes to making specific household payments. Both ASM and farming require inputs, including seeds, tools, food (for laborers) and fertilizers. The linkages between the two, however, could be as clear-cut as the former generating the money used to purchase inputs for the latter, and the latter providing the food that facilitates operation of the former.

The third and final assumption is that labor is needed for both ASM and farming. Households' capacity to undertake both activities, therefore, is contingent upon a steady supply of labor, which can include internal household (labor) supply and external assistance (through contracts). Households with ready-access to sizable supplies of labor (e.g. larger households) are better-positioned to pursue a mixed-livelihoods approach: some members engage in agriculture, while others undertake ASM. Households with a more constrained labor supply (e.g. smaller households or single individuals) are likely restricted to carrying out a smaller range of activities.

The conceptual model is underpinned by two interconnected hypotheses, each of which is also informed by the burgeoning body of literature on ASM-agriculture linkages in sub-Saharan Africa. First, it is assumed that any decision to combine ASM and farm work stems from the belief that doing so helps to reduce uncertainty over the basket of goods and services that a household can provide (as long as the uncertainties pertaining to output from either are unrelated or at least not positively related). Second, households' preference to engage in ASM and/or farming is due, in part, to the uncertainty surrounding returns from either activity, and governed by their perception of risk associated with, and the services provided by, a particular sector. The priority for households with many dependents is likely to be food security, which means most emphasis will be placed on subsistence farm production to complement any pre-existing cash-generating activities such as mining or cash-crop farming. Conversely, in instances where households have a preference for disposable income, they are most likely to pursue mine work and/or engage in cash-crop farming, rather than operating as both miners and farmers.

The model is expected to yield important clues about who, specifically, engages in both ASM and subsistence farming simultaneously in sub-Saharan Africa and why.

3.3. Additional assumptions and predictions

The conceptual model was developed – in line with messages resonating in the literature – with the belief that the impetus behind why individuals from households engage in ASM and farming simultaneously is to help satisfy the needs of the households they are a part of. This includes the aforementioned food requirements, as well as addressing costs linked to housing, education and health. These needs are bound to vary from case-to-case, again, governed by factors such as age, family role, level of education and personal preferences. Additional assumptions made, based on views contained in the body of conceptual work produced to date on ASM-farm linkages in rural sub-Saharan Africa and reinforcing many points already raised in this paper, are as follows:

- Household needs can be met by ASM (e.g. provision of income used to purchase goods and services) work or farming (e.g. through subsistence crops meeting nutritional needs), specifically through sales of crops that generate earnings that can then be used to pay for other goods and services.
- That the two activities in tandem help to stabilize households by providing a more consistent and reliable stream of income. This

especially holds true when outputs from one may be uncertain (e.g. due to fluctuations in mine output or crop failures).

- Households’ decisions to engage in ASM and/or farming are based, in part, on the uncertainty of returns from one or the other, and their personal preference, determined by the goods and services the revenue they earn can help deliver.
- Both farming and ASM require inputs (e.g. the former features implements used to cultivate crops, seeds and fertilizers, while in the latter, specialized tools are used), which, for either, can be purchased using the revenue generated by the other.
- That labor is required to carry out both activities, and thus households’ capacity to undertake both simultaneously hinges upon access to supply. As indicated, this can include an internal household supply, and/or be externally-sourced. A greater supply of labor (larger households) would allow for more engagement in a mixed-livelihoods approach, whereby some members undertake agriculture and others, mining. Households with a more constrained labor supply (e.g. smaller or single individuals) are more restricted, and therefore likely to engage in a smaller range of activities.

Based on these assumptions, a prediction of the types of factors that increase the likelihood of individuals engaging in the twin-livelihood activities can be made.

$$Prob (Mining) = f (Labor Supply, Preference for disposable income, Uncertainty of returns, Level of risk aversion)$$

Households are more likely to pursue ASM if a greater supply of labor is available, they have a preference for disposable income, if the uncertainty of returns in the sector is lower, and/or if they have a lower level of risk aversion.

$$Prob (Farming – cash crop) = f (Labor Supply, Preference for cash, Uncertainty of returns, Level of risk aversion)$$

Households are more likely to engage in cash-crop farming if, again, they have access to a pool of labor, a preference for disposable income, if the uncertainty surrounding returns from agricultural activities is minimal, and/or if they have a lower level of risk aversion.

$$Prob (Farming – subsistence) = f (Labor Supply, Preference for food supply, Uncertainty of returns, Level of risk aversion)$$

Households are more likely to engage in subsistence farming if their labor supply is large, their preference for food supply (food security) is greater (i.e., if they have more people to feed or if their ability to purchase food from markets is compromised), if uncertainty surrounding returns is minimal, and/or if they are more risk averse (i.e., they prioritize food supply over disposable income).

Guided by the conceptual model, the next section of the paper reports and analyzes findings from the research.

4. Survey results

4.1. Regression analysis

To articulate further the causal relationship between why those engaged in ASM also carry out farming and some of the accompanying

Table 1

Descriptive statistics for the variable considered for inclusion in the conceptual model.

	Yes	No
Do you farm?	109	85
Are you licensed?	107	87
Secondary educated	99	95
Illiterate	7	187
How long have you been mining?	Average: 5.29 years	S.D. 6.29 years
Number of dependents	Average: 3.30 years	S.D. 2.73 years
Age	19–25	72
	26–35	57
	36–45	50
	46–55	8
	56–65	3

factors identified in the descriptive analysis, a logit regression was undertaken utilizing data extracted from interview transcripts, guided by the conceptual model. The dependent variable used was the *whether or not miners had a farm*. Given that this was a binary categorical variable (either a “yes” or “no”), the logit regression was judged to be the most appropriate strategy to analyze the data. As the dataset covered only miners, it was not possible to test the first prediction for the model regarding the probability of households engaging in ASM. The data also

did not allow for distinction between subsistence and cash cropping, although some of the questions did elicit qualitative descriptions of farm production that made this possible, the details of which are shared in Section 4.2. The data do, however, allow for reflection on the robustness

of predictions regarding the general predilection of miners engaging in farming activity, and the main factors responsible for this at sites visited in Manica Province.

The following variables were considered for inclusion in the model,

each of which provides proxies for the key conceptual drivers put forward in Section 3:

- Age, which was treated in the survey as a categorical variable. It was included as a set of dummy variables, with the category “Age 19–25” used as the base. Age may act as a proxy both for preference for finance and risk aversion.
- Licencing status, specifically, whether the miner interviewed was in possession of a permit or not. This variable may proxy for individuals’ aversion to risk.
- How long the interviewee has been engaged in ASM (number of years). This is proposed as a proxy for individuals’ understanding of the nature of uncertainty in ASM (with longer time periods proxying for greater understanding of uncertainty).

Table 2
Results of logit-regression¹

Variable	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	-0.988** (0.463)	-0.642** (0.226)	-0.9288** (0.261)	-1.225** (0.327)	-0.633 (0.427)
Licenced	1.583** (0.367)	1.679** (0.315)	1.544** (0.321)	1.628** (0.334)	1.531** (0.354)
How long have you been mining	0.126* (0.051)		0.075** (0.032)	0.138** (0.049)	0.149** (0.050)
Age 26–35	-0.466 (0.454)			0.065 (0.394)	0.061 (0.404)
Age 36–45	-1.118 (0.593)			0.170 (0.460)	-0.204 (0.494)
Age 46–55	-1.589 (1.472)			-0.146 (1.361)	-0.664 (1.372)
Age 56–65	-5.913** (1.900)			-5.102** (1.830)	-5.933** (1.886)
Secondary	-0.942* (0.379)				-0.907** (0.369)
Illiterate	0.171 (0.928)				0.348 (0.890)
Number of dependents	0.288** (0.100)				
Number of observations	194				
Pseudo R2	0.2410	0.1161	0.14	0.1805	0.2068

¹** Significant at one percent level, and * Significant at five percent level.

Table 3
Results of probit-regression (con't.).

Variable	Coefficient
Intercept	-0.615* (0.271)
Licenced	0.948** (0.217)
How long have you been mining?	0.075* (0.030)
Age 26–35	-0.284 (0.274)
Age 36–45	-0.658 (0.345)
Age 46–55	-0.927 (0.896)
Age 56–65	-3.547** (1.131)
Secondary	-0.552* (0.224)
Illiterate	0.138 (0.556)
Number of dependents	0.172** (0.100)
Number of observations	194
Pseudo R2	0.2421

- The individual's level of education, with "primary" used as the base. This proxies for level of risk-aversion.
- The individual's number of dependents, which proxies for labor supply and also preferences for food supply.

Descriptive statistics for the variables are presented in [Table 1](#).

The results of the logit regression are reported in [Table 2](#) and [Table 3](#). Five separate models were used to test variously the impact of inclusion of all the predictor variables described above and a combination of factors, each with the dependent variable of whether to farm or not. The first model included all predictor variables; the second only the question of licensing to examine just the impact of risk aversion; the third also included length of mining to include a proxy for uncertainty; the fourth added the various age profiles; and the fifth added the educational variables. Tests for multicollinearity confirmed that there were no issues

between the independent variables. A link test was conducted, which revealed no issues with the specification of the model.⁸ To ensure robustness, a probit model was also run using the same variables; results did not differ significantly. The results revealed the main reasons behind why interviewees engaged in ASM are more likely to pursue agricultural work. They were as follows:

- Having a licence;
- Being immersed in ASM activity for a longer period of time;
- Having only a primary education; and
- Having a greater number of dependents.

In addition, interviewees aged 56 to 65 were observed to be significantly less likely to have a farm than their more youthful counterparts (three individuals fell into this category and therefore, the robustness of this effect is likely to be small).

The results point to each of the variables included in the model having different scale impacts on the odds of an individual possessing a farm. The coefficients of the logit regression can be interpreted by understanding how they impact the odds ratio by taking their exponent. Possession of a licence (*Senha Mineira*) increases the odds of a miner having a farm by 387 percent, *ceteris paribus*; having a secondary education reduces the odds by 156 percent. Having one more family dependent increases the odds of having a farm by 33 percent, while mining for one more year increases the odds of having a farm by 13 percent. The impact of being aged 56–65, however, was by far the largest factor – although the sample here was small, and therefore, results should be treated with caution.

These findings suggest that risk aversion influences miners' decisions to engage in farming activity. It is assumed here that holders of licences are more risk averse (although equally, they may also have access to more capital), and are thus more willing to engage in additional income-earning activities. This is also supported by the suppositions surrounding education. Less-educated miners – who, it is assumed, may be more risk-averse due to a lack of access to other means of securing either cash or food supply – are more likely to engage in dual livelihood strategies. Those with higher educational levels (*i.e.*, those who will probably have more opportunities when ASM activity fails) are less likely to engage in

⁸ Results of these tests are available upon request.

farming.

Uncertainty is also important. Those who have engaged in ASM for the longest periods are more likely to have a farm (when controlling for other factors such as age). If it is assumed that a longer engagement in ASM leads to an improved understanding and appreciation of uncertainty, it can then be proxied that this provides an impetus for engaging in the sector *and* farming. A final point worth noting is that larger families are more likely to engage in mining *and* farming activity, either because of a need to provide food for more people or because of an availability of labor supply.

4.2. Profiling Manica's ASM operators

Analysis of the survey data revealed important details about the links between farming and ASM at the study sites. From the sample interviewed, there were a total of 194 useable responses. All percentages discussed in this section therefore relate to this sample (of 194). The majority of miners interviewed (56 percent $n = 109$) indicated that they also engage in agricultural work, although less than 20 percent reported that they do so for commercial purposes. This underscores the importance of preference for food supply in the decision-making underpinning dual livelihood strategies. All interviewees who reportedly engaged in farming, including the small number who grow crops for market, reported doing so for personal consumption or to help meet the food supply needs of their households. The high percentage of harvested crops being consumed by households engaged in agriculture could explain why only 43 percent of these interviewees identified and therefore, appear to view, farming as an "economic activity." What may also contribute to this explanation is the abysmally-low productivity of their farms (70 percent reported crop harvests of less than one ton per year). This is unsurprising, as many of those interviewed explained that they are forced to use monies generated from ASM to support their farms in a multitude of ways. Some of the explanations given included "Artisanal mining has impacted my farming activities because with that money [I] can buy seeds and pay my workers,"⁹ "[ASM] has impacted because I can buy medicine with the money I earned in mine to combat grasshopper plague,"¹⁰ and "[ASM] has impacted because I inject money to buy seeds, manure and to pay workers."¹¹

The vast majority (92 percent) of interviewees who responded "yes" to the question, "Do you carry out any other economic activity?" listed agriculture as the "other economic activity," as well as identified themselves as farmers. This deliberate distinction may seem inconsequential but it has enormous policy implications in a region (*i.e.*, sub-Saharan Africa) where agriculture, particularly support for the smallholder ("small farm first"), has long been a centerpiece of donor-driven rural development and poverty alleviation strategies (Ellis and Biggs, 2001). As highlighted in previous sections of this paper, scholars have repeatedly argued over the years that in sub-Saharan Africa, ASM and farming are interconnected across seasons, and that finances and labor move freely between both. The key takeaway from the data collected in Manica, however, is that many of the interviewees continue to refer to themselves as "farmers" despite their success as gold panners. This implies a very different mindset to that of individuals who have progressively *disassociated* themselves from agriculture and increasingly associated themselves with ASM, on the basis of the latter becoming their primary source of income. When Maconachie and Binns (2007) raised the question, "Farming miners or mining farmers?" in their pioneering longitudinal study of communities in rural Sierra Leone, the intention was to highlight the nexus between artisanal diamond digging and subsistence agriculture in the country. Specifically, these labels, it appears, were purposely devised, and have since been used to

underscore how "Sierra Leoneans chose to mine alluvial gold in the dry season when their land requires less attention, and farm in the wet season when the alluvial gold mines are less accessible." These interconnections, government officials would later claim, have enabled "mining farmers" or "farming miners" to "stabilize their income, and to use the revenues earned in one activity to invest in the other activity, thereby enhancing their resilience in coping with future shocks" (Republic of Sierra Leone, 2020, p. 36). This further supports the conclusions from the model above that critical to the determination of undertaking these dual activities is the need to manage uncertainty and to help fulfil risk averse preferences.

In the wider context of sub-Saharan Africa, "farming miners" and "mining farmers" have since become far more loaded terms; they can now also be used to depict, unchallengingly, where many individuals are invested both mentally and emotionally. When Maconachie and Binns (2007) introduced these terms, the aim was to draw attention to a phenomenon and little more. Neither these authors, nor Hilson (2016), who more recently argued that in sub-Saharan Africa, "[some] individuals who have 'branched out' into ASM continue to view agriculture as their primary occupation whilst others no longer do so," were actively seeking to juxtapose one activity with the other for the purposes of determining *which* of the two (activities) households relate to, and aspire to engage in, more. Moving forward, however, articulating more clearly which of these scenarios – *i.e.*, whether it is ASM or agriculture that rural households nestled within "diversified landscapes" identify with the most – is imperative, as each requires separate policy treatment.

4.3. Mining farmers or non-farming miners?

When the "mining farmers" – "farming-miners" lens is used to analyze the data gathered in Manica, a pattern emerges, which Figure 3 captures. Those who best represent "mining-farmers," or who mostly identified with agriculture, tended to be older laborers, the greatest share being those aged between 36 and 45. At the other end of the spectrum are those who, in this context, are referred to as "non-farming miners" (in this case, those who best represent "farming-miners"), who identify more with ASM. These are mostly younger people, aged between 19 and 25, who, at the time of interviewing, were not engaged in meaningful agricultural work.

While explanations were not provided (nor requested), the likely reason why the younger people consulted do not engage in agriculture is because they have little desire to do so. In the context of the model, their preferences for food supply are low, while their desire for cash is high. This is the case in many areas of sub-Saharan Africa and the wider developing world, where, as officials at the OECD explain, it "is becoming increasingly clear" that "rural youth are turning their backs on small-scale agriculture," because "they have high expectations, do not want to farm, and aspire to have better jobs elsewhere" (OECD, 2018, p. 9). A more nuanced and indeed precise explanation is provided by Sumberg et al. (2021), who argue a "large numbers of young people are leaving rural areas because of the realities of much smallholder farming: hard, dirty, physical work, with poor and uncertain returns, and no respect or recognition from the broader (read "urban") society" (p. 5). This, however, does not apply in locations such as Manica, where youth are not fleeing rural areas *en masse* to pursue economic opportunities in urban areas but are rather staying, with the intention of engaging in ASM because they believe it can more closely fit their preferences for outcomes such as disposable income, especially in the context of highly uncertain economic returns from agriculture.

These individuals are progressing rapidly along a trajectory akin to that of the *lifetime miner*: the person who pursues a livelihood in which agriculture barely features, if at all. Compared to "mining-farmers," however, this group has substantially less experience in ASM. Among the "mining-farmers" interviewed, the average length of time each had reportedly engaged in ASM was 6.6 years, compared to just 3.6 years for "non-farming" (although the means for each are significantly different

⁹ Interview, Miner #12, Munhena.

¹⁰ Interview, Miner #13, Munhena.

¹¹ Interview, Miner #43, Mimosa.

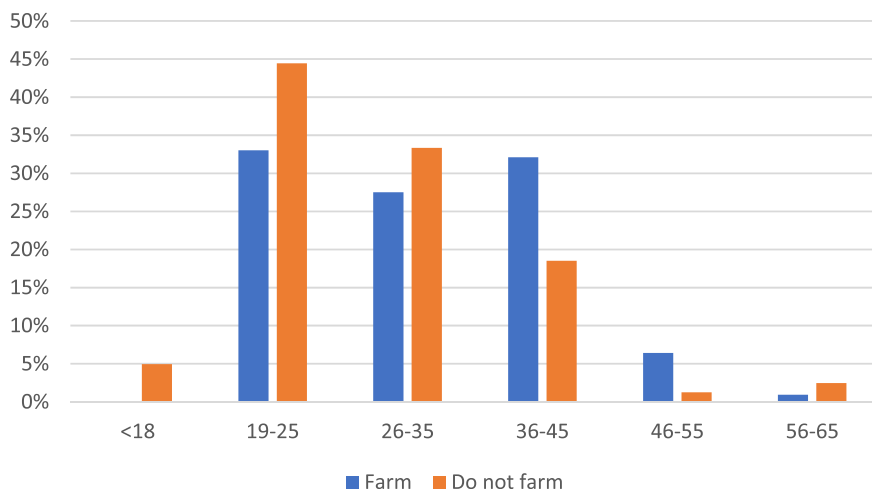


Figure 3. Depiction of “mining-farmers” – “farming-miners” profile across the study locations.

from each other).¹² Perhaps this is the result of most of the former possessing a license, which provides much-needed security of tenure and therefore, puts them in a position to plan their lives – in this case, the foundation needed to set up a farm. Nearly three-quarters (72 percent) of “mining-farmers” interviewed claimed to be in possession of a *Senha Mineira* or working with someone who possesses one. Again, these mining passes authorize the holder to access designated areas, specifically plots less than 1000 ha in size (Mondlane and Shoko, 2003).¹³ By comparison, only 33 percent of “non-farming miners” were in possession of a *Senha Mineira* at the time of interviewing.

The security of tenure which a *Senha Mineira* affords is very important for the “mining-farmers” interviewed who, on average, have four dependents compared to only 2.4 in the case of their non-farming counterparts.¹⁴ As the following extracts highlight, most emphasized, in interviews, how earnings from mining not only helped households with their food security but also with covering other critical expenses such as school fees:

Sector mining I have good experience related with underground gold identification. The money I earn as miner I buy food for my family and invest in my farming.¹⁵

The mining sector has been impacting a lot in my life because with the money I earn here is do a lot of things. Grace this activity is have good house, my son go to school, have bag and exercise book, uniform...¹⁶.

Mining sector has been helping me. My life is going well because I succeed to build my house, pay the school fees for my children.¹⁷

Significantly, however, many non-farming miners were quick to explain, in interviews, how the monies generated from ASM were also instrumental in stabilizing their own food security situations. More specifically, as the following interview extracts capture, they recognize that income from ASM provides an much-needed avenue to obtaining food:

¹² Testing the hypothesis that the two sample means are different gives a t-statistic of 3.58 compared to a test statistics of 1.97 for a two-tailed 5 percent test.

¹³ Became law following implementation, in 2003, of Decree N828/2003.
¹⁴ These two sample means are significantly different with a t-statistic of 4.62.
¹⁵ Interview, Miner #190, Munhena.
¹⁶ Interview, Miner #138, Tsetsera.
¹⁷ Interview, Miner #155, Misoma.

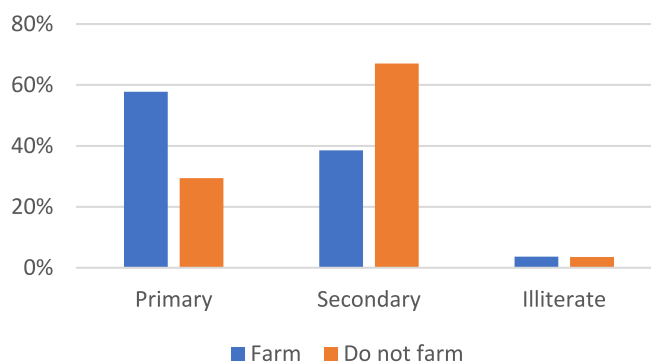


Figure 4. Age profiles of “mining-farmers” and “non-miners”.

After I start to work as a miner I improved a lot in my food. Now I can buy cheese, butter, bread and another food good.¹⁸

Has improved positively because I buy quality food for my son.¹⁹

Has improved positively. Now I help my parents buy food.²⁰

Has improved positively because we have a lot of food at home and every day we have all meals.²¹

These passages reinforce further the crucial role preferences for food supply have in driving the decision to be farming-miners.

Approximately one-third of mining-farmers reported that they used income earned from ASM to support their agricultural work; on average, 15.7 percent (with a range of 5 to 40 percent) is reportedly diverted for this purpose. Some 85 percent of interviewees reported that their mine earnings are reinvested in their households, further evidence that ASM is helping to stabilize livelihoods – even if only for the short term – in rural Mozambique, highlighting the crucial roles played by preferences for food supply and uncertainty in driving this move to being farming-miners. Interestingly, this runs counter to accounts that have consistently surfaced over the years about how, in sub-Saharan Africa, male small-scale miners squander their earnings on prostitutes, cigarettes, alcohol and drugs at their sites of work (see e.g. Werthmann, 2008;

¹⁸ Interview, Miner #19, Munhena.
¹⁹ Interview, Miner #20, Bandire.
²⁰ Interview, Miner #27, Mimoso.
²¹ Interview, Miner #99, Tsetsera.

Cuvelier, 2017). On the contrary, only 11 percent of those interviewed indicated that they spent sizable proportions of their earnings from ASM at sites and most indicated that this spend was largely made to bolster operations. A smaller yet still significant percentage of interviewees reported that they use mine monies to pay for children's school fees (16 percent) and to stabilize savings (15 percent). The key takeaway here is that in Manica Province, individuals of all ages pursue work at ASM sites because they believe that the earnings generated benefit their households in different ways.

This is, of course, most visible with farming, into which again, monies from ASM are regularly injected. The move, in turn, stabilizes/increases crop production and by extension, improves the food security situation, of a household. It applies to even "non-farming miners," for whom it would not by any means be far-fetched to assume that as they age and their families expand, will increasingly view farming as a more strategic enterprise for their households, the idea being that they would grow more of the food they and their dependents consume and purchase less from the market. Securing a *Senha Mineira* is certainly one way of improving security of tenure and providing the stability individuals need to invest more reliably in their plots and harvests.

4.4. Education levels

The education levels of interviewees varied considerably (Figure 4). Low-levels of schooling were most prevalent among "mining-farmers," approximately 60 percent of whom (n = 63) had only completed a primary education. By comparison, approximately 70 percent of non-farming miners (n = 57) (again, in this case, the equivalent of "farming miners") interviewed had completed secondary education.

This surely has important policy implications, although no attempt was made during fieldwork to interrogate respondents further about their education, in particular, why they decided to stop schooling. It is likely the case, however, that older farmers' education was considerably disrupted by the country's civil war, which caused population displacement and led to the closure of schools. Moreover, the pattern observed is also likely attributed to a combination of tradition and legacy, mirroring developments that have been witnessed with agriculture across sub-Saharan Africa over the past two decades. Despite claims made by donors that agriculture employs upward of three-quarters of Mozambicans, the sector remains woefully unproductive, owed to a lack of crop diversity and reduced production. Consequently, agriculture only accounts for approximately 25 percent of the country's GDP: despite experiencing a strong "catch up" in the early-1990s, due to improved security and more integrated crop markets, per capita food production in 1993 was still three quarters of that of pre-war levels (1980s), and continues to stagnate (Brück, 2003; Brück and van den Broeck, 2006; Balchin et al., 2017; FAO, European Union and CIRAD, 2022). Given this outcome, it makes sense for older individuals with low levels of education, who were likely born into farming and therefore committed to it, or simply recognize, with their lack of education, that there are few, if any, viable income-earning alternatives available, to become more risk-averse and thus rely on the twin livelihoods of agriculture and mining.

Further interrogation of the data reveals some additional interesting trends. As indicated, the "farming-miners" who reported that they harvest crops not just for personal consumption but also for commercial purposes, tended to be younger than the wider group as a whole. At the time of interviewing, an estimated 40 percent who claimed to be doing so were under the age of 25. This could be in part due to this contingent boasting a higher level of education amongst those in the mining-farmers category, or reflective of a greater preference for the cash that ASM (or commercial farming) offers, rather than the food supply that subsistence farming provides. An estimated 55 percent had completed secondary school, compared to 39 percent for the mining-farmers category. Of the mining-farmers consulted, only 52 percent claimed that they themselves undertake agricultural activities. Small

percentages (between 7 and 12 percent) reported that their parents, children or grandchildren were involved in farming, although the vast majority (77 percent) reported that their spouses carry out this work.

What these findings underscore is, in the context of rural livelihood diversification in sub-Saharan Africa where ASM features, the importance of viewing the *family* as the unit, as opposed to the *individual*, and the role of decision-making, inclusive of preferences, aversion to risk, and perceptions of uncertainty at the household level. Important dynamics were unearthed when the household or family lens was applied to the current study, revealing details about who Manica's residents are, and generating insights on why they undertake and how they balance both ASM and farming. As indicated, of the individuals sampled, mining-farmers tended to be older, more established, with larger families and more formalized – with likely preferences for food supply over cash, and lower levels of risk and uncertainty. Their households combine ASM with subsistence farming, utilizing a portion of income earned from the former to support the latter, and relying on household labor supply to facilitate such a twin livelihood approach. They shared stories of how their spouses, children and even grandchildren were involved in farming activities while they engaged in ASM. Conversely, non-farmers (or Manica Province's equivalent of "farming-miners") tended to be younger and more educated. They also engage in farming but do not view this as nearly a strategic enterprise as their "mining-farmer" counterparts.

Regardless of where individuals fall on the "farming-miner" – "mining-farmer" continuum, as research from Manica Province has demonstrated, the retrieval of quantitative data from communities positions policymakers to design and implement interventions that are more in tune with target groups.

5. Discussion and conclusion

This paper set out to add depth to the debate on ASM-farming linkages in rural sub-Saharan Africa. While burgeoning and dynamic, analysis of the subject has, to date, been largely-conceptual and reliant almost exclusively on qualitative data to reinforce ideas. As has been demonstrated in this paper using findings from research conducted in Manica Province (Mozambique), however, quantitative data help to nuance further several aspects of this debate.

Quantitative data offer the granularity missing from the current discussion on this subject; stories laced with these data could go a long way toward rewriting the narrative on ASM's functions in the region. More grounded analysis of the economic impacts of ASM in sub-Saharan Africa is a key to stimulating a much-needed rethink about the role the sector plays in the region's wider rural economy, and to facilitate appropriate policy changes. In the case of the present study, the data gathered offered important clues about the demographics, tastes and needs of individuals engaged in ASM and farming in Manica Province, Mozambique. Highlights include miners with larger families more likely to have a farm; there being an inverse relationship detectable, among those interviewed, between education level and probability of engaging in agriculture; and how interviewees in possession of a *Senha Mineira* (a mining pass) tended to feel that they have the security of tenure needed and generally, more flexibility, to plan accordingly around these two economic activities. These quantitative data make it possible to disaggregate individuals on the basis of livelihood choices, enabling construction of a "farming-miners" – "mining-farmers" typology that depicts fairly representatively the situation in Manica's gold-bearing territories. This has important implications for national planning, as each category of individual demands separate policy treatment.

Research which generates these granular details more importantly thrusts ASM into, and legitimizes its inclusion within, broader policy debates on key development topics that are relevant to sub-Saharan Africa from which it has been excluded *hitherto*. One of the more significant subjects is food security, a pressing concern in sub-Saharan Africa today because of the region's rampant poverty and large

segments of its population being susceptible to climate-induced shocks and stresses. Conservative estimates suggest that at least 123 million people in sub-Saharan Africa (12 percent of the region) are acutely food insecure – that is, suffering from high malnutrition and unable to meet minimum food consumption needs (Baptista et al., 2022). The situation is worsening, and is most visible in locations impacted by extreme events such as flooding and drought; in some of the region's most vulnerable locations, food insecurity increases by 5–20 percentage points following each extreme event (IMF, 2020).

What the data gathered in Manica Province suggest is that families engaged in ASM are willing to invest money in, and allocate labor to, farming for the purposes of stabilizing their food supplies. While there have been pieces published over the years that support the idea that in sub-Saharan Africa, ASM in some way facilitates access to food (see e.g. Bansah et al., 2023), far more scholars maintain that a proliferation of the sector's operations impacts negatively on subsistence agriculture by destroying arable land which, consequently, compromises food security locally (e.g. Ofuso et al., 2020; Nunoo et al., 2023). Moreover, Mozambican authorities, including provincial governors, have over the last few decades periodically criticized small-scale miners for causing siltation of rivers which, they claim, harms farmers. Those found in this camp, however, barely acknowledge in their assessments the connections ASM and farming have across seasons in sub-Saharan Africa; even those found in the former camp are limited in their focus, hinting that ASM improves local food security by positioning families to purchase food from markets, as opposed to encouraging them to grow crops.

It seems counterintuitive to carry out mining in ways that would degrade and/or contaminate lands and thus prevent farm-dependent families from practicing agriculture productively. This has led some scholars (e.g. Mabe et al., 2024) to correctly report that those who reclaim lands used to support their mining activities have far more productive farming seasons. Regardless of scholarly position, with sub-Saharan Africa being the world's poorest area, it is crucial that ASM, in light of burgeoning accounts of it dovetailing farming, gains some traction in the debate on food security in the region. Quantitative data such as those gathered in Manica Province would go a long way toward legitimizing ASM's inclusion in this discussion. More data are needed that illuminate further the inter-relationship between ASM and agriculture, especially across different geographical spaces. The collection of information on the investment made with revenues generated by ASM, the division of labor within households between the sector's operations (and other nonfarm activities) and agriculture, and the nutritional statuses of families, using household surveys, should be prioritized.

A second significant – and very much, related – subject is resilience. Although the term “resilience” is understood by researchers and policymakers in many different ways, in general, it refers to people's abilities to cope with the impacts of external shocks and stresses (Arnall, 2015) or to “build back better” following a perturbation or disaster (Sinha et al., 2022). In the context of sub-Saharan Africa, there is growing interest among researchers in the effects of global environmental change on the livelihoods of small-scale farmers and how they respond to such impacts (e.g. see Ackerl et al., 2023). The ASM sector, however, does not feature in this body of work. Similarly, a range of rural resilience-building programs funded by international organizations such as the World Food Programme (WFP) and the International Fund for Agricultural Development (IFAD) focus on small scale farming activities but pay little attention to how earnings from ASM could supplement or enrich livelihood portfolios and thus make rural systems more resilient. There are opportunities in Mozambique to build ASM more concretely into ongoing donor-led rural development and agricultural programs that focus heavily on building resilience and improving food security at the household level, and which are heavily anchored in the SDGs. The list includes the World Food Program's US \$819.27 million *Mozambique Country Strategic Plan, 2022 – 2026*; IFAD's US\$49 million *Republic of Mozambique Country Strategic Opportunities Program, 2023 – 2027*; and the World Bank US\$150 million

Mozambique Sustainable Rural Economy Program, 2021 – 2026 (World Food Program, 2022; IFAD, 2023; World Bank, 2024).

As revealed in the present paper, for both “mining-farmers” and “farming-miners,” the (ASM) sector is an integral component of the income portfolios of rural families. This income diversity and the stability it provides, in turn, builds livelihood resilience (Bahadur et al., 2010). Moving forward, therefore, it is imperative to recognize the contribution ASM can make to rural resilience more broadly, particularly the ways in which the income it generates insulate individuals and groups from shocks and stresses. Given the current high profile of resilience-based thinking among the research, policymaking and donor communities, taking such an approach would help to legitimize ASM as a central component of the region's rural development agenda (Hilson et al., 2021b). A conceptual model similar to that developed to guide the work conducted in Manica Province can assist with pinpointing the areas where quantitative data on farming-miners and mining-farmers can be gathered that are capable of nuancing already-rich storylines infused with qualitative analysis. Emphasis should be placed on gathering information to broaden understanding of how their livelihood activities change in relation to seasonality, economic factors (such as commodity prices), and shocks induced by extreme weather events. Recall surveys can be useful in this regard but what is really needed is research emphasizing longitudinal data collection, across seasons, in different geographical settings in sub-Saharan Africa.

In summary, quantitative data, such as those shared in this paper, would go a long way toward enriching already-powerful storylines that showcase the links between ASM and subsistence agriculture. Moving forward, emphasis could initially be placed on packaging these findings as food security and resilience, themes that speak directly to the SDGs, and which would give ASM more visibility in rural development and poverty alleviation strategies in sub-Saharan Africa.

CRediT authorship contribution statement

Gavin Hilson: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Tim Laing:** Writing – review & editing, Writing – original draft, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Abigail Hilson:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Alex Arnall:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Salvador Mondlane:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

Funding for this research was provided by the International Growth Centre, under the grant *Formalizing Small-Scale Mining in Rural Mozambique: Issues, Challenges and Ways Forward* (MOZ-19016). The authors would like to thank all of the interviewees for taking time out of their busy schedules to participate in the research. The authors would also like to thank the Dr Claudio Frischtak and the International Growth

Centre Mozambique staff and three anonymous reviewers for comments on a previous draft of this paper. Needless to say, any errors this paper may contain are the sole responsibility of the authors.

References

- Acaps. (2023). *Mozambique: Flooding in Maputo Province and City*. ACAPS, Geneva: Briefing Note.
- Ackerl, T., Weldemariam, L. F., Nyasimi, M., & Ayanlade, A. (2023). Climate change risk, resilience, and adaptation among rural farmers in East Africa: A literature review. *Regional Stability*, 4, 185–193.
- Arnall, A. (2015). Resilience as transformative capacity: Exploring the quadripartite cycle of structuration in a Mozambican resettlement programme. *Geoforum*, 66, 26–36.
- Arthur-Holmes, F., & Abrefa Busia, K. (2020). Household dynamics and the bargaining power of women in artisanal and small-scale mining in sub-Saharan Africa: A Ghanaian case study. *Resources Policy*, 69, 101884.
- Arthur-Holmes, F., & Abrefa Busia, K. (2022). Women, North-South migration and artisanal and small-scale mining in Ghana: Motivations, drivers and socio-economic implications. *The Extractive Industries and Society*, 10, Art. 101076.
- Ashley, C., & Carney, D. (1999). *Sustainable livelihoods: Lessons from early experience*. London: UK Department for International Development.
- Bahadur, A. V., Ibrahim, M., & Tanner, T. (2010). *The resilience renaissance?* IDS Sussex, Brighton: Unpacking of resilience for tackling climate change and disasters.
- Balchin, N., Coughlin, P., Papadavid, P., te Velde, D. W., & Vrolijk, K. (2017). *Economic Transformation and Job Creation in Mozambique*. London: Overseas Development Institute.
- Banchirigah, S., & Hilson, G. (2010). De-agrarianization, re-agrarianization and local economic development: Re-orientating livelihoods in African artisanal mining communities. *Policy Sciences*, 43(2), 157–180.
- Bansah, K. J., Arthur-Holmes, F., & Assan, E. (2023). Climate induced transformation of agriculture to artisanal mining economy in dry regions. *Journal of Rural Studies*, 99, 11–19.
- Baptista, D., Farid, M., Fayad, D., Kemoe, L., Lanci, L., Mitra, P., Muehlschlegel, T., Okou, C., Spray, J., Tuitoek, K., & Unsal, F. (2022). *Climate Change and Chronic Food Insecurity in Sub-Saharan Africa*. Washington DC: International Monetary Fund. Report DP/2022/016.
- Barrett, C. B., Bezuneh, M., & Aboud, A. (2001a). Income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya. *Food Policy*, 26(4), 367–384.
- Barrett, C. B., Reardon, T., & Webb, P. (2001b). Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics, and policy implications. *Food Policy*, 26(4), 315–331.
- Barry, M. (1996). *Regularizing Informal Mining: A Summary of the Proceedings of the International Roundtable on Artisanal Mining*. Washington, DC: World Bank.
- Block, S., & Webb, P. (2001). The dynamics of livelihood diversification in post-famine Ethiopia. *Food Policy*, 26(4), 333–350.
- Brück, T. (2003). *Coping Strategies in Post-War Rural Mozambique*. DIW Berlin, Berlin: German Institute for Economic Research.
- Brück, T., van den Broeck, K. (2006). Growth, Employment and Poverty in Mozambique Issues in Employment and Poverty Discussion Paper 21, International Labour Organization, Geneva.
- Bryceson, D. F. (1999). African rural labour, income diversification & livelihood approaches: A long-term development perspective. *Review of Africa Political Economy*, 26(80), 171–189.
- Bryceson, D. F. (2002). The Scramble in Africa: Reorienting Rural Livelihoods. *World Development*, 30(5), 725–739.
- Burr, K. (2005). The Evolution of the International Law of Alienability: The 1997 Land Law of Mozambique as a Case Study. *Columbia Journal of Transnational Law*, 43, 961–997.
- Buss, D., Rutherford, B., Kumah, C., & Spear, M. (2021). Beyond the rituals of inclusion: The environment for women and resource governance in Africa's artisanal and small-scale mining sector. *Environmental Science and Policy*, 116, 30–37.
- Buxton, A. (2013). Responding to the challenge of artisanal and small-scale mining How can knowledge networks help? International Institute for Environment and Development (IIED), London.
- Carman, J. S. (1985). The Contribution of Small-Scale Mining to World Mineral Production. *Natural Resources Forum*, 9(2), 119–124.
- Carman, J. S. (1987). Why Small Mining? *Episodes*, 10(3), 159–164.
- Carswell, G. (1997). *Agricultural intensification and sustainable rural livelihoods: A think piece*. Brighton: University of Sussex. IDS Working Paper 64.
- Carney, D. 1999. Approaches to Sustainable Livelihoods for the Rural Poor. Overseas Development Institute Poverty Briefing 2, Overseas Development Institute, London.
- Chambers, R., & Conway, G. R. (1991). *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. Brighton: University of Sussex. IDS Discussion Paper 296.
- Craig, D., & Porter, D. (2003). Poverty Reduction Strategy Papers: A New Convergence. *World Development*, 31(1), 53–69.
- Crisp, B. F., & Kelly, M. J. (1999). The Socioeconomic Impacts of Structural Adjustment. *International Studies Quarterly*, 43, 533–552.
- Cuvelier, J. (2017). Money, migration and masculinity among artisanal miners in Katanga (DR Congo). *Review of African Political Economy*, 44(152), 204–219.
- D'Souza, K. 2003. ASM in Africa: Testing an Integrated Poverty and Practice Model at the Country Level, paper presented at the Communities & Small Scale Mining Annual General Meeting and Learning Event (CASM), Elmina, 7–10 September 2003.
- Davignon, R. (2018). Primitive Techniques: From 'Customary' to 'Artisanal' Mining in French West Africa. *The Journal of African History*, 59(2), 179–197.
- Delgado, C., Hazell, P., Hopkins, J., & Kelly, V. (1994). Promoting Intersectoral Growth Linkages in Rural Africa through Agricultural Technology and Policy Reform. *American Journal of Agricultural Economics*, 76(5), 1166–1171.
- Department for International Development (DFID). (1997). *Eliminating World Poverty: A Challenge for the 21st Century*. London: UK Department for International Development.
- Dondeye, S., & Ndunguru, E. (2014). Artisanal gold mining and rural development policies in Mozambique: Perspectives for the future. *Futures*, 62, 120–127.
- Dondeyne, S., Ndunguru, E., Rafael, P., & Bannerman, J. (2009). Artisanal mining in central Mozambique: Policy and environmental issues of concern. *Resources Policy*, 34, 45–50.
- Drace, K., Kiefer, A. M., Veiga, M. M., Williams, M. K., Ascari, B., Knapper, K. A., Logan, K. M., Breslin, V. M., Skidmore, A., Bolt, D. A., Geist, G., Reidy, L., & Cizdziel, J. V. (2012). Mercury-free, small-scale artisanal gold mining in Mozambique: Utilization of magnets to isolate gold at clean tech mine. *Journal of Cleaner Production*, 32, 88–95.
- Dreschler, B., 2001. Small-scale Mining and Sustainable Development within the SADC Region. Mining, Minerals and Sustainable Development (MMSD). International Institute for Environment and Development and World Business Council for Sustainable Development, London.
- Dumett, R. (1999). *El Dorado in West Africa: The Gold Mining Frontier, African Labor and Colonial Capitalism in the Gold Coast, 1875–1900*. London: James Currey.
- Ellis, F. (1998). Household strategies and rural livelihood diversification. *The Journal of Development Studies*, 35(1), 1–38.
- Ellis, F. (2000a). *Rural Livelihoods and Diversity in Developing Countries*. Oxford: Oxford University Press.
- Ellis, F. (2000b). The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics*, 51(2), 289–302.
- Ellis, F., & Biggs, S. (2001). Evolving Themes in Rural Development 1950s–2000. *Development Policy Review*, 19(4), 437–448.
- Ellis, F., Kutengule, M., & Nyasulu, A. (2003). Livelihoods and Rural Poverty Reduction in Malawi. *World Development*, 31(9), 1495–1510.
- Fisher, E., Mwaipopo, R., Mutagwaba, W., Nyange, D., & Yaron, G. (2009). "The ladder that sends us to wealth": Artisanal mining and poverty reduction in Tanzania. *Resources Policy*, 34(1–2), 32–38.
- Food and Agricultural Organization (FAO). 2022. Food Systems Profile - Mozambique: Catalysing the sustainable and inclusive transformation of food systems. Food and Agricultural Organization (FAO), Rome.
- Food and Agricultural Organization (FAO), European Union and CIRAD. (2022). *Food Systems Profile – Mozambique*. Rome, Brussels and Montpellier, France: Catalysing the sustainable and inclusive transformation of food systems.
- Forecast Based Financing. (2019). *Mozambique*. Berlin: Forecast Based Financing.
- Fraser, A. (2005). Poverty reduction strategy papers: Now who calls the shots? *Review of African Political Economy*, 32(104–105), 317–340.
- Haggblade, S., Hazell, P. B., & Brown, J. (1988). Farm-Nonfarm Linkages in Rural Sub-Saharan Africa. Policy, Planning, and Research Working Paper 6. *Agriculture and Rural Development Department*. Washington DC: The World Bank.
- Haggblade, S., Hazell, P., & Brown, J. (1989). Agricultural technology and farm-nonfarm growth linkages. *Agricultural Economics*, 3(4), 345–364.
- Haggblade, S., Liedholm, C. 1991. Agriculture, Rural Labour Markets and the Evolution of the Rural Non-farm Economy, pp. 542–557, in Sustainable Agricultural Development: The Role of International Cooperation, Proceedings of the Twenty-First International Conference of Agricultural Economists (eds. G.H. Peters and B.F. Stanton), Queen Elizabeth House, Oxford.
- Hentschel, T., Hruschka, F., & Priester, M. (2002). *Global Report on Artisanal and Small-Scale Mining, Minerals Mining and Sustainable Development (MMSD) Project*. London: International Institute for Environmental Development.
- Hilson, G. (2009). Small-scale mining, poverty and economic development in sub-Saharan Africa: An overview. *Resources Policy*, 34(1–2), 1–5.
- Hilson, G. (2016). Farming, small-scale mining and rural livelihoods in Sub-Saharan Africa: A critical overview. *The Extractive Industries and Society*, 3(2), 547–563.
- Hilson, G., & Garforth, C. (2012). 'Agricultural Poverty' and the Expansion of Artisanal Mining in Sub-Saharan Africa: Experiences from Southwest Mali and Southeast Ghana. *Population Research and Policy Review*, 31, 435–464.
- Hilson, G., & Van Bockstael, S. V. (2012). Poverty and Livelihood Diversification in Rural Liberia: Exploring the Linkages between Artisanal Diamond Mining and Smallholder Rice Production. *The Journal of Development Studies*, 48(3), 413–428.
- Hilson, G., & Potter, C. (2005). Structural Adjustment and Subsistence Industry: Artisanal Gold Mining in Ghana. *Development and Change*, 36(1), 103–131.
- Hilson, G., Mondlane, S., Hilson, A., Arnall, A., & Laing, T. (2021). Formalizing artisanal and small-scale mining in Mozambique: Concerns, priorities, and challenges. *Resources Policy*, 71, 102001.
- Hilson, G., Sauerwein, T., Cardoso, M.E.G. 2021b. Small-Scale Mining, Rural Resilience and the Sustainable Development Goals in Sub-Saharan Africa. Handbook of Sustainable Politics and Economics of Natural Resources. S. Tsani. London, Edward Elgar Publishing.
- Hopkins, J., Kelly, V., Delgado, C. (1994). Farm-Nonfarm Linkages in the West African Semi-Arid Tropics: New Evidence from Niger and Senegal. Select paper presented at the 1994 AAEA Annual Meetings, 7–10 August 1994, San Diego.
- International Fund for Agricultural Development (IFAD). 2023. Republic of Mozambique Country strategic opportunities programme 2023–2027. International Fund for Agricultural Development (IFAD), Rome.
- International Labour Organization (ILO). (1999). *Social and labour issues in small-scale mines*. Geneva: International Labour Office.

- International Monetary Fund (IMF). (2020). *COVID-19: An Unprecedented Threat to Development*. International Monetary Fund, Washington DC: Regional Economic Outlook Sub-Saharan Africa.
- Kamlongera, P. (2011). Making the Poor 'Poorer' or alleviating poverty? Artisanal Mining Livelihoods in Rural Malawi. *Journal of International Development*, 23(8), 1128–1139.
- Legge, C. (1990). Small-scale mining: Making it work. *Appropriate Technology*, 17(2), 10–13.
- Mabe, F. N., Issifu, S., & Wongnaa, C. A. (2024). Farmers' coping strategies to artisanal small-scale mining activities: Welfare improvement or deterioration in Asutifi North District of Ghana? *Journal of Economics and Development*, 26(1), 50–66.
- Maconachie, R. (2011). Re-agrarianizing 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.
- Maconachie, R., & Binns, T. (2007). 'Farming miners' or 'mining farmers'? Diamond mining and rural development in post-conflict Sierra Leone. *Journal of Rural Studies*, 23(3), 367–380.
- Maconachie, R., & Hilson, G. (2018). 'The war whose bullets you don't see': Diamond digging, resilience and Ebola in Sierra Leone. *Journal of Rural Studies*, 61, 110–122.
- Mondlane, A.I. 2004. Floods and droughts in Mozambique – the paradoxical need of strategies for mitigation and coping with uncertainty, pp. 371-379, in Risk Analysis IV (ed. C.A. Brebbia), WIT Press, Ashurst.
- S. Mondlane D.S.M. Shoko G.M. Hilson A.A. Balkema The socio-economic and environmental impacts of artisanal and small-scale mining in Mozambique. In, The socio-economic impacts of artisanal and small-scale mining in developing countries 2003 Rotterdam 265 280.
- Nopeia, M., Mondlane, S., Takahashi, R., Jamal, D., Abdulgani, I., & Baptista, I. (2022). An integrated geoscience approach to effective formalization of artisanal mining in Mozambique: A case study of Namuno District, northeastern Mozambique. *The Extractive Industries and Society*, 11, 101098.
- Noetstaller, R. (1987). *Small-Scale Mining: A Review of the Issues*. Washington DC: The World Bank.
- Nunoo, I., Boansi, D., & Owusu, V. (2023). Does the use of cocoa farmlands for artisanal small-scale gold mining really increase household food insecurity? Evidence from Ghana. *Resources Policy*, 87, 104329.
- Ofosu, G., Dittmann, A., Sarpong, D., & Botchie, D. (2020). Socio-economic and environmental implications of Artisanal and Small-scale Mining (ASM) on agriculture and livelihoods. *Environmental Science & Policy*, 106, 210–220.
- Organization for Economic Cooperation and Development (OECD). (2018). *The Future of Rural Youth in Developing Countries: Tapping the Potential of Local Value Chains*. Development Centre Studies: OECD Publishing, Paris.
- Osumanu, I. K. (2020). Small-scale Mining and Livelihood Dynamics in North-eastern Ghana: Sustaining Rural Livelihoods in a Changing Environment. *Progress in Development Studies*, 20(3), 208–222.
- Pijpers, R. (2014). Crops and carats: Exploring the interconnectedness of mining and agriculture in Sub-Saharan Africa. *Futures*, 62, 32–39.
- Ponte, S. (2002). *Farmers and markets in Tanzania: Policy reforms and changing rural livelihoods*. London: James Currey Publishers.
- Republic of Sierra Leone. (2020). *Republic of Sierra Leone National Action Plan for Reducing Mercury Use in the Artisanal and Small-scale Gold Mining (ASGM) Sector in Sierra Leone*. Geneva: Republic of Sierra Leone and UN Environment Programme.
- Rutherford, B. (2020). The governance of artisanal and small-scale mining in Manica District, Mozambique: Implications for women's livelihoods. *Canadian Journal of African Studies*, 54(1), 139–156.
- Sarris, A., Shams, H. (1991). *Ghana under structural adjustment: The impact on agriculture and the rural poor*. New York: New York University Press.
- Scoones, I. (1998). *Sustainable Rural Livelihoods: A Framework for Analysis*. IDS Working Paper 72. Brighton: University of Sussex.
- Scoones, I. (2009). Livelihoods perspectives and rural development. *The Journal of Peasant Studies*, 36(1), 171–196.
- Simmons, R. K. (1978). *Mozambique: An Economic Base Study with Emphasis on Agriculture*. Washington DC: USAID.
- Sinha, S., Narain, N., & Bhanjdeo, A. (2022). Building back better? Resilience as wellbeing for rural migrant households in Bihar, India. *World Development*, 159, 106031.
- Smart, T., Hanlon, J. (2014a). Agricultural land is a Mozambican resource. The case for small commercial farmers. Paper presented at IV Conferência Internacional do IESE, 27–28 August, 2014.
- Smart, T., & Hanlon, J. (2014b). *Chickens and beer: A recipe for agricultural growth in Mozambique*. London: Bicycles+Development Ltd.
- Solesbury, W. (2003). *Sustainable Livelihoods: A Case Study of the Evolution of DFID Policy*. London: Overseas Development Institute.
- Spiegel, S. (2015). Shifting Formalization Policies and Recentralizing Power: The Case of Zimbabwe's Artisanal Gold Mining Sector. *Society & Natural Resources*, 28(5), 543–558.
- Stewart, D. F. (1989). Large-scale vs small-scale mining: Meeting the needs of developing countries. *Natural Resources Forum*, 13(1), 44–52.
- Sumberg, J., Flynn, J., Oosterom, M., Yeboah, T., Crossouard, B., Thorsen, D. (2021). African Youth and the Rural Economy: Points of Departure. In J. Sumberg (Ed.), *Youth and the Rural Economy in Africa: Hard Work and Hazard* (pp. 1–22). Wallingford: CAB International.
- Tanner, C. 2010. Land rights and enclosures: Implementing the Mozambican land law in practice, pp. 105-130, in The struggle for land in Africa: conflict, politics and change (eds. W. Anseuw and C. Alden), HSRC Press, Cape Town.
- Traoré, M., Hilson, G., & Hilson, A. (2024). Reimagining entrepreneurship in the artisanal and small-scale mining sector: Fresh insights from sub-Saharan Africa. *Africa Journal of Management*, 10(2), 176–207.
- Tychsen, J., Batista, M. J., & Carvalho, J. (2022). *Artisanal and Small-Scale Mining Handbook for Southern Africa Region*. Copenhagen, Denmark and Geological Survey of Portugal, Lisbon: Geological Survey of Denmark and Greenland.
- United Nations Department of Economic and Social Affairs (UNDESA). 2003 *Poverty Eradication & Sustainable Livelihoods: Focusing on Artisanal Mining Communities*. SPPD Project RAF/99/023, United Nations Department of Economic and Social Affairs (UNDESA), New York.
- University of Zambeze and Mining Development Fund. (2012). *The Problems of Artisanal Gold Mining in Manica Province*. Beira: University of Zambeze.
- Usaid. (2017). *Feed the Future Mozambique Agricultural Innovations Activity (FTF Inova): Manica-Sofala Rapid Market Assessment*. Washington DC: USAID.
- Van Bockstael, S. (2014). The persistence of informality: Perspectives on the future of artisanal mining in Liberia. *Futures*, 62, 10–20.
- Wels, T. A. (1983). Small-scale mining – The forgotten partner. *Transactions of the Institution of Mining and Metallurgy*, 92(1), A19–A27.
- Werthmann, K. 2008. "Frivolous squandering": Consumption and redistribution in mining camps, pp. 60-76, in "Frivolous squandering": Consumption and redistribution in mining camps (eds, G.J. Abbink and A. van Dokkum), African Studies Centre, Leiden.
- World Bank. (2021). *Vulnerability, Risk Reduction, and Adaptation to Climate Change: Mozambique*. The World Bank, Washington DC: Climate Risk and Adaptation Country Profile.
- World Bank. (2024). *Agriculture Support Policy Review Realigning Agriculture Support Policies and Programs Assessment of Government Support to Agriculture (2019–2022)*. Washington DC: The World Bank.
- World Food Program. (2022). *Mozambique Country Strategic Plan (2022–2026)*. World Food Program, Rome: Country Strategic Plan.