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"The ladder that sends us to wealth": Artisanal mining and poverty reduction in Tanzania

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ABSTRACT

This article explores the contribution that artisanal and small-scale mining (ASM) makes to poverty reduction in Tanzania, drawing on findings from research on gold and diamond mining in Mwanza Region. The evidence suggests that people working in mining or related services are less likely to be in poverty than those with other occupations. However, the picture is complex; while mining income can help reduce poverty and provide a buffer from livelihood shocks, people's inability, to obtain a formal mineral claim or to effectively exploit their claims, contributes to insecurity. This is reinforced by a context in which ASM is peripheral to large-scale mining interests, is only gradually being addressed within national poverty reduction policies, and is segregated from district-level planning.

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Introduction

Research on artisanal and small-scale mining (ASM) in Africa suggests it is a livelihood activity with poverty reduction potential (Noetstaller et al., 2004). It has been identified as an important economic opportunity for people in rural areas, which provides income for household livelihoods (Hentschel et al., 2002; Dreschler, 2001; Maconachie and Binns, 2007). However, improved livelihood security from ASM is not straightforward; evidence also shows it can contribute to poverty, and expose people to income vulnerability and health and safety risks (Hilson and Pardie, 2006; Noetstaller et al., 2004).

In seeking to steer a course through conflicting evidence, the lack of knowledge on poverty dynamics within ASM communities is apparent. This includes weak statistical information on the demographics of mining populations (Hilson, 2005), lack of longitudinal data (Noetstaller, et al., 2004), and inadequate understanding of the relationship between ASM and wider livelihood processes (Hentschel et al., 2002; Labonne, 2002b). The absence of such baseline information hinders informed decision making on the future development of the sector and the design of appropriate poverty reduction strategies (Hilson, 2005; Labonne, 2002a).

It is against this background that this article explores whether ASM can offer opportunities for income generation and livelihood security in Tanzania. To do this, it considers whether ASM has the potential to reduce poverty and whether households earning a living from operations fare better in terms of poverty levels than those dependent on other livelihood sources. The analysis contributes to the body of evidence on ASM's poverty-reducing potential in Africa. Before proceeding, it is helpful to explain how the terms poverty and vulnerability are used in this article because how they are conceptualised guides our methodology and thinking about poverty reduction. Our understanding of poverty and vulnerability follows definitions used by the Tanzanian Government: "Poverty…describes a situation in which households are placed below a socially defined minimum level of well-being, usually manifest in hunger, sickness, powerlessness, illiteracy, etc." (R&AWG, 2002, p. 89).[1] This definition incorporates

[1] Studies on ASM frequently use the metaphors of the "poverty trap" or "poverty cycle" to describe how it is "poverty driven" (e.g. Labonne, 2002b). This draws on systems theory to portray the self-perpetuating nature of lack of development in ASM (Noetstaller et al., 2004). We find these metaphors unhelpful

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the idea that poverty is concerned with non-material, as well as material, manifestations (URT, 2004, p. 15). Linked to poverty, the concept of vulnerability is important because it highlights how certain groups in society are particularly vulnerable to shocks that threaten their livelihood security or survival (R&AWG, 2002, p. 89). In this respect, "vulnerability is about the probability, or likelihood, that an individual, household or community will experience a decline in well-being" (URT, 2004, p. 16).

For poverty analysis of this type, the value of combining methods is recognised in development research (Holland and Campbell, 2005). Therefore, this study combines a random sample survey to capture data on involvement in mining at household level with inductive qualitative research to understand people's experiences of ASM, and to situate these experiences within the wider policy context. This is necessary to capture change in artisanal and small-scale miners' poverty status: individual miners and mining households may have been poor in the past but are not necessarily poor today; conversely, they may have the potential to fall into poverty in the future. A key question we wish to ascertain is whether change in poverty status and potential for vulnerability or improved security are due to mining activities.

The information presented in this article is drawn from a study conducted over a period of 10 months in 2004, augmented by two short periods of further research in 2005 and 2006.[2] The research was conducted in three locations within the Mwanza Region: Nyarugusu and Mgusu Villages in Geita District (gold-producing areas) and Mabuki Village in Misungwi District (a diamond-producing area).[3] The decision to undertake research on gold and diamonds reflects the fact that they are amongst the most important minerals for ASM in Tanzania. Selection of field sites within Geita and Misungwi Districts was based on three key criteria. Firstly, sustainability of the mineral reserve to permit continuation of the project. Secondly, the type of mining settlement, with deliberate attempts to avoid a mine rush area under the rationale that linkages between mining and livelihood activities could best be examined within established settlements.[4] And, thirdly, the technology used, to capture some of the variation between artisanal mineral extraction using simple hand tools and small-scale mining operations employing workers and using machinery to extract and recover minerals.[5]

The next section of the article elaborates on the national context to mineral sector development and poverty reduction processes in Tanzania. We then turn to consider what role ASM plays in poverty reduction at household level in the cases of gold and diamond mining in Mwanza Region.

Mineral sector development and poverty reduction

Economic policies for mineral sector development in Tanzania have historically been isolated from policies for human development and social service provision. Until the 2000s, this remained the case, but change is gradually occurring. The mineral sector is today identified as a priority area for national economic growth and poverty reduction (IDA/IMF/URT, 2005; MEM, n.d.). How this poverty reduction potential is realised is a major question facing the government. The issue of leverage from mineral sector development, to encourage growth in other sectors and to ensure that benefits are broadly shared and poverty reduction potentials realised, is a substantial challenge. This is complicated by the fact that although the mineral sector has recorded the highest level of sectoral growth since 1990, the proportion of GDP remains small (IDA/IMF/URT, 2005). In this respect, the government's strategy for rural growth and poverty reduction remains focused on agricultural development (IDA/IMF/URT, 2005, p. 26).

How artisanal mining fits into this national picture is a complex question. Having grown up as an unregulated sector in the 1970s and 1980s, ASM is often controversial (Chachage, 1995; Kulindwa et al., 2003). As in other parts of Africa, it is associated with conflicts with large-scale mining interests, with poor regulation, and with a host of socio-economic and environmental problems (Dreschler, 2001; Tan Discovery, 2003). This has made ASM a difficult policy arena regarding its potential contribution to economic development.

Until recently, mineral sector policy was disconnected from wider poverty reduction strategies (URT, 1997). The Interim Poverty Reduction Strategy Paper (URT, 2001), largely ignored the extractive industries, including mining, both large and small scale (Pegg, 2003, p. 7). However, the second PRSP (2005) marked a shift in thinking. In the intervening years, political pressure to take mining into account grew; indeed, the scale of mineral sector expansion made it difficult to disregard. The second PRSP or National Strategy for Growth and Reduction of Poverty (the MKUKUTA) reflects this shift (IDA/IMF/URT, 2005).

The MKUKUTA places mineral sector development in a central position regarding national strategies for poverty reduction, while noting that there are serious poverty concerns regarding impacts on the environment and tensions over land rights and labour relations. It identifies a key challenge as being able to ensure that investment benefits the wider economy, with particular attention to disadvantaged regions. In terms of ASM, specifically, the emphasis is on technological development, safety awareness, education, and information sharing. This is a technical approach, which, although a step forwards, has no counter-balancing social focus. Thus, systematic poverty linkages between ASM and cross-cutting PRSP themes such as HIV/AIDs, gender relations, and the special attention required for vulnerable groups are absent, as is an emphasis on the potential of the sector to contribute to employment and income generation. Furthermore, the need to address critical issues such as the ownership of mineral rights, how miners access financial markets, and integrated development planning for communities, makes the realisation of poverty reduction potentials from ASM, indeed for the mineral sector overall, a difficult issue.

A mechanism for implementing national policy on poverty reduction is through district-level planning. This raises interesting

(*footnote continued*)
as a means to frame the analysis because they tend to homogenise the complexity of change in ASM communities. Instead we have sought to provide a socio-economically differentiated view of potential benefits from ASM within the communities under study.

[2] Research conducted in 2005 and 2006 was undertaken by Rosemarie Mwaipopo.

[3] The methods used for the primary research in 2004 were as follows (distributed across the three villages): (i) a socio-economic survey conducted with 306 households; (ii) 13 focus group discussions using different participatory methods; (iii) 44 semi-structured interviews; (iv) six detailed case studies combining life histories and technical information; (v) technical data gathering, including observation at mining sites and interviews with operators, owners of pits and equipment, and mine inspectors; (vi) collection of basic village data; (vii) eight semi-structured interviews with selected district officials; and (viii) discussions with stakeholders, including government officials and civil society representatives at a district stakeholder workshop. In 2005 and 2006, a total of 25 semi-structured interviews were conducted with officials in Geita Town, and claim holders and village residents in Mgusu Village.

[4] A typological distinction between established settlements and mine rush areas was later found to be unhelpful because mine rushes occur in and around existing settlements (gold mining).

[5] The majority of gold and diamond miners rely on hand tools and manual labour. In the case of gold, a small number of people own powered crushers, compressors, and/or water pumps. In the case of diamonds, approximately four concession holders in the study site use some mechanization; the rest rely on hand tools for extraction of diamond-bearing gravel (see Mwaipopo et al., 2004 for details on types of mining operation).

questions for ASM because the mineral sector remains under centralised control, unlike most other sectors, which have been decentralised. Districts with mineral resources recognise that the mining sector can be a potential source of local revenue, but mining does not have local government representation. Beyond questions of revenue benefits, planning for ASM is isolated from wider sectoral planning at the district level.[6]

The technical orientation of the PRSP (with respect to ASM), and a more general absence of pro-poor development strategies for ASM communities at the district level, underlines the lack of support that exists to address poverty reduction in ASM communities. Given this background, one can question how ASM operators make a living and seek to transform their own poverty status in a policy and institutional environment that does little to facilitate their capacity to develop.

Artisanal mining livelihoods in the study areas

Lying within the Lake Victoria Goldfields and next to Lake Victoria, Mwanza Region is naturally endowed with abundant mineral and fisheries resources, while land is used for agriculture and livestock keeping. When combined with trade and petty business, this makes for a diversified local economy (URT, 2003).

Mabuki Village has a total population of 6888 people in 1019 households, with diamond mining concentrated in Imalange, one of its 13 hamlets (Village Government Statistics (VGS), 2004). Nyarugusu Village is a centre for artisanal gold mining, with a population of approximately 27,211 people (VGS, 2004). Mgusu Village has a population estimated to be 4437 (VGS, 2004). At the time of research, it was an illegal settlement in Geita Forest Reserve, where mineral and settlement rights are disputed, contributing to conflict and insecurity.[7]

In interviews, people stated that they migrated to these mining areas in search of new opportunities. This migration is borne out by our household survey, which shows that 72% of residents in Nyarugusu, 46% of residents in Mabuki, and 92% of residents in Mgusu were born elsewhere. According to the survey, 28% of the population of Nyarugusu, 30% of the population in Mabuki, and 67.1% of the population in Mgusu are directly involved in mining and processing activities.[8] These figures equate with over half of all households having a member mining in Nyarugusu (60%) and Mabuki (53%) and as many as 90% in Mgusu. Figures for dependence on mining would be higher if related activities such as service provision, transportation, and specialized services such as blacksmithing, were taken into account. Among the miner respondents (gold and diamonds combined), over 50% have mined for between 11 and 20 years.

The ease with which people can take up artisanal mining means it is perceived to be an avenue for the pursuit of a better life. This was captured by gold miners in Nyarugusu Village, who explained that "mining is like a ladder that sends us to wealth" (field diary, May 2004). However, although this perception exists, and people can readily find income-generating activities in mining areas (particularly gold mining), entry into mining as a licensed 'claim holder' or even a self-supporting 'pit owner' requires experience, knowledge of the industry, and capital, even at the artisanal level.[9]

This information suggests that mining is perceived to be an attractive long-term livelihood option capable of transforming people's poverty status. However, this goal is not without barriers. This raises the question of whether this perception is in fact the case: does ASM have an impact on poverty levels and people's ability to generate household income?

Poverty levels in the artisanal mining communities

To answer the question of whether artisanal mining in these villages contributes to poverty reduction we can start by examining poverty levels in the study sites. Following international practice, income poverty is defined as that expenditure (and by implication income) required to provide either minimum calorie requirements (the food poverty line) or goods and services to meet basic needs (the basic needs poverty line). Both poverty lines were defined for 1991/1992 and 2000/2001. The 2001 Household Budget Survey (HBS) identifies a poverty line in terms of the Tanzanian Shillings (TzSh) required each 28 days per adult equivalent in the household (URT, 2002).[10] The amount of money needed to feed young children is lesser than for adults and we have followed the HBS in adjusting income and expenditure for the age structure and gender of the household. We have adjusted these poverty lines to 2004 prices using the consumer price index. This gives a food insecurity poverty line (a measure of extreme poverty—Poor 2) of 5702 TzSh and a basic needs poverty line of 7811 TzSh per 28 days (Poor 3).[11]

Unlike the HBS, it was not possible to draw on diaries of household expenditure owing to the time frame for research. The discussion is thus based on information on sources of income, own food production, and typical weekly expenditure. Using these data we calculate that approximately 25% of households live below the food insecurity level and 35% below the basic needs level. Describing themselves according to local characteristics of wealth and poverty, the qualitative wealth-ranking exercises identified many similarities in the characteristics of who was poor across the three villages, as outlined in Table 1.

There are, however, also differences in local characteristics of poverty across the three villages; in particular, as Mgusu borders a forest reserve (where land ownership and cultivation is not permitted) and mining is the main economic activity, focus groups did not refer to land ownership or cattle keeping. In contrast, at Mabuki, a more traditional Sukuma village, where cattle are prized and agriculture is a mainstay of household economies, land ownership and cattle keeping are significant indicators of socio-economic status. Nevertheless, in all communities, poverty was directly related to lack of money to sustain basic needs, and especially food security. In Mabuki, one's immigrant status also featured as an indicator of poverty because of difficulties for incomers in obtaining land on which to grow food.

The household survey built on the characteristics identified in Table 1 by asking various questions related to respondents'

[6] Space does not permit elaboration on this issue, see Mwaipopo et al. (2004) and Fisher (2008).

[7] It has since become a registered village (2006).

[8] These figures exclude children under 16 and the disabled.

[9] A 'claim holder' is the person who possesses a Private Mining Licence from the government conferring mineral rights over the concession. An individual known as a 'pit owner' or group can informally lease rights from the claim holder to develop a pit or pits within a concession. 'Mine workers' are employed by the claim holder or pit owners. Sub-leasing is a very common practice although not formally recognised by government (see Mwaipopo et al., 2004; Fisher, 2007, 2008).

[10] 1 USD = 1239 TZS (April 2008).

[11] Poor 2 = Below food poverty line. Food poverty, expressed in monetary cost per person per day, is the cost of meeting the minimum caloric requirement when consuming a typical basket of food. Poor 3 = Below basic needs poverty line. A higher basic needs poverty line makes allowance for the fact that individuals need more than just food to live. According to the Household Budget Survey (on which our estimate is based), the share of expenditure on non-food items in the poorest 25% was used to increase the food poverty line to allow for non-food consumption.

Table 1
Local perceptions of socio-economic status[a].

Economic status	Village		
	Nyarugusu	Mgusu	Mabuki
High	The few very successful mineral claim holders earning high profits (est. = 3). Land of 20 acres and above Owners of large businesses (transporters, large shops, large bars)	Claim holder(s) (est. = 1) Mineral dealers (large) Business people with large businesses	Livestock keepers with more than 50 head of cattle Land of 30 acres and above Business people owning big shops Pit (mine) owners
Middle	Claim holders Mineral dealers who may not have adequate capital but have the knack of business deals and can be loaned money	Able-bodied miners who can earn at least enough money for their living	Livestock keepers with 10–20 cattle 10–15 acres Livestock traders Small-business people
Low	Mine labourers, stone crushers, the elderly, those who do not own or have very minor assets	The elderly, stone crushers (women)	Little or no cattle Little or no land Daily labourers in mining or farming (esp. new comers)

[a] Based on focus group discussions.

perceived well-being. The one we draw on to define a further poverty line (Poor 4) is whether the "household has experienced food shortage over the last year". As 2004 was a very dry year and nearly two thirds of the sample grow at least some of their own food, it is not surprising to find that 65% of all households are defined as poor using this measure. There is a close relationship between the three poverty measures (Poor 2–4). All those who have insufficient income for food security are basic needs poor—almost 80% of those who describe themselves as having experienced food shortage during the past year are in this category.[12]

Probit analysis can be used to investigate which factors are associated with a household being below or above the poverty line (see Table 2). Starting with the largest group, those who say they have experienced food shortage in the last year are significantly more likely to be living in Mabuki, to have lost a family member or food aid during the last year, to be directly involved in mining, and to have a high dependency ratio (children/elderly to working adults). These results are expected. More surprising perhaps is that being a recent migrant (making it difficult to grow your own food) is no disadvantage. In fact having to rely heavily on mining income rather than agriculture during a very dry period is actually a (small) advantage. The role of artisanal mining as a cause of vulnerability (through ill health for example) is well documented, as detailed below, but our research shows that in some circumstances, it can also reduce vulnerability. Other variables that are interesting for their lack of impact are being claim holders (as many are inactive claims and therefore bring no economic benefit) and being members of local credit/support organisations (very few people are in this category).

Turning to the next largest group, households were more likely to have expenditure below that needed to meet their basic needs if they lived outside Mgusu (where mining is the main activity). Losing remittances, food aid, or a family member in the past year increases the likelihood of basic needs poverty as does having no one in the household with more than 3 years of schooling (and hence functional literacy). Female-headed households are also more likely to be in this category but not the other types of poverty (we discuss why later on). A high dependency ratio is associated with poverty as it makes it difficult for the small number of working members of the household to earn sufficient income or grow sufficient food to support the remainder of those who cannot work.

Certain factors make it less likely that a household will be basic needs poor. Those respondents who worked in a mining pit or provided services for mining were significantly less likely to have households in poverty than respondents with other occupations in the three sample sites. Those households experiencing the most extreme poverty (as indicated by insufficient income or expenditure to meet food security needs) were also most likely to be living outside Mgusu. To illustrate just how much difference this location makes, we can estimate how many households would be in extreme poverty if all other factors apart from location remained constant. If all miners relocated from Mgusu to the other sample sites, the level of extreme poverty would rise from 24% of households to 40%.[13] This does not change the fact that households in Mgusu can be more vulnerable. The analysis below shows that these households experience multiple shocks. However, potential for income gained from gold mining helps explain why migrants are willing to take the risk of mining in Mgusu and live illegally with crude housing and sanitation.

It is the loss of remittances rather than loss of food aid or a family member that tends to push households into this category of extreme poverty. Those mining in a pit (rather than providing services) are less likely to be in this type of poverty. Unlike the other categories of poverty, being a claim holder or pit owner makes it significantly less likely for an individual to have such low income so as to be food insecure. This is confirmed by our qualitative research, where it was noted that those with the access to social and financial capital required to own a pit or hold a claim (even if inactive) tend to avoid slipping into extreme

[12] When local people talk about food in the context of food shortage it does not necessarily mean they have no food to eat but that they are not able to eat what they consider their normal diet.

[13] Projected using coefficients and sample means for each variable and reducing the mean proportion living in Mgusu from 0.2 to 0.

Table 2
Probit analysis of poverty status.

Dependent variable	Poor 4 (food shortage own definition) Coefficient	Poor 3 (basic needs income) Coefficient	Poor 2 (food insecure income) Coefficient
Constant	0.781	−0.554**	−0.631**
Mgusu or Nyarangusu	−0.793**		
Mgusu		−0.717**	−0.935**
Recent migrant	−0.509		
Loss of remittances	0.643		1.321**
Loss of family member	0.496*		
Loss of food aid	1.083*		0.458
Combined impact of above losses		0.505**	
Serious illness in family	0.170		
Mining in pit	0.421**	−0.349*	−0.627**
Other mining activities			−0.230
Provides services for mining	−0.429	−0.827**	−0.355
Pit owner		−0.257	
Claim holder		−0.436	
Pit owner or claim holder			−0.551*
Dependency ratio	0.162*	0.223**	0.153**
No one in family with 4+ years education	0.365	0.408*	0.142
Female-headed household	0.165	0.426*	0.243
Grows own food	−0.292	−0.055	0.047
ASM as % of all occupations	−0.353		
Member of credit/savings group		0.306	0.237
Member of Mwanza Regional Miners Association		−0.444	−0.565

Notes: Sample = 291 households (observations).
* "t" statistic significant at 10% level.
** "t" statistic significant at 5% level.

poverty. Even for those people without assets, who work at the margins of mining operations (gold mining)—manually crushing rocks or reprocessing tailings, for example—although the conditions in which they work can be terrible and the income they accrue negligible, in interviews it was repeatedly confirmed that because work is available and there is the possibility of earning something on a regular basis, mining can be better than any other option.

While a high dependency ratio (found, for example, when children are abandoned or elderly residents have no children nearby) is strongly associated with being in extreme (as in other categories of) poverty, female-headed households are not more likely to be in this severe poverty. Our qualitative research suggests that women heading these households typically undertake many petty occupations (such as cooking for miners or collecting wild foods). Taking jobs that men cannot or will not do, as well as reliance on prostitution in some cases, helps some female-headed households stay above extreme food insecurity but does not enable them to escape basic needs poverty. Furthermore, a finding of the qualitative research is that there are some women in the gold-mining areas who, financially, have become very well off, as a direct result of service activities. This has enabled them to finance mining operations and be directly involved in mineral production, a change from the 1990s (see Mutagwaba et al., 1997).

These data support the contention that people working within mining or related services are less likely to be in poverty than people with other occupations in the sample sites; there is also some evidence to suggest that income accruing from mining may help to reduce vulnerability in certain circumstances. For example, in farming households when the harvest is poor, mining can generate cash to pay for food, or for chronically poor people who may have few options for income generation outside mining. The issue of vulnerability is complex, however, when one takes into account legal and institutional factors that expose certain categories of people within the mining population to long-term vulnerability due to lack of access to a mineral right and poor institutional support for mining. This demands further elaboration if we are to fully appreciate poverty dynamics in these communities.

Vulnerability in the artisanal mining communities

Through the household survey and semi-structured interviews, our research sought to understand what factors contribute to vulnerability and how they impact on mining households in the study areas. From the survey, households in the three villages reported various types of risks experienced as shocks (Table 3). These results indicate that some risks are localised while others are common to all villages. Despite commonalties, however, there is a statistically significant association between incidence of risk and location.

Two highly significant common sources of risk that households had experienced as shocks within the last year were food shortage and serious sickness of a household member (including but not exclusively HIV/AIDS). In Mabuki, with households particularly dependent on the agricultural harvest for their consumption needs, and following a period of drought in 2003/2004, food shortage was a particularly significant shock that challenged households' capacity to cope. Other risks were more specific to gold-mining areas, with a low price for products and mine-related health problems being notable. Here, we should be wary of the figures, because diamond miners can receive a poor price for produce but be less aware of it than gold miners. Drought was not an issue of concern, except in Mabuki, where agriculture is prominent and there is a correlation to food shortage. In this area, ASM based on infrequent diamond finds does not provide regular income to overcome food shortage.

As illustrated by the data presented in Table 3, the high level of certain types of shocks that households have experienced in Mgusu within the last year is striking when compared to the other two villages. The low price of gold, mine-related health problems, conflict, threat of eviction, legal problems, theft, fire accidents, and failure to recover a loan are all shocks experienced in the recent past at a significantly higher rate than in Mabuki or

Table 3
Household experience of shocks by (percentage in a) villages.

Shock	Nyarugusu	Mabuki	Mgusu	Significance
Food shortage	59.7	81.3	54.8	**
Low price for products	26.6	5.2	51.8	**
Member of household sick	46.5	30.6	46.8	*
Involved in conflict	7.5	1.2	21.0	*
Injury to member of household	8.8	0.0	4.8	*
Mine-related health problem to household member	13.8	3.8	25.8	**
Eviction threat	1.3	5.9	16.1	**
Legal problem	1.3	1.2	30.6	**
Theft	11.3	2.4	24.2	**
Fire accident	4.4	0.0	11.3	*
Failure to recover money lent to others	9.4	10.6	27.4	**
Loan repayment problem	7.5	3.5	7.8	*
Draught	0.01	4.7	0.01	**

Shocks reported as experienced within the last year.
* Chi-square significant at 10% level.
** Chi-square significant at 5% level.

Table 4
Association between reported incidences of shocks (%) and socio-economic characteristics (percentage within socio-economic characteristic).

		Food shortage	Low price	Conflict	Health problem	Eviction threat	Legal problem	Theft	Money loss	Loan repayment problem	Lost remittance
Food Poverty	Non-poor	59.3	31.2	10.4	15.2	6.1	9.1	14.6	16.9	9.1	1.3
	Poor	81.3	16.0	2.7	8.0	4.0	1.3	2.7	2.7	4.0	5.3
	Sig.	**	*	*			*	*	**		*
Basic needs poverty	Non-poor	56.8	32.7	10.6	15.1	6.5	8.5	14.1	17.6	9.5	1.5
	Poor	79.4	17.8	4.7	10.3	3.7	4.7	6.5	5.6	4.7	3.7
	Sig.	**	**					*	**		
Female-headed household	No	63.6	29.7	8.9	14.9	5.9	7.8	11.5	14.1	7.1	2.2
	Yes	73.0	10.8	5.4	7.2	2.7	2.7	10.8	8.1	13.5	2.7
	Sig.		*		*						
Migrant	No	60.6	31.5	10.8	14.1	5.2	8.5	14.1	14.1	8.9	1.9
	Yes	74.2	18.3	2.3	11.8	6.5	4.5	5.4	11.8	5.4	3.2
	Sig.	*	*	*				*			
Only work in ASM	No	66.7	22.1	7.4	11.6	6.2	5.8	10.9	12.8	7.8	2.7
	Yes	54.2	56.3	14.6	22.9	2.1	14.6	14.6	16.7	8.3	0.0
	Sig.		**		*		*				
Mine-related work	No	63.8	19.9	8.1	10.0	6.8	8.1	10.4	12.2	5.9	2.7
	Yes	67.1	47.1	9.4	22.4	2.4	4.7	14.1	13.4	12.9	1.2
	Sig.		**		**					*	
Claim or pit owner	No	63.5	69.5	4.7	10.3	1.7	3.0	9.0	11.6	8.6	1.3
	Yes	68.5	71.2	20.5	23.3	17.8	20.5	19.2	19.2	5.5	1.4
	Sig.			**	*	**	**	*			

* Chi-square significant at 10% level.
** Chi-square significant at 5% level.

Nyarugusu. This does not come as a surprise given the insecure nature of Mgusu, and given that people work as 'pit owners' or 'mine workers' within the mineral claims of one individual with whom there has been a long-standing dispute. However, it does underline how vulnerable people are who live in the area, even though poverty levels and dependency ratios are lesser than in the other two settlements.

The next step of our analysis is to investigate who is likely to be affected by a shock and which categories of people are least likely to be able to cope. Cross-tabulation and chi-square statistical test results are reported in Table 4.

Results suggest that our previous estimated poverty lines (food and basic needs) are closely associated with most of the shocks. For instance, while poor households have higher incidence of food shortage, other households are more likely to report low mineral prices, and legal and crime-related incidences.

Probit analysis quantifies the probability or likelihood of reporting an incident among households with different

socio-economic characteristics. For instance, living in Mgusu increases the likelihood of reporting all shocks except food shortage but with a high number of young men in the population and a lower dependency ratio, capacity to cope is greater than in the other villages. Households below the food poverty line are more likely to report food shortages but less likely to experience theft than non-food poor, perhaps because they have little assets to loose. In this respect, even the better-off segments of the society are at risk from some shocks such as theft, although this is hardly a surprise, and these households are less vulnerable than those below the estimated poverty lines (food and basic needs).

Survey data on household experience of shocks in the study areas underline a complex picture: that food shortage and serious sickness are among the most significant shocks experienced by households across the sample sites but also that vulnerability to risk is differentiated socio-economically and according to location. The issue of location is important because it brings to the fore how, even where there is a lower dependency ratio and household members are better able to cope, vulnerability to multiple shocks can be magnified by insecurity of settlement rights and poor access to mineral resources. This was the starkest in the case of Mgusu, where—when data collection took place—the population had neither settlement rights nor secure access to minerals, although it was also apparent in Nyarugusu and Mabuki.

Conclusions

This article has focused on whether ASM has the potential to contribute to poverty reduction, an issue of contemporary relevance across sub-Saharan Africa. This research suggests that in the study areas, people working in mining or related services are less likely to be in poverty than people who are with other occupations in the sample sites. Although published literature widely associates ASM with vulnerability, the data demonstrate that a regular income from gold mining may also reduce vulnerability within mining households. Production from diamond mining is too sporadic to provide a dependable income to buffer households against vulnerability to livelihood shocks. The issue of vulnerability is complex, however, because people's access to a mineral claim, and capacity to securely exploit and develop that claim, affects their ability to attain livelihood security.

It has been demonstrated that ASM has the potential to contribute to poverty reduction. However, for this potential to be fully realised, and for the development of comprehensive strategies to overcome social and environmental problems, a substantial shift needs to take place in the way the sector is approached within national and international poverty reduction strategies.

Whether and to what extent policy makers base decisions on evidence from research is an open question. Nevertheless given the lack of knowledge of poverty dynamics in artisanal mining communities across sub-Saharan Africa we suggest the need for further research on the contribution of ASM to poverty reduction. This should include comparison across mineral types and localities, an examination of the multiplier effect of ASM on local economies, and longitudinal analysis of change to mining populations' poverty profile. Opportunities to collect baseline data on ASM incomes and livelihoods may exist within national survey instruments (e.g. the Household Budget Survey and the Labour Force Survey in Tanzania); such opportunities should be grasped wherever possible.

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