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A policy and practice divide? Zambia's artisanal and small-scale mining sector and the Sustainable Development Goals

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ABSTRACT

Zambia continues to promote resource-based development through mineral exploration and exploitation. Whilst expanding copper production remains a top priority, recent Government announcements have signalled an intent to diversify export revenue by scaling-up exploitation of other minerals (e.g. gemstones, manganese, gold). The development of its artisanal and small-scale mining (ASM) sector has been pinpointed as a strategy to do so. This paper investigates, firstly, whether Zambia's policy ambitions for the sector are, in theory, compatible with achieving the Sustainable Development Goals (SDGs); and secondly, to what extent it has, in practice, achieved progress. An original framework was developed to map Zambia's ASM-related policies to the SDGs. We find that, on paper, the ASM policy framework is compatible with most SDGs. However, an overemphasis on large-scale mining and economic growth persists, whilst other positive socioeconomic and environmental synergies are missed. Additionally, a new sector bias has emerged towards artisanal and small-scale *gold* mining, with less attention paid to other minerals in the policy framework. The findings also reveal that some policies with high social impact potential have, so far, been inadequately implemented. Consequently, issues relating to availability and accessibility of finance, inadequate equipment and training, unsafe mining conditions, gender and child labour concerns, as well as poor environmental performance, persist. The study concludes that Zambia's ASM sector is still far from achieving the SDGs and reiterates the need for targeted policies that foster socioeconomic transformation of the sector.

1. Introduction

Artisanal and small-scale mining (ASM) – the low-tech, labour-intensive processing and extraction of minerals (Hilson, 2009) – is a critical sub-sector of the mining industry. Globally, ASM is a vital source of minerals and metals, including gold, gemstones, copper, lithium, and cobalt (de Haan et al., 2020). For Africa, evidence suggests that the sector has become the continent's most important rural, non-agricultural economic activity, providing livelihoods for 60 million individuals in at least 40 of its 54 countries (Hilson and Maconachie, 2020; The World Bank, 2019a). Despite ASM's global and regional significance, research reveals a paradox: the sector has, in many instances, failed to deliver transformative widespread social, economic, and environmental benefits (Gibb and O'Leary, 2014; de Haan et al., 2020). These revelations have triggered governments' attention towards ASM, with policymakers recognising the sector's potential and, in turn, increasingly incorporating it into policies (Hilson, 2020). This has emerged in the Republic of Zambia (hereafter "Zambia"), which is the focus of this paper.

Zambia is rich in natural resources. Accordingly, mining is a major sector in Zambia and is highly important to the country's economy: in 2022, it contributed 11.1 % to GDP and accounted for 79.5 % of export revenues (MMMD, 2024). However, for close to a century, large-scale copper mining has dominated the economic landscape and overshadowed the exploitation of other minerals, such as gemstones, manganese, and gold (Banda, 2022; Cervantes Barron et al., 2024). Meanwhile, ASM is estimated to provide a direct source of livelihood for over 500,000 people, and produces a variety of minerals such as copper, gold, cobalt, manganese, and the so-called 3Ts (tungsten, tin, tantalum) (AMDC, 2017; Wakiaga and Gankhuyag, 2024).

To diversify its exports and build economic resilience, the Zambian government has indicated its ambitions to promote the exploration and

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exploitation of minerals beyond copper in its Eighth National Development Plan (8NDP), including through the development of its ASM sector (MFNP, 2022).

This paper analyses Zambia's ambitions to expand and diversify its mineral production through ASM. It aims to ascertain whether Zambia's policy ambitions for the sector are, in theory, compatible with achieving the UN Sustainable Development Goals (SDGs) and to what extent the approach has, in practice, achieved progress. The research is guided by the following research questions: (1) To what extent can ASM contribute to Zambia's progress towards the SDGs?; (2) Does the current ASM policy framework facilitate such progress?; and (3) Under the current policy framework, how much progress has been made to support a more sustainable and equitable ASM sector, and what more could be done? This study introduces a novel SDG mapping framework and applies it to Zambia, thereby providing a theoretical and empirical contribution to literature on ASM.

The rest of the paper is structured as follows. Section 2 reviews the academic literature relating to ASM, Section 3 details the methodology, Section 4 presents the results and analysis, and Section 5 summarises the conclusions.

2. Literature review

'ASM' typically refers to low-tech, labour-intensive mineral processing and extraction driven by poverty and undertaken by individuals, groups, or cooperatives in remote areas (Hilson, 2009; Hentschel et al., 2003). This is despite the term encompassing two distinct practices with unique characteristics. 'Artisanal' mining is often characterised by informality and manual labour, and is practised by individuals or small groups; whereas 'small-scale' mining tends to be formal, semi-mechanised, and usually governed by similar rules to large-scale mining (AMDC, 2017). These nuances are under-explored in the literature and policy, which tend to conflate these terms or use them interchangeably. For pragmatism, this paper uses the collective term 'ASM'.

Notwithstanding these conceptual nuances, ASM is distinguished from large-scale mining (LSM), which is typically capital-intensive, mechanised, and export-focused with fully licensed operations (Hilson and Maconachie, 2020).

2.1. Socio-economic, health, and environmental impacts of ASM

Historically, the discourse surrounding ASM has focused on the negative impacts of the sector, particularly its social and environmental issues. The former includes a prevalence of child labour (O'Driscoll, 2017; Hilson, 2010; Mvile and Bishoge, 2024), injury (Schwartz et al., 2021; Omotehinse and Ogunlade, 2022), exposure to toxic substances (Rwiza et al., 2023), and gender inequality (Buss et al., 2019; Weldegiorgis et al., 2018; Blair et al., 2017). The ecological costs of ASM activities are also well-documented, and include deforestation and land degradation, riverbed disruption, and chemical pollution (Swenson et al., 2011; Caballero Espejo et al., 2018; Sonter et al., 2018; Veiga et al., 2014). These environmental impacts have effects on socio-economic outcomes and health, although this topic is less well-researched (Hirons, 2020; Laing and Moonsammy, 2021).

Some scholars suggest that these negative impacts link to an 'ASM poverty trap' (Hilson and Pardie, 2006; Kumah et al., 2020; Schwartz et al., 2021), in which poor mining practices worsen the environmental impacts and undermine the health and wellbeing of communities. Consequently, miners are unable to enhance their working conditions or pursue other livelihoods and education, thus perpetuating a cycle of poverty (de Haan et al., 2020; Hilson and Pardie, 2006; Kumah et al., 2020). The ASM literature also highlights gendered manifestations of this phenomenon, where the sector's failures to address the marginalisation of women perpetuates gender inequality and poverty (Mvile and Bishoge, 2024). For instance, women are typically confined to peripheral and less desirable roles in ASM – such as panning, transportation, or processing of minerals – which limits their access to income and knowledge, whilst exposing them to increased health risks through the handling of dangerous chemicals (de Haan et al., 2020). These dynamics often prevent women from making meaningful financial gains in the sector, reduce their opportunities to build expertise, and leave them largely excluded from decision-making and leadership roles (Buss et al., 2019; Weldegiorgis et al., 2018; Hinton et al., 2003).

There has been a "prolonged neglect" of ASM by policymakers and donors, which Hilson and Maconachie (2020) suggest has contributed to these dominant negative narratives (p. 126). This neglect may stem from a bias towards LSM (Hilson, 2019; Hamango et al., 2023). Hilson (2019) describes this bias as the continual implementation by governments and donors of economic strategies which emphasise LSM development, and which are driven by an increase in demand for mining as well as revenue extraction. The bias towards LSM may link to ASM's informality, as large-scale land acquisitions by mining companies have left prospective ASM licensees with limited land to carry out mining activities (Hilson and Maconachie, 2020; Sauerwein, 2023; Lange, 2006; Patel et al., 2016; Hilson, 2019). This is often compounded by bureaucratic and costly licensing procedures that disincentivise ASM miners to register and formally operate (Hilson and Maconachie, 2020).

Amidst the literature highlighting the negative aspects of and challenges facing ASM, there is also growing recognition of its positive contributions. Research points to its importance for socio-economic development as ASM activities can help to alleviate poverty; diversify rural livelihoods; and finance education, agriculture, and entrepreneurship (Cartier and Bürge, 2011; Hilson and McQuilken, 2014; Franks et al., 2016; Barreto et al., 2018; Ofosu and Sarpong, 2022; Tschakert, 2009). However, knowledge gaps remain: for example, details of the sector's organisational structures, its supply chains, and the basic demographics of those engaged in ASM activities are limited (McQuilken and Hilson, 2018; Schwartz et al., 2021). As such, it has been argued that ASM is one of the most poorly studied sectors in the Global South (The World Bank, 2019a).

2.2. Formalisation

ASM scholarship and policymaking are dominated by the topic of formalisation, which is often presented as a 'magic bullet' for solving many of the sector's challenges (Siwale and Siwale, 2017). Formalisation has taken on various conceptualisations (Ofosu and Sarpong, 2022; see McKay, 2025). Some perspectives view formalisation as simply 'legalisation', meaning efforts to integrate ASM into top-down legal frameworks through licensing regimes (Hirons, 2020; Siwale and Siwale, 2017). However, purely legalistic formalisation efforts have often been unsuccessful (Bester, 2023). For example, efforts to legalise ASM and the "hasty enactment of licensing systems" across 36 African countries in the 1990s failed to consider ASM miners' needs (Hilson and McQuilken, 2014, p. 111). Instead, these superimposed interventions created a system of 'legal' and 'illegal' ASM and prioritised LSM activities which, as mentioned above, has disincentivised the uptake of ASM licenses and contributed to the increase in informal ASM in recent years (ibid., p. 112; Hilson and Maconachie, 2020).

In response to these unsuccessful attempts at formalisation, some scholars have more recently argued for the overhaul of existing, top-down formalisation frameworks, and instead advocate for bottom-up, participatory, and inclusive approaches that are context-specific, actively engage local communities, and respond to their needs (Verbrugge and Besmanos, 2016; Hilson et al., 2017; Hilson and Maconachie, 2020; Hirons, 2020; Singo and Seguin, 2018; McKay, 2025). Proponents present this alternative, inclusive conceptualisation of ASM formalisation as key to addressing the sector's problems (Bester, 2023). For example, de Haan et al. (2020) map ASM onto the SDGs in both its informal and formal states, suggesting that *all* the sector's negative impacts on the SDGs can be alleviated through formalisation that is "comprehensive, inclusive and anchored on a bottom-up, human

Table 1
Literature on ASM and select SDGs.

SDG	Literature	Identified links
1 (No Poverty)	Hilson and Maconachie (2020)	• Highlights positive potential linkages due to ASM's contribution to job creation and subsequent economic benefits.
	Hirons (2020)	• Identifies that ASM creates livelihood opportunities for people with few alternative employment prospects.
2 (Zero Hunger)	Hilson and Maconachie (2020)	• Asserts ASM and agriculture are intrinsically connected, with the former supporting the latter through its ability to generate supplementary income and improve food security. • Individuals tend to be involved in both activities which 'dovetail' one another.
5 (Gender Equality)	Hilson and Maconachie (2020)	• Identifies that women's involvement in ASM has enabled them to overcome barriers in access to capital, access to land, and food production, therefore, contributing to a sense of empowerment. This is despite their typical confinement to peripheral roles in the sector.
	Yakovleva et al. (2022)	• Highlights that ASM creates employment opportunities for women which has a multiplier effect: women can invest their income into their children's education, agriculture, and entrepreneurship. • However, women still face issues in relation to gendered divisions of labour, lack of decision-making capacity, lower wages, and gendered environmental and social impacts, such as health issues and gender-based violence. These issues are magnified in the informal ASM sector.
8 (Decent Work and Economic Growth)	Hilson (2021)	• Identifies three priority areas for governments to facilitate progress towards SDG 8: managing mercury use through flexible policies; developing context-specific guidelines for work practices; and investing in technical, financial, and operational support for ASM miners.
15 (Life on Land)	Dales and Cordy (2021)	• Argue the deficits in financial and human capital in ASM exacerbate the issue of resource and land degradation.
Most SDGs	Clifford (2022) (excluding SDGs 7, 9, 11, 16 and 17)	• Most SDGs have either a weak, harmful, or non-existent relationship with ASM, with the only potentially positive relationship being with SDG 8 on Decent Work and Economic Growth.
	Laing and Moonsammy (2021)	• Map the direct and indirect impacts of ASM to all SDGs, bar SDG 17. • The positive impacts of ASM arise in those SDGs related to economic activity and poverty; the negative effects arise in categories relating to health and environment; whilst those relating to hunger and work could occur in both directions.

rights-based approach" (p. v). Some countries across Sub-Saharan Africa are starting to adopt such processes, such as Sierra Leone and in eastern Democratic Republic of Congo (de Haan, 2021). As McKay (2025) concludes, however, the outcomes of this conceptualisation of ASM formalisation are yet to be determined.

2.3. The SDGs and ASM

The UN SDGs framework does not include an explicit goal on mineral extraction. However, given the mining sector's interplay with social, economic, and environmental issues, experts have drawn linkages with the SDGs (UNDP, 2016; Mbilima, 2021; Ofosu and Sarpong, 2022). For example, Mvile and Bishoge (2024) comment that the sector has the "exceptional ability to contribute to several goals at the same time" (p.13). As a sub-sector, ASM also links to multiple SDGs. Some authors have attempted to map ASM onto select SDGs, detailed in Table 1. Others have focussed on just artisanal and small-scale *gold* mining (ASGM); for example, Lara-Rodriguez and Fritz (2023). Meanwhile, De Haan et al.'s (2020) comprehensive study mapped the sector across all 17 SDGs, contending that, even in its informal state, ASM positively contributes to most SDGs.

Whilst most of these authors present the connections between ASM and the SDGs as logical, Clifford (2022) disagrees, going as far as to argue that "ASM cannot contribute in any meaningful way towards the SDGs by 2030" nor "towards sustainable development more widely in the future" (p. 164). Meanwhile, Laing and Moonsammy (2021) contend that a crucial area for further research is to identify where policy interventions in ASM may affect its positive and negative impacts on the SDGs. This paper contributes to addressing this research gap. It also provides a comprehensive review of Zambia's ASM policy and sector in relation to its progress towards the SDGs which, to date, is missing in the literature.

2.4. ASM in Zambia

Large-scale copper mining has dominated Zambia's economic landscape since the early 1930s (Dreschler, 2001). Importantly, ASM in Zambia also dates back to this period, when emerald deposits were discovered in Ndola, Copperbelt Province, in 1931. ASM activities in Ndola remained unlicenced until 1984, when the area first became subject to formal licensing (ibid.). However, as highlighted by Siwale and Siwale (2017), these early attempts at formalisation have often been interpreted as government strategies aimed more at displacing informal miners and gaining control of mineral-rich areas, rather than genuinely supporting and developing the sub-sector.

At the time of writing, ASM was formally recognised under the Mines and Minerals Development Act (MMDA) 2015.[1] The MMDA provided licensing arrangements for ASM miners through two categories: Artisanal Mining Rights, reserved for Zambian nationals only, and Small-Scale Mining Licenses, available to citizen-owned, citizen-influenced or citizen-empowered companies only (GRZ, 2015).

As of 2022, there were 4246 active licenses in Zambia, with the majority being for large-scale activities. Only 14 % were Artisanal Mining Rights and 11 % were for small-scale operations (Zambia EITI, 2023). Gemstones have traditionally dominated ASM in Zambia, however, the sub-sector also extracts copper, cobalt, manganese, gold, the 3Ts (tungsten, tin, tantalum), and other minerals (Wakiaga and Gankhuyag, 2024). Whilst data are difficult to obtain, estimates suggest that ASM provides livelihoods for over 500,000 Zambians (AMDC, 2017).

3. Material and methods

To understand the ASM landscape in Zambia, an exploratory research approach was adopted, which comprised two main components. Firstly, an in-depth analysis and mapping of Zambia's ASM policy regime and, secondly, an exploration of the current state of Zambia's ASM sector. The first component primarily relied on policy document review and analysis, whilst the second used a combination of document analysis, semi-structured interviews, and a workshop in Zambia. These are described in greater detail below.

3.1. Mapping ASM and the SDGs

The first component of this study involved an extensive mapping

[1] Since the research was conducted, the Mines and Minerals Development Act 2015 has been repealed and replaced by the Minerals Regulation Commission Act 2024. A key amendment is the allowance for Artisanal Mining Right holders to enter into joint ventures with foreign investors (GRZ, 2024).

Table 2
Overview of identified policies and legislations.

Type	Name	Year(s) incl. key amendments	Mention of ASM?	Included in mapping exercise?
Policy	*National Critical Minerals Strategy 2024-2028*	2024	Yes	No
Policy	*National Green Growth Strategy*	2024	Yes	No
Policy	*National Three Million Tonnes Copper Production Strategy*	2024	Yes	No
Policy	*Revised National Micro Small and Medium Enterprise Development Policy*	2023	No	No
Policy	*Eighth National Development Plan*	2022	Yes	Yes
Legislation - Act	*Environmental Management Act*	2011, 2023	No	No
Legislation - Act	*Investment, Trade and Business Development Act No.18*	2022	No	No
Legislation - Act	*Zambia Development Agency Act No.17*	2022	No	No
Policy	*National Minerals Development Policy*	2022	Yes	Yes
Policy	*The National Action Plan for Artisanal and Small-Scale Gold Mining*	2020	Yes	Yes
Policy	*The Export Diversification Strategy for Gold and Gemstones*	2020	Yes	Yes
Legislation - Act	*Mines and Minerals Development Act*	2015, 2016, 2019, 2022	Yes	No
Legislation - Act	*The Minerals Regulations Commission Act*[a]	2024	Yes	No
Legislation - Act	*The Geological Minerals Development Act*[a]	2025	Yes	No
Legislation - Act	*Occupational Health and Safety Act*	2010	No	No
Legislation - SI	*Environmental Management Licensing Regulations No.112*	2013	No	No
Legislation – Act	*The Co-Operative Societies Act*	1998	No	No
Legislation - SI	*Environmental Impact Assessment No.28*	1997	No	No

[a] This Act was enacted after the analysis was conducted.

exercise to shed light on the potential contribution of Zambia's ASM sector to the SDGs under the current policy regime. The SDGs were chosen as an analytical framework due to their all-encompassing nature and prominence in Zambia's policy pronouncements (MNDP, 2020). Several previous studies helped to inform the mapping process (de Haan et al., 2020; Hilson and Maconachie, 2020; Siaciti and Masinja, 2022; Laing and Moonsammy, 2021; Bisaga et al., 2021 & Mancini et al., 2019). However, this is the first such exercise to be conducted on Zambia's ASM sector, so experimentation was necessary throughout.

There is no standalone ASM policy in Zambia, so the data collection for the mapping process consisted of identifying and reviewing relevant publicly available government policies (Table 2). As illustrated in Table 2, the Mines and Minerals Development Act, Minerals Regulation Commission Act,[2] Geological Minerals Development Act,[3] National Green Growth Strategy (NGGS), National Critical Minerals Strategy (NCMS), and National Three Million Tonnes Copper Production Strategy (NTMTCPS) were excluded from the policy mapping despite their inclusion of ASM. The Acts were excluded due to being legal, rather than policy, documents. While legislation is central to the formal governance of the ASM sector, this study focuses specifically on policy-level articulation of ASM. The NGGS and NCMS were excluded due to containing only limited references to ASM and, given the research focuses on non-copper ASM, the NTMTCPS was excluded due to its sole focus on copper. Therefore, the final selection of policy documents for review, and which therefore constituted the 'ASM policy framework', for this study include:

1. The Eighth National Development Plan (8NDP) (2022–2026) (MFNP, 2022)
2. The National Mineral Resources Development Policy (NMRDP) (2022) (MMMD, 2022c)
3. The Export Diversification Strategy for Gold and Gemstones (EDSGG) (2020) (MCTI, 2020)
4. The National Action Plan for Artisanal and Small-Scale Gold Mining (NAP) (2020) (ZEMA, 2021)

Before mapping these documents, the SDG Goals and Targets that can be reasonably interpreted as of limited relevance in this context were excluded. SDG 14 (Life Below Water) was excluded as it has been nationally agreed that it does not apply to Zambia as a landlocked country (UN Zambia, 2017). The decision was also made to exclude the Means of Implementation (MoI) Targets[4] and only focus on the Outcome Targets[5] given that the mapping focused on the policy objectives and interventions rather than implementation strategies. The remaining Goals and Targets were then selected based on a review of de Haan et al.'s (2020) SDG-ASM assessment and determining which SDG Targets the report alluded to and specifically highlighted. This process resulted in the selection of 16 Goals and 68 Targets (see Fig. 1).

A thematic analysis was then carried out to identify the relevant policy objectives and associated interventions outlined within the policy documents. The policy documents contained policy objectives, policy strategies, and policy interventions (read collectively as a 'policy') which were either explicit within the policy or were identified through interpretation of the policy narrative. Therefore, there was an interpretive aspect to this policy analysis which, Bouma et al. (2019) argue, is inevitable due to there being "no universal rule to define and demarcate a single instrument or objective" (p. 35).

Each policy was then cross-referenced with each Target and mapped using Excel. Based on the degree of alignment or conflict between the policy and the Target, the policy was given a point and colour. This coding system assigned each policy to one of four categories:

- direct alignment (dark green),
- indirect alignment (light green),
- indirect conflict (light red), or
- direct conflict (dark red).

This approach aligns with the SDG Impact Assessment Tool method (GMV, 2020). The definitions of these categories are summarised in Table 3 below.

The analysis was performed by the lead author and then, to improve reliability, one of the co-authors reviewed the analysis. This was followed by a discussion amongst the authors to reduce the risk of misinterpreting the policies and their linkages to the SDGs.

The result of this process was an Excel document consisting of over 2000 rows that mapped 36 policy objectives – encompassing 62 interventions and 125 associated strategies – across the 68 SDG Targets. The full results of this mapping exercise can be viewed in Appendix A (A.1).

Following this analysis, cumulative scores for each SDG and policy document were calculated to gauge each policy's overall relationship with a particular SDG. These scores were then standardised, aggregated,

[2] This Act was enacted after the research was conducted. It repeals the Mines and Minerals Development Act 2015, which was originally analysed.
[3] This Act was enacted after the research was conducted.
[4] Those Targets with letter designations.
[5] Those Targets with number designations.

Fig. 1. Selected Goals and Targets relevant to Zambia's ASM sector.
Source: Authors' own. The selected Targets are highlighted in green.

and graphically represented in a matrix (Fig. 2). The matrix provides an overview of the various interactions between Zambia's ASM policy framework and the SDGs, showcasing the potential synergies, trade-offs, and gaps within the landscape and providing an analytical foundation to inform the subsequent interviews and workshop.

3.2. Semi-structured interviews and workshop

Interviews were conducted to supplement the secondary data, and to gain unique insights that would be difficult to obtain through other methods. Semi-structured interviews were conducted in two phases. Phase one interviews focused on contextual understandings of Zambia's ASM landscape and the practical implementation of the ASM policy approach. Phase two also examined this whilst including additional questions that sought to ascertain feedback on the mapping results (Section 4.1.2). The aim of this additional dimension was to enable participants to reflect on the gaps between the mapping results and the reality of Zambia's ASM sector.

After receiving relevant ethical approvals, potential participants were identified using a purposive sampling approach (Bryman, 2016). The sample were identified based on the following inclusion criteria:

- Expertise in Zambia's ASM sector;
- Affiliated with a Zambian mining association, think tank, university, civil society organisation, or development organisation present in Zambia; and
- Willingness to participate voluntarily, over Teams/Zoom, and within the given timeframe.

Potential participants were contacted and provided with the participant information sheet, with the opportunity to voluntarily agree to participate in the study.

Six interviews were conducted in August 2023 and a further six beginning in July 2024 once the mapping had been finalised. Phase one interviews were centred on Zambia's ASM sector only, whilst phase two also asked for feedback on the mapping exercise. Each interview lasted between 60 and 80 min.

The interviews were transcribed and pseudoanonymised, and participant numbers (P1-12) were used. Table 4 summarises key information about the participants.

Subsequently, a thematic coding process was undertaken using NVivo software to systematically analyse the data. Themes were identified relating to socio-economic factors, environmental issues, and governance, and contained several sub-themes.

In November 2024, a validation workshop was conducted in Lusaka, Zambia, to present the findings and improve reliability by obtaining stakeholder feedback. The workshop was attended by some of the original interviewees, as well as additional government, NGO, and private-sector stakeholders involved in ASM in Zambia. During the workshop, the study's initial results of the study were presented. Guiding questions were developed to prompt attendees to reflect on the results of the mapping exercise, as well as the emergent themes from the

Table 3
Definitions of alignment and conflict categories in the mapping exercise.

	Definition	Example from analysis
Direct alignment	1. An ASM-dedicated policy document; AND 2. The policy[a] has clear reference to the SDG Target being assessed/has a one-step effect on the Target OR 1. Not an ASM-dedicated policy document; AND 2. The policy[a] has clear reference to ASM; AND 3. The policy[a] can be clearly linked to/interpreted as reasonably linked to the SDG Target being assessed/has a one-step effect on the Target	**SDG Target**: SDG 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters **Policy**: NAP for ASGM **Objective**: To increase the percentage of formalised groups of ASGM miners in all gold mineralised areas from the current 2 % to 50 % by 2030 **Strategy**: Facilitate formation of miners' organisations **Interventions**: Establish 100 viable ASGM cooperatives; Provide training on governance and business administration, mining technical services, safety, health and environment to ASGM cooperatives and individuals; Establish a national association of ASGM miners with the support of the ministry responsible for mining; Organize and facilitate participation of ASGM players in local, regional and international workshops/conference/exhibitions on ASGM activities. OR **Policy**: 8NDP **Objective**: An industrialised and diversified economy: Promote Traditional and Non-Traditional Minerals **Strategy**: Tap into regional and global markets and value chains by encouraging local beneficiation, participation, and value addition to minerals **Interventions**: Programmes: Mineral and petroleum exploration and exploitation; Mineral tax and mining reforms; Mineral beneficiation and value-addition; ASM development
Indirect alignment	1. Any policy document (dedicated or undedicated to ASM); AND 2. The policy[a] does not have clear reference to the SDG Target being assessed; AND 3. There is an implicit connection between the policy and Target/the policy[a] has a secondary effect on the Target further down a chain of events	**SDG Target**: SDG 2.2: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. **Policy**: NMRDP **Objective**: Facilitate the development and growth of the ASM sub-sector to enhance its contribution to economic development and wealth creation **Strategy**: Facilitate access to modern technologies and markets **Interventions**: N/A **Reasoning**: Supporting ASM can lead to dual income and additional capital from ASM which can be used to pay for seeds, fertilisers, and equipment for agriculture. This enhances productivity and generates income to purchase sufficient food for families and dependents (de Haan et al., 2020)
Direct conflict	1. Any policy document; AND 2. The policy[a] has a one-step or clear counter-effect on the SDG Target.	**SDG Target**: SDG 12.2: By 2030, achieve the sustainable management and efficient use of natural resources **Policy**: 8NDP **Objective**: An industrialised and diversified economy: Promote Traditional and Non-Traditional Minerals **Strategy**: Open new mines and increase production in existing ones, with the aim of increasing copper production to 3 million metric tonnes by 2032. **Interventions**: Programmes: Mineral and petroleum exploration and exploitation; Mineral tax and mining reforms; Mineral beneficiation and value-addition; ASM development.
Indirect conflict	1. Any policy document; AND 2. The policy[a] has a secondary or unintended counter-effect on the SDG Target further down a chain of events.	**SDG Target**: SDG 8.4: Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead **Policy**: EDS for G&G **Strategy**: To improve the production capacity of artisanal and small-scale miners **Interventions**: Provide geological information to small-scale gold and gemstone miners **Actions**: MMMD to disseminate geological information in a simplified manner to artisanal and small-scale gold and gemstone miners **Reasoning:** Providing geological information to ASM miners could increase mining and its harmful effects; regulated/geologically-informed mining may mitigate some of this (Hilson and Maponga, 2004). Indirect due to chain of events.

[a] Whether the policy objective, policy strategy, and/or policy intervention(s).

policy review and interview data. These additional insights were captured through comprehensive notetaking, and then integrated into the final results and analysis.

3.3. Study limitations

There are some methodological limitations worthy of noting. Firstly, both the study's context (Zambia's ASM sector) and method (policy mapping) are inherently complex, so the mapping process was an ambitious and challenging task (Grainger-Brown and Malekpour, 2019). The decision to manually conduct the mapping analysis was taken to capture the nuances and complexities of the policy framework, involving a level of unavoidable subjectivity which should be acknowledged (Guyadeen and Seasons, 2016). However, measures were taken to minimise subjectivity and improve reliability. For example, co-authors reviewed and discussed the analyses, and literature was used

Fig. 2. SDG-ASM policy matrix for Zambia.
Source: Authors' own.

to support the decisions to assign indirect classifications.

Secondly, twelve individuals were interviewed, so the sample size means not all viewpoints may have been captured, which affects the generalisability of the findings (Bryman, 2016). The small sample of interviewees can be attributed to the limited number of experts in Zambian ASM. However, a benefit of this was that it allowed for a deeper, case-oriented study (Onwuegbuzie and Collins, 2007).

Table 4
Summary of interview participants.

Interview Phase	Interviewee	Type of Organisation/Profession
1	Participant 1 (P1)	Technical Expert
	Participant 2 (P2)	Think Tank
	Participant 3 (P3)	Think Tank
	Participant 4 (P4)	Think Tank
	Participant 5 (P5)	Academic & Technical Expert
	Participant 6 (P6)	Technical Expert
2	Participant 7 (P7)	ASM Miner
	Participant 8 (P8)	ASM Miner
	Participant 9 (P9)	ASM Miner
	Participant 10 (P10)	Civil Society Organisation
	Participant 11 (P11)	Non-Governmental Organisation
	Participant 12 (P12)	International Organisation

Finally, there may be some limitations associated with the results and analysis. The findings discuss ASM's relationship with the SDGs at a high-level, and detailed analyses at the mineral- or district-specific levels were beyond the scope of this research. Nevertheless, the insights provided can serve as a foundation for future, more targeted studies aimed at addressing community-specific needs across Zambia's ASM sector.

4. Results and analysis

This Section presents the results from the ASM-SDG policy mapping exercise and the interviews. It aims to provide a comprehensive overview as to how Zambia's ASM policies interact with the SDGs and to assess the extent to which these policies are being realised in practice.

4.1. The ASM-SDG policy matrix

4.1.1. Interpreting the matrix

The matrix in Fig. 2 visually represents the relationships between Zambia's ASM policy framework and the SDG framework. The following points offer some guidance on how to interpret the matrix and use it to analyse Zambia's ASM policy framework in the context of the SDGs:

1. A block of four cells corresponds to a specific SDG-ASM policy combination (for example, the top left block depicts the relationship between SDG 1 and the 8NDP);
2. Within a block, each cell represents a different category of interaction between an SDG and policy document: direct alignment between the SDG and policy (top-left), indirect alignment (top-right), direct conflict (bottom-left), and indirect conflict (bottom-right);
3. The inner part of the matrix with bold-coloured blocks shows: a) Four columns with scores for each policy document across all sixteen SDGs; b) Sixteen rows with scores for each SDG across all four policy documents; c) Direct and indirect alignment category scores ranging from 0 to 75 and 0 to 305, respectively; and d) Direct and indirect conflict scores ranging from 0 to 40 and 0 to 90; and
4. The outer right column and bottom row of the matrix with faded-coloured blocks show the aggregated scores for individual SDGs and individual policy documents, respectively.

The matrix provides for various levels of analysis. Firstly, in the inner part of the matrix, each block can be analysed to show how a particular policy interacts with a particular SDG. Secondly, in the inner part of the matrix, an entire row can be read to compare how all policy documents interact with a particular SDG. Thirdly, in the inner part of the matrix, an entire column can be read to assess how a particular policy document interacts across all the SDGs. Fourthly, in the aggregated scores in the outer right column, each block can be analysed to indicate the overall ASM policy framework's alignment with a particular SDG. Finally, in the aggregated scores in the bottom row, each block can be read to indicate

Table 5
Summary of results.

SDG	ASM Policy Expectations	Reality of ASM
SDG 1: No poverty	Access to finance, markets, skills, services, and technologies will empower ASM communities and improve their livelihoods.	Government emphasis on revenue capture with limited bottom-up efforts perpetuates the poverty cycle for ASM miners.
SDG 2: Zero hunger	Access to finance, skills, and markets could indirectly improve food security and agricultural productivity.	The lack of rehabilitation of ASM sites and the increasing commercialisation of ASM have raised concerns about the sector's potential to displace agriculture.
SDG 3: Good health and wellbeing	A mercury-free ASGM sector, and ASM communities with access to healthcare services.	The use of chemicals (e.g. mercury) and communicable diseases in ASM sites are prevalent. Access to healthcare facilities is limited in rural ASM communities.
SDG 4: Quality education	Access to finance, skills, and markets and the formation of cooperatives could indirectly provide access to education.	ASM communities lack education due to child labour in mining sites, poor access to schools, and mining not being on the national curriculum.
SDG 5: Gender equality	Increased female participation in ASM.	Social and cultural norms continue to hamper women's full inclusion.
SDG 6: Clean water and sanitation	The gradual phasing out of mercury in ASGM will lead to safe and affordable drinking water and improve water quality.	The use of mercury in ASGM remains prevalent and, therefore, continues to contaminate water sources.
SDG 7: Affordable and clean energy	Access to finance, skills, and markets could indirectly help by providing income to re-invest in energy access.	*Not enough data.*
SDG 8: Decent work and economic growth	A diversified and inclusive sector that is comprised of formalised, skilled, and productive ASM miners who have adopted modern technologies, best practices, and decent labour standards.	Informality, child labour, unsafe conditions and exploitation are prevalent.
SDG 9: Industry, innovation and infrastructure	A supported ASM sector with increased participation, infrastructure improvements, improved production capacity, and access to value chains and markets.	*Not enough data.*
SDG 10: Reduced inequalities	Prosperous and inclusive local operations that provide jobs, income, and skills development for *all* ASM miners.	LSM is prioritised in the licensing process, which is costly, arduous, and inaccessible. Women are excluded from ASM and exploitation occurs.
SDG 11: Sustainable cities and communities	Access to finance, skills, and markets could indirectly help by providing income and critical materials for affordable and resilient housing.	*Not enough data.*
SDG 12: Responsible production and consumption	Access to geological knowledge and regulatory enforcement could prevent aimless mining, land degradation, and chemical use.	Chemical use and discharge (e.g. mercury) is widespread in ASGM. Geological information is practically non-existent for ASM miners who continue to degrade land in search of minerals.
SDG 13: Climate action	Access to finance, skills, and markets could indirectly help by strengthening resilience and adaptive capacity of rural communities.	*Not enough data.*
SDG 15: Life of land	Delineation of ASM sites, elimination of mercury, and skills development will prevent the destruction of the natural environment. ASM sites will be rehabilitated and remediated.	Extensive land degradation occurs due to inadequate geological information and enforcement of reclamation requirements.
SDG 16: Peace, justice and strong institutions	Appropriate health, safety, environmental, and labour laws and regulations, and their enforcement, will combat violence, deaths, exploitation, illicit flows, and corruption. Institutional capacity will be strengthened.	Issues of child labour, violence, informality, and corruption remain widespread in the ASM sector.
SDG 17: Partnerships for the Goals	A sector characterised by stakeholder collaboration, well-resourced cooperatives, and adequate investment.	A lack of a government unit dedicated to ASM (at the time of writing), a lack of funding, and 'one size fits all' approach by NGOs have meant ASM miners' diverse and unique needs are often left unaddressed.

a particular policy document's score across all the SDGs.

4.1.2. Mapping reflections

The feedback workshop provided a chance for experts to reflect on the matrix as a tool and on the results of the mapping.

Usefulness of the mapping as a tool. The general sentiment of the feedback session suggested an appreciation of the mapping approach, given its aim to connect ASM to sustainable development issues. The matrix was suggested to be useful to support different stages of the policy cycle – from policy formation to monitoring – for the ASM sector. For instance, the mapping output can identify areas where policy gaps exist – represented by low direct alignment scores, such as with SDGs 2, 5, 6, 7, 11, and 13 – and where interventions can be strengthened to achieve certain SDGs. For the matrix to be practically used, it should be made publicly accessible and simple to use and could be further refined with government and expert input.

Results of the mapping. Participants reiterated that the findings from the mapping reflect the shortcomings of having no national policy on ASM. Existing policies may refer to ASM, but this was viewed as being symbolic and failing to address concerns in a serious way. Moreover, the feedback session included participants raising concerns about ineffective policy implementation which, as the following sections set out, is illustrated by the gaps between what *could* be achieved versus what is *actually* happening. This was a point of frustration for some actors, who highlighted that their persistent calls to government for action are not being heard.

The matrix provides a plethora of interactions for the reader and stakeholders to explore, which can be analysed in-depth when read in conjunction with the full assessment in A.1. Only the key findings will be considered in the next sections.

4.2. Zambia's ASM policy framework and the realities on the ground

This section critically examines Zambia's ASM policy framework by juxtaposing the policy objectives, as outlined in the policy documents, with the reality of the sector, as revealed through interviews and supporting literature. The analysis integrates these perspectives under four thematic areas: policy strengths, missed opportunities, deficiencies, and trade-offs.

Overall, the policy analysis reveals that Zambia's ASM policy framework is compatible with the SDGs. However, there are also missed opportunities and trade-offs within the policy framework. Furthermore, despite ASM's socio-economic potential and the theoretical alignment of Zambia's ASM policy framework with most of the SDGs, the sector's benefits and policy strengths have not been realised. For example, issues of corruption, gender inequality, environmental degradation, and poor access to skills, education, and finance remain. This lack of progress can be attributed to systemic failures in the policy and its implementation. Table 5 summarises these findings, which will be explored in more detail in the following sections.

4.2.1. Policy strengths versus the sector's realities

The Policy. The policy framework shows overall compatibility with the SDGs. This is evident from the outer right column, which shows direct alignment scores for most of the SDGs and high indirect alignment scores across all SDGs. Therefore, if the policy framework is effectively

implemented, Zambia's ASM sector can meaningfully contribute to the SDGs. When analysing A.1, most of the policy framework's positive scores come from policies relating to capacity-building; for example, facilitating access to technologies, markets, services, and finance; the formation of ASM cooperatives; and local participation in the sector. According to the NAP, the expected results of such interventions include improving financial literacy and savings among ASM players, local economic transformation, and reduced exploitation of ASM participants. These economic gains, in turn, may feed into indirect positive impacts, such as the ability to increase investment in agriculture and education (de Haan et al., 2020). The policy framework's overall compatibility with the SDGs correlates with other assessments of Zambia's ASM policy framework, which view it as able to support sustainable development within the sector (Banda, 2022; ZEMA, 2021, Siaciti, 2022; World Bank, 2016; P5; P6; P7; P10; P12). As P10 summarised:

> "*The policies are very good, the laws are well stipulated … They speak to the connections and how these SDGs can be addressed*".

Nonetheless, the matrix reveals the framework prioritises SDGs relating to economic growth, poverty reduction, and partnerships in the framework. This is shown by the high direct alignment scores of SDG 1 (score of 110 out of the maximum score 149), SDG 8 (score of 149), SDG 10 (score of 128), and SDG 17 (score of 101), and their respective low conflicting scores. These results are unsurprising given Zambia's 8NDP is centred around economic prosperity and private sector investment (MFNP, 2022).

The Reality. Despite the policy framework's strong scores, all interviewees reiterated that ASM in Zambia remains a poverty-driven activity which is both a symptom and cause of many of the sector's challenges. P2 summarised this notion:

> "*The challenges in this sub-sector are enormous because it's poverty-driven. The majority of the participants are poor, they don't have access to finance, they don't even know if they can access finance from the bank. All they do is wake up, go to the mining field or dumpsite, conduct their mining processes with unconventional tools, use chemicals in gold where they employ mercury and the like and, even children, they miss schools*".

These shortfalls in human capital have left miners vulnerable to exploitation (P1; P2; P4; P6; P10). For example, in Luapula Province, where ASM of silica and manganese is widespread, female miners may spend an entire week using basic tools to extract a single tonne of silica. They will then sell this tonne for only 75 kwacha (approximately USD $2.65 at the time of writing) to intermediaries, who will then resell it to copper mines at a significantly higher price (250 kwacha or USD$8.85) (P10). This exploitative pricing means most Zambians involved in ASM lack sufficient capital to undertake mining formally with a license which, according to interviewees, costs 250,000 kwacha for a small-scale license (USD$8995) (P11; P7). This has led to foreign nationals operating using Artisanal Mining Rights (P11; P12). As P11 explains:

> "*… most of the Zambians don't have the capital, they don't have the equipment. What they have is a national registration card which, inevitably, puts them in the position of being fronts for mostly Chinese operations.*"

At the time of writing, this was illegal under the Mines and Minerals Development Act 2015, which stipulates Artisanal Mining Rights are reserved for Zambian nationals only.[6] These instances of exploitation and corruption risk thwarting miners' social, economic, and political inclusion and their chances of breaking cycles of poverty (de Haan et al., 2020).

The perpetuation of poverty, poor working conditions, exploitation, and corruption in Zambia's ASM sector – and, therefore, the lack of progress towards SDGs 1, 8, 10, and 16 – can be attributed to a commonly-raised challenge amongst interviewees: despite an array of policies relating to formalisation, access to finance and training, increased participation, value addition, local beneficiation, and entrepreneurship, implementation is ineffective. This also points to a lack of progress towards SDG 17, despite its strong scores in the policy mapping. Interviewees and workshop participants attributed this implementation gap to various issues, including: political involvement and vested interests; weak capacity and coordination amongst the relevant ministries; poor knowledge of the policies; policies being driven by donors rather than the demands of communities; over-generalised policies or NGO interventions that fail to address community-specific needs; a bias towards foreign rather than local players; a lack of stakeholder collaboration; inadequate monitoring and evaluation; and a lack of a single voice and reporting mechanism that represent ASM interests (P5; P6; P7; P11; P12; comments from workshop).

4.2.2. Policy missed opportunities and their manifestations

The Policy. The matrix highlights notable positive impacts that ASM can *indirectly* have on facilitating progress towards SDG 2 (Zero Hunger), SDG 4 (Quality Education), and SDG 7 (Affordable and Clean Energy). In other words, it shows how ASM can positively reinforce many aspects of socio-economic development. This is evidenced by the high indirect positive alignment scores for these SDGs. For example, policies that promote alternatives to mercury in ASGM indirectly support SDG 2 because responsible and environmentally-sound ASM practices helps reduce farmland degradation, waterway siltation, and pollution, which could otherwise threaten food security (de Haan et al., 2020). Similarly, policies that promote value addition help to increase miners' income which can then be invested in seeds, fertilisers, and equipment for agriculture, children's tuition fees, or electrification projects (de Haan et al., 2020; Hilson et al., 2022). Therefore, ASM indirectly supports SDGs 2, 4, and 7.

However, at the same time, there is a notable lack of policies that *directly* address these areas. For example, none of the policies explicitly address the connection between ASM and agriculture, despite their increasingly strong linkages (Ofusu et al., 2020; Bansah et al., 2023). On the one hand, ASM often serves as an alternative or complementary economic activity for rural communities due to the seasonal nature of agriculture and the challenges in sustaining agriculture as a sole livelihood due to, for example, the impacts of climate change (Hilson, 2016; Bansah et al., 2023; Gubser, 2023). This is highly topical given, at the time of writing, Zambia is experiencing one of its worst droughts in forty years (IFRC, 2024). On the other hand, the "Janus-faced nature" of ASM means that its destructive environmental impacts and competition with agricultural land, labour, and water can put the two livelihood activities at odds with each other (Ofosu et al., 2020, p. 211). From either perspective, Zambia's policy framework does not explicitly make these connections. Therefore, whether intentionally or not, the policy framework fails to facilitate these positive synergies and to mitigate the potential for trade-offs between ASM and agriculture.

The Reality. The relationship between ASM and education was recognised by interviewees who reiterated that participants take part in ASM to obtain "*income to support their children to go to school*" (P2). However, the lack of policies directly linking and supporting ASM and education have manifested in such a manner that those involved in ASM may have withdrawn from, or have never been to, school due to being compelled to work on mining sites to support their families, or due to a lack of schools in the typically remote mining areas (P2; P5; P9; P10; P12). As such, there is a high prevalence of child labour in Zambia's ASM sector (P2; P4; P6). For those who do go to school, mining is not on the national curriculum and can only be studied at university (P9; P10). These circumstances have resulted in a lack of education and skills

[6] Since the research was conducted, the Mines and Minerals Development Act 2015 has been repealed and replaced by the Minerals Regulation Commission Act 2024. A key amendment is the allowance for Artisanal Mining Right holders to enter into joint ventures with foreign investors (GRZ, 2024).

amongst ASM communities, which feed into a host of other socio-economic challenges in the sector. For example, miners may lack training on issues such as: chemical handing; ICT usage (required for applying for licenses); or mineral pricing and budgeting. The consequences of such are environmental degradation, adverse health impacts, a deficit of license applications, and economic exploitation (P2; P5; P9; P10). This calls for the need to better resource and implement those policies that contribute to SDG 4, namely, facilitating the formation of cooperatives and access to finance, services, skills, and training.

Interviewees also highlighted the strong link and complementarity between ASM and agriculture in Zambia (P2; P3; P6; P7; P12). One interviewee reiterated the seasonal nature of ASM and its role in supporting those involved in agriculture during the dry offseason (P3). However, another contended that ASM is becoming increasingly commercial in nature and, therefore, its seasonal character is diminishing (P12). This shift has raised concerns about the growing use of land for ASM activities, which are often accompanied by a lack of rehabilitation, leading to the destruction of arable land (P6). The competing interests of ASM and agriculture, therefore, necessitate a policy framework that better integrates these sectors by clearly defining priorities and management systems, enabling them to co-exist rather than compete (Maconachie, 2011; Musukwa et al., 2023).

4.2.3. Policy deficiencies and sector challenges

The Policy: biases. The matrix reveals that the large-scale mining bias persists within Zambia's ASM policy framework, which reflects observations in the literature (e.g. Cervantes Barron et al., 2024). This evaluation stems from the positive scores for the NMRDP, which are predominantly indirect due to the policies having no explicit reference or link to ASM. Read in conjunction with the NMRDP's 'Vision', which focuses mainly on the 'mining sector' and references the 'ASM sub-sector' only once, it can be reasonably interpreted that the policies aim to target primarily LSM. The LSM bias is also implicit in the direct and indirect negative scores for the NMRDP and 8NDP,[7] many of which resulted from the policy objectives relating to scaling up exploration of mining activities.[8] The emphasis on LSM and copper production was an issue reiterated by several interviewees (P1, P2, P4), with P2 commenting:

> "*The focus so much on commercial mining is killing artisanal mining … Even when they are developing policies, they develop policies with no proper regard to the sub-sector*".

Nonetheless, more recent policies could signal an attempt to safeguard ASM miners from this LSM bias. For example, in 2023, corporate income tax was amended so that ASM miners pay 4 % on income earned (ZRA, 2023). This compares to the earlier regime, which subjected all mining companies – regardless of scale – to the same 30 % corporate tax rate (Mundashi et al., 2023). Such tax reforms represent a first step away from an LSM bias in policymaking. However, as most interviewees expressed, a more welcome step would be a standalone ASM policy (P2, P3, P4, P6).

Another bias that is less explored in the literature but emerged during the research is within the sub-sector: a bias towards artisanal and small-scale *gold* mining (ASGM). The fact that two of the four policies in the ASM policy framework are specific to gold suggests a prioritisation of this mineral. A number of factors may explain this bias, including: the Zambian government views gold as an opportunity to stabilise the Zambian economy; ASGM is the largest anthropogenic source of mercury emissions; and the NAP is a requirement and receives funding under Article 7 of the Minamata Convention on Mercury (Siwale, 2019; Lara-Rodriguez and Fritz, 2023; Banda and Chanda, 2021; P1). The NAP received the highest positive SDG scores compared to the other policy documents. This can be viewed as a strength of the NAP. However, it highlights that other minerals have not received the same attention in policymaking. Development minerals[9] are especially neglected in the policy framework, as illustrated by P1 who argues:

> "*Gold mining gets a lot of airtime, and it was reported that up to 80 % of all of artisanal mining is gold. But I think that that is completely skewed by the fact that we do not have a good view on how important the development minerals industry is*".

This is incongruous with the 8NDP's objective to diversify mineral exploration through ASM. Nonetheless, these critiques should not take away from the high level of policy attention to ASGM, which is a positive development in Zambia's ASM sector. Paying attention to ASGM offers an opportunity to address key socio-economic and environmental challenges. For example, using alternatives to mercury, as envisioned under the NAP, could contribute positively to almost all SDGs (Lara-Rodriguez and Fritz, 2023; see Matrix).

The Reality. These policy biases have resulted in scepticism amongst miners and a lack of trust in the Zambian government's intentions to formalise the sector (P1; P4; Siwale, 2019). For example, miners perceive formalisation efforts as veiled attempts to increase taxation, with one interviewee noting that miners "*feel like formalisation is just a way for the government to tax them on whatever little gain that they're making within the sector*" (P4). This perception reflects broader concerns that government interventions are driven by revenue capture and macroeconomic stability (SDG 8), with less regard for building the livelihoods and welfare of ASM miners (SDGs 1, 2, 3, 4, 5, and 10) (P1; Siwale, 2019). These views have been echoed in reaction to the Ministry of Mines and Minerals Development's decision to revoke over 2500 small-scale licenses (MMMD, 2024). This was due to small-scale miners defaulting on the requirement to obtain formalisation consents from the relevant institutions within the two-year timeframe which, as P7 explained, are timely and costly, amounting to 250,000 kwacha (USD$ 8995) (P7). ASM mining associations in Zambia expressed concerns that these licenses will be reallocated to foreign mining companies (Zambia Monitor, 2024). According to one interviewee, pressure from the Associations for Small-Scale Miners did result in the government rescinding their decision on the condition that miners evidence production returns every quarter. However, as they pointed out: "*How do you do that when you're not doing anything and [your license] has not been approved?*", and so some licenses remain revoked (P7).

The costly, arduous, and centralised licensing process makes it economically and geographically inaccessible to most ASM miners (World Bank, 2016; P3; P4; P6; P11). Ultimately, large-scale players benefit from this current system, given they are well-connected, optimally located, and can, therefore, acquire licenses more easily (Jonsson and Fold, 2014). As explained by P7 and reiterated by P8 and P10:

> "*The small-scale miners are the ones who discover most of these minerals*" but "*because most small-scale miners are in the rural parts of the country, it's very difficult for them to come to Lusaka about 1,000km away – the licensing office is only in Lusaka. By then, you find that the LSM who have other people around will apply and the small-scale miner is pushed aside.*"

As such, the LSM bias implicit in the policy framework is reflected in practice. While reforms and processes in place as of November 2024,

[7] The NAP and EDSGG are excluded because they apply exclusively to ASM.

[8] The NMRDP contains the intervention: "Enhance geological mapping and mineral resource exploration to increase commercial exploitation of mineral resources in Zambia" (MMMD, 2022, p. 10). The 8NDP looks to the "[O]pening up of new mines and increasing production in existing ones. For copper, the aim is to increase production to 3 million metric tonnes by 2032" (MFNP, 2022, p. 35).

[9] This includes semi-precious stones, such as garnet, tourmaline and amethyst; industrial minerals, such as gypsum and salt; construction materials, such as sand and gravel; and dimension stones, such as marble and granite (Tychsen et al., 2018).

such as the establishment of an ASM desk at the Ministry of Mines and Minerals Development and the consultation of ASM associations in the policy process, are steps in the right direction to addressing these biases, they fall short of addressing systemic issues in the sub-sector (DELVE, 2023; P7; P8). The consultation process occurs too late in the policy-making cycle for ASM miners to have meaningful impact, leaving them feeling marginalised and like "*a drop in the ocean*" (P7). Instead, miners wish to be included from the outset of policymaking, not just during the later validation stage (P9).

Structural reforms, including the establishment of a dedicated ASM Department and the development of a standalone ASM policy, could help level the playing field. These measures would address the inherent biases in the existing policy framework and ensure that the voices of ASM miners are at the heart of policymaking (P3; P4; P6; P7; P9 Siaciti, 2022; Pearce et al., 2023; DELVE, 2023; World Bank, 2016).

The Policy: gender issues. The matrix also reveals low scores in relation to SDG 5 (Gender Equality) (direct alignment score of 25) compared to other SDGs addressing social issues, such as SDGs 1 (No Poverty) (score of 110), 3 (Good Health and Wellbeing) (score of 85), and 10 (Reduced Inequalities) (score of 128). This indicates a lack of policies that specifically address gender inequality. The NMRDP does have one policy objective to "Mainstream gender, HIV/AIDS, disability and other vulnerable groups in the mining sector", however, this is across the mining sector and fails to directly target ASM. As such, there are no policies that explicitly speak to ending discrimination against women and girls in ASM. Furthermore, the policy is vague and fails to provide specific gender mainstreaming interventions. This reflects P4's comment:

> "*As much as the policy says they intend to mainstream gender within the sector, they don't say by how much or what the percentage target is*"

. This highlights the need for targeted and specific gender-sensitive interventions in the policy, such as implementing quotas for female mining licenses owners (P4).

The lack of such policies for the ASM sector has, in turn, led to gender inequalities within the sector.

The Reality. Women constitute an estimated 50 % of Zambia's ASM workforce (AMDC, 2017). Despite this, they continue to face discriminatory social norms, exploitation, limited access to finance, and gender-based violence (P1; P4; Tychsen et al., 2018; Pearce et al., 2023). For example, interviewees explained that women are prohibited from entering some mining sites because miners believe they will make the minerals disappear (P4; P8; P9; P10). A critical barrier to breaking these social norms to increasing participation is, once again, a lack of education amongst ASM miners and of finance for female miners. Almost all interviewees highlighted the inadequate provision of finance (P1, P2, P3, P4, P6; P9); indeed, gender-sensitive financing – such as easily accessible, exclusive loans to female miners and cooperatives – has the potential to empower women and break persisting poverty cycles (Weldegiorgis et al., 2018). This could also address another prevalent issue cited by the interviewees, that of child labour (P2; P4; P6). Child labour is often due to a failure to economically empower mothers within the sector (Hilson, 2012; Pearce et al., 2023). Providing access to finance and implementing this in a gender-sensitive manner should be a priority (Pearce et al., 2023). This could take the form of continuing to encourage women to form cooperatives, introducing a quota system for women, and allocating a proportion of funding to these cooperatives (P4; P9). A critical first step in this allocation process will also be for the Mining Cadastre Department to start disaggregating its database in terms of gender, which has been a barrier to gauging gender inequalities within the sector (P4).

4.2.4. Policy trade-offs and their consequences

The Policy. Out of the four policy documents (8NDP, NMRDP, NAP, and EDSGG), three centre around increasing and diversifying Zambia's mineral exploration and exploitation: the 8NDP, NMRDP, and EDSGG. These policies are largely behind the high direct negative scores for the SDGs relating to the environment, namely SDGs 6, 12, and 15. This is foreseeable given mining activities generally negatively impact ecosystems, biodiversity, water sources, and carbon sinks (Dales and Cordy, 2021). These policies are also behind many of the indirect conflict scores across the SDGs, most notably SDG 3 on Health and Wellbeing. For example, scaling up exploration leads to influx of workers and increased risks of communicable diseases in ASM communities (Gottesfeld and Khoza, 2022; Landrigan et al., 2022).

The Reality: environmental impacts. All interviewees stressed that ASM, especially in its informal state, is detrimental to Zambia's natural environment. This issue has become more prevalent due to the recent discoveries of gold deposits, which have resulted in gold rushes across the country (P4; P5; P11; Siaciti, 2022; Hilson, 2020). Interviewees highlighted that these are characterised by no regard for the environment:

> "*People just go in and churn up the land and then move on and then churn up that land*"

(P5). Two notable factors are behind these environmentally-detrimental practices. First, miners struggle to access geological information that enables them to locate mineral deposits (P2; P5; P6). Second, miners must submit an environmental commitment plan in their application for an Artisanal Mining Right or an Environmental Project Brief for a Small-Scale License (MMMD, 2022b). However, miners often fail to produce these due to a lack of financial and/or educational capacity (P9; P10) and an inability to produce comprehensive, compliant assessments for the same reasons; or they are usually not held accountable for these assessments. Therefore, rehabilitation, remediation or restoration do not take place, and the opportunities to train and include ASM miners in conservation, sustainable land management, and landscape restoration are being missed (P1; P5; P6; P9; P10; P11; Dales and Cordy, 2021). One expert suggested that this is where LSM can help, explaining that, as a country with an extensive LSM industry, Zambia can and should capitalise on its ability to manage the adverse environmental impacts of mining (P1). This necessitates cooperation between LSM and ASM communities and the operationalisation of those policies in the NMRD relating to the Corporate Social Responsibility of LSM companies (P10; Bester and Groenewald, 2021). Moreover, developing trust between the ASM and LSM sectors, as well as the government, through education, access to finance, and equipment, will be essential to support sustainable practices (Bester, 2023).

The Reality: health impacts. Most issues relating to health were raised in the context of ASGM, which could be due to several factors. Firstly, interviewees pointed to gold rush activities across Zambia causing influxes of ASM miners and buyers which have, in turn, increased the levels of communicable diseases, such as HIV, in rural communities (P5; P8; P11; P12). This issue is compounded by communities' lack of access to healthcare facilities (P8; P9). For example, one interviewee reported that, across Zambia, there are currently only two health clinics serving ASM communities: one in Mapatizia in the Southern Province and the other in Rufanyama in the Copperbelt Province. Elsewhere, ASM miners must rely on hospitals in towns, which are often 40–100 km away (P9). Secondly, the use of mercury appears to remain prevalent in Zambia despite the NAP (P1; P2; P5; P9; P11). Interviewees put this down to limited awareness of mercury-related risks and low technology adoption by ASM miners (P2; P5; P9; Lara-Rodriguez and Fritz, 2023). As P2 highlighted:

> "*Most of these people will wash their minerals in that river or clean their gold using water and let it flow into the river. They are not privy to the health costs of that activity, which are enormous*".

Interviewees pointed to three factors which inhibit the uptake of modern technologies: lack of finance means miners cannot access suitable materials and chemicals; lack of education and formal training means miners are not aware of how to handle those materials; and lack

of trust amongst miners means they are hesitant to adopt new technologies (P1; P2; P5; P10).

These findings suggest that the implementation of the NAP has, to date, been poor. Lara-Rodriguez and Fritz (2023) observe that the influence of powerful agents involved in the gold industry is partly behind the poor implementation of the NAPs under Article 7 of the Minamata Convention on Mercury. This issue was raised in the Zambian context by some interviewees (P2; P5; P12); for example, P12 commented:

> "… *the space is actually quite rife with politically exposed individuals – so it means that things that are done in that space are not always above board … the vested interests overrides the greater good*".

To safeguard against this – and, therefore, ensure better implementation of the NAP – the licensing processes should include provisions for conflict-of-interest disclosures (P12). For ASGM to achieve meaningful progress towards SDG 3, the government could also focus on bottom-up, more indirect, policy interventions related to providing education, awareness, and social services that build the knowledge and trust of ASM miners (P2, P4, P5, P6).

5. Conclusion

This research contributes to the growing body of literature linking ASM and sustainable development. It sought to enhance understandings of Zambia's ASM sector by mapping its policy framework to the SDGs and by assessing progress towards the SDGs through interviews and a stakeholder workshop.

The findings reveal that Zambia's ASM sector and its policy framework hold significant potential to advance several SDGs, particularly those that relating to rural resilience (SDGs 1, 2, 3 and 4) and economic development (SDGs 8 and 10). However, notable shortcomings in the policy hinder progress towards Zambia's SDG ambitions. These include the failure to directly link ASM with education and agriculture, biases towards large-scale mining and artisanal and small-scale gold mining, and an overemphasis on economic growth compared to livelihood support. These policy shortcomings are coupled with a lack of implementation of those policies that demonstrate theoretical promise towards achieving the SDGs. Consequently, Zambia's ASM miners remain in cycles of poverty due to poor access to education, health, and finance, whilst issues of corruption, environmental degradation, child labour, and gender inequality persist. Furthermore, there are few incentives to formalise due to costly, lengthy, and inaccessible licensing processes and a lack of trust in the government's intentions to formalise the sector. As a result, Zambia's ASM sector is far from achieving its potential to contribute to the SDGs.

By quantifying ASM's policy alignment with development goals and identifying its strengths, overlooked opportunities, and trade-offs, this research provides policymakers with actionable insights into ASM governance. In the Zambian context, it highlights the urgent need for – and could help with the development of – a dedicated ASM policy, a recommendation consistently raised by interviewees. Such a policy must respond to the needs and challenges faced by ASM communities, making it more relevant and implementable. Other policy implications of this research include the need to highlight and capitalise upon the important link between ASM and agriculture. The suggested standalone ASM policy could clearly define sector priorities and management systems, enabling ASM and agriculture to positively co-exist, rather than compete. This is an area where interministerial collaboration and further research is required to fully understand the intersections of policy issues between the sectors. Policy can also seek to empower ASM miners through bottom-up support. To support sustainable expansion and management of the sector, the government could create a formalisation process that guarantees ASM miners access to technical and economic capacity-building. Furthermore, to incentivise ASM miners to formalise, the licensing process must also be streamlined, accessible, and user-friendly, particularly for prospective ASM miners in rural areas and those with low IT literacy.

Beyond Zambia, the mapping exercise offers a replicable framework for other countries grappling with the complexities of ASM, highlighting areas where ASM has untapped potential to drive progress towards certain SDGs whilst addressing the inherent trade-offs with others. Further research should build on these findings by investigating the barriers that hinder the effective implementation of promising policies, and by applying the mapping framework across different ASM contexts to further refine and enhance its value as a policy analysis tool. Recognising the importance of ASM is crucial in a world where its role is only growing in scale and consequence, driven by an accelerating demand for critical minerals essential for low-carbon technologies and the intensifying effects of climate-induced shocks. ASM is set to play a pivotal role in supplying these resources, whilst also serving as a climate adaptation strategy. In light of this, recognising and harnessing the full range of ASM's contributions, whilst mitigating its negative impacts, will be vital for achieving equitable and inclusive development towards 2030 and beyond.

CRediT authorship contribution statement

M. Kaczmarska: Methodology, Formal analysis, Visualization, Writing – original draft, Project administration, Investigation, Conceptualization. **R.K.M. Clube:** Validation, Writing – review & editing, Supervision. **F.C. Mubanga:** Validation, Writing – review & editing. **J. Tomei:** Funding acquisition, Writing – review & editing, Supervision, Conceptualization, Validation.

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Declaration of competing interest

All authors have declared they have no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrurstud.2025.103774.

Data availability

The data that has been used is confidential.

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