

Formalising and enhancing performance of artisanal and small-scale gold mining in Ethiopia

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A Base Line Study
On
“FORMALISING AND ENHANCING PERFORMANCE OF ARTISANAL AND SMALL-SCALE
GOLD MINING IN ETHIOPIA”

For
The Ministry of Mines of FDRE

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1. INTRODUCTION

1.1. Background and Objective

Defining Artisanal and small-scale mining (ASM) has remained a point of difference as Hentschel et al (2003) admit, by then, that common definition of ASM had yet to be established. In some countries 'artisanal mining' is purely manual and on a very small scale, and 'small-scale mining' has some mechanization. In some countries, small-scale mining is differentiated from artisanal mining by the presence of permanent, fixed installations. Following Hentschel et al (2003), Artisanal and small-scale mining refers to "mining by individuals, groups, families or cooperatives with minimal or no mechanization, often in the informal sector of the market". In the Ethiopian context, this definition fits the reality of ASM.

In the report by Hentschel *et al* (2003), it is generalized that artisanal and small-scale mining (ASM) is largely a poverty-driven activity in many developing countries, where about 13 million people in about 30 countries are directly engaged, while 80 to 100 million people are indirectly depending on ASM. Largely women and children are the participants in this sector. The report further acknowledges that small-scale mining negatively affects the environment and can have detrimental consequences to health and safety of workers and surrounding communities, due mainly to the poor practices in mining and processing. Because of the fact that Artisanal and small-scale mining is a marginalized activity with poor regulations, there can be very serious disputes with communities, government agencies and large-scale mining interests. "Conflicts over access and land-use can be a particular issue in areas where indigenous or tribal peoples have traditional land rights or land-use patterns" (*ibid*). Child labor, access to health care and education are the other problems commonly associated with ASM. Artisanal and small-scale mining typical face problems to geology, law, finance, marketing, technology, human resources, and organization.

Several sub-Saharan Africa economies (e.g., Mozambique, Liberia, Sierra Leone, Rwanda etc.) are increasingly relying on the mining sector with varying degree of contribution to GDP. The sector is becoming an important source of foreign exchange though evidences show that the sector is often disconnected from the wider economy (e.g., M'cleod, 2019; Biryabarema, 2019). A large proportion of mineral exports from the region is in raw/unprocessed form with small share in semi-processed concentrated form. While the ASM sector in these countries is very much underdeveloped (i.e., a semi-skilled workforce, limited access to infrastructure, and insufficient capital investment, almost exclusively relying on low-tech, labour-intensive mineral extraction and processing), the sub-sector provides much needed source of income to otherwise-jobless people. A number of studies (e.g., Childs, 2014; Hilson et al., 2018; Mutemeri et al., 2016; Sauerwein, 2020; Seccatore *et al.*, 2014; Spiegel, 2015) show that ASM could be the most important rural off-farm activity in the region with farming households engaging in ASM simultaneously with subsistence agriculture.

A study undertaken by Ethiopian Extractive Industries Transparency Initiative (EITI, 2015) with an objective of analyzing the “various aspects of artisanal mining operations in Ethiopia, its economic value, social contribution and social impacts” has come up with findings that the contribution to the overall economy or GDP of artisanal mining is low; artisanal miners are at the peak of their productive/reproductive age; migrant miners from other regions account for 25% to 30% in SNNPR and Oromia regions while in Tigray, Amhara and Benishangul Gumuz regions migrants account for low percentage and they are from neighboring woredas; conflicts among the artisanal mining communities are rare while conflicts between artisanal miners and private companies seems serious where the conflicts are due to overlapping of mining areas arising from poor licensing and area delineation problems; mining is the backbone of the miners’ livelihood and it is a difficult and risky occupation with no guarantee of quick returns; artisanal mining communities seemed disadvantaged in physical infrastructure facilities compared to other non-mining areas; the legal enforcement of proclamations is weak at grass-roots level; nearly all miners of gold and gemstone use manual tools and surface mines seem to be exhausted everywhere in the country and hence extracting rocks deep in the earth has become important; the total population involved in gold mining (legal and illegal) is estimated at 1.24 million producing 18000kg annually where the largest production is Oromia followed by SNNPR; the annual income per miner was birr 8000 to 10000; marketed gold through formal (legal) channel is estimated at only 39% of the total production; nearly all miners have little environmental knowledge on the harmful effect of mining; political commitment with is required to give attention to the sector.

With the recognition that a sector-wide strategy is necessary to define a “Roadmap that sketches the vision, objectives and key activities that need to be prioritized for implementation”, Ministry of Mines and Power (MOMP) and SUMM-CIRDI ¹(2019) produced a document that “presents the roadmap which lays out the framework for the Artisanal Special Small-Scale Mining (ASSM) strategy’. The Priority thematic areas were identified to be Governance, ASSM business, Economic linkages, Social, Environmental, Health and Safety (SEHS). Governance aspect incorporated issues related to laws and regulations, and related issues of the sector. ASSM business aspect includes issues related to labor skill, capital and finance, mining technology, management and technical support in relation to ASS mining. Economic linkages aspect refers to market linkages, value addition, infrastructure and related issues. SEHS issues focus on the impacts of ASSM on standards and technologies affecting environment, the society, operators’ health and safety.

The mining sector in Ethiopia, in general, has not been harnessed. Large scale and small mining alike are underdeveloped. The share of this industry in GDP remained less than one percent in recent years. Artisanal and small-scale mining (ASM) dominates the mining sector where more than 1.2 million rural communities and urban youth are employed (CIRDI-SUMM, 2019). In Ethiopia, as it is in the whole world, artisanal and small-scale mining is an industry of the poor where a large number of unskilled and semi-skilled labor force find refuge in developing countries. It is an informal engagement which

¹ Supporting the Ministry of Mines (SUMM), Canadian International Resources and Development Institute (CIRDI)

has not been properly studied and recorded. The informality is manifested by working without license, without legal protection and without support of the government on the one hand and not complying with regulations in fiscal, mining, and environmental matters.

As the sector has large untapped potential to grow and contribute to output and employment, the government has given attention to the development and formalization of this sub-sector through the then Ministry of Mines and Petroleum (MoMP). The development and formalization of this sector requires adequate information about the sector. Currently the available information is inadequate and a scoping study that highlights what information has been generated so far and what is not yet known has been undertaken recently (Keili *et al*, 2021). The scoping study aimed at documenting existing information and data on ASMs in Ethiopia and further developed a framework for a more comprehensive survey of the sub-sector. The content of the framework formulated by the scoping study aimed at documenting the current situation and justifying the possible interventions to realize the policy objectives. The generic areas identified were synthesized from previous studies and incorporated technical aspect, economic aspect, legal aspect, institutional and organizational aspect, environmental aspect, health and safety aspect, and community aspect.

As the sector has large untapped potential to grow and to contribute to output and employment, the government through the Ministry of Mines (MoM) has given attention to the development and formalization of this sub-sector. The development and formalization of this sector requires adequate information about the sector. As suggested by the scoping study that developed a framework for a more comprehensive survey of the sub-sector, this report is an account of the findings of a baseline study as a sequel to the scoping study and attempts to identify the various factors that shackled the development of ASM to assist the eventual resolution of the gaps.

The main objective of the study is identification of the Technical, Legal, Economic, Institutional, and organizational, Environmental, Health and safety, Gender, Child labor and Community aspects of the sector with the respective measures of addressing the knowledge and informational gaps and to indicate the intervention areas.

1.2. Data and methods

A base line study was conducted, in consultation with the Ministry of Mines, on artisanal and small scale gold miners and additional qualitative information was also generated from gold sellers and government organs at regional, zonal and woreda levels from gold producing areas. Gold producing areas were categorized in two groups of woredas: intervention woredas and control woredas. Sharkole woreda from Benishangul Gumuz, Dima woreda from Gambella, Oddo Shakiso woreda from Oromia and Bero woreda from South Western region, fall in the first group while Adola Redde in Orimia, Menge woreda in Benishangul Gumuz, Abobo woreda from Gambella and Gasana kebele from Bero woreda in South West region fall in the second or in the control group. The four woredas selected for intervention by government were those with relatively higher potential of production of gold and favorites for government intervention to enhance the performance of the sectors in various aspects.

The Ministry provided lists of all gold miners, except from Benishangul Gumuz region where there are no lists of individual gold miners from this region. In the list two types of major groups of gold miners were identified: organized artisanal and small-scale gold miners including special small scale gold miners and individual artisanal gold miners who are licensed and unlicensed. The first group (organized gold miners) is registered or licensed gold producers with fixed/specific areas of operations provided by the government and they have adopted a higher level of technologies. The second groups of gold miners are individual miners who are mostly unlicensed and they do not have fixed areas to mine gold, indicating that they mine gold in open spaces where gold deposits are expected to be available. These types of gold miners rarely use improved gold mining and processing technologies. Among the organized and licensed gold miners about 240 were selected from intervention woredas and 115 from control woredas in these four major gold producing regions. In addition, 600 unlicensed individual gold miners were sampled from intervention woredas.

Once all gold miners (artisanal and small scale) are identified, the study made complete enumeration or census of all the organized or group gold miners including organized traditional gold miners, small scale gold miners and special small scale gold miners from all the selected four regional states (Benishangul Gumuz, Gambella, Oromia and South West region). From the second group, the study selected sample of individual gold miners based on the sample size determination formula as follows.

$$\text{sample size} = \frac{n}{1 + \frac{n}{N}}$$

Where, $n = \frac{Z^2 p(1-P)}{e^2}$ N = population size, e = Margin of error (percentage in decimal form) , z = z-score (the number of standard deviations a given proportion is away from the mean and P is the proportion of the population with the given characteristics(expressed in decimal form of usually 0.5).

Once the sample size is determined, the total individual gold miners are distributed across the four regional states based on the total population of individual gold miners (see the above table). Finally, individual gold miners were selected from target kebeles in selected woredas using simple random sampling technique where the random number is generated using the RAND formula in excel. Thus, the study applied both proportional and random sampling techniques. Distribution of organized and individual gold miners in intervention woredas by region is presented in table 1 below.

Table 1: distribution of population of organized and individual gold miners by regions

Regions	Planned sample from intervention woredas			Actual sample from intervention woredas			Percentage of actual to planned
	Organized	Individual	Total	Organized	Individual	Total	Total
Gambella	35	148	183	36	164	182	99.5
Benishangul Gumuz	28	107	135	28	108	136	100.7
Oromia	155	6	161	113	3	116	72.0

South west Ethiopia	22	99	121	18	99	117	96.7
Total	240	360	600	195	356	551	91.8

After individual and organized gold miners were selected, 12 experienced and well-trained data collectors were deployed to collect the data under the close supervision of four supervisors. The data collection was done using face-to-face data collection method. In order to better control quality of data, the data collection was done using Computer Assisted Personal Interview (CAPI) or tablets programmed with CSPro software and the collected data were frequently synchronized to the center where data programmer controls the quality and consistency of the data. The team of researchers and the data manager had provided five days trainings for data collectors and supervisors using the CAPI on how to use the electronic devices for data collection before deployment. The baseline survey was conducted in April-May period in 2022.

The qualitative data analysis technique was used to narrate different topics and cases and stories of gold miners and clearly mapping the challenges and constraints related to production, technologies, legal aspects, market aspects, institutional aspects, environmental and social aspects that the gold miners faced in the selected regions and woredas.

The quantitative data analysis includes descriptive statistics on individual characteristics of gold miners, production and productivity, types and nature of available technologies, etc., and the causal effect of accessing gold mining machines on a given outcome variable where doubly Robust (DR) technique was employed. To estimate the causal effect of accessing gold mining machines on a given outcome variable, we employ the Doubly Robust (DR) technique. Estimating the causal relationship between a given 'treatment' and a given outcome variable using observational data is complicated by potential confounders that could be related to both potential outcome variables (Y_i) and treatment exposure (T_i)². Number of methods have been put forward to control for these potential

² Let $T_i \in [0, 1]$ be treatment indicator variable where $T_i=1$, treated and $T_i=0$, controls. Let $Y_i(t)$ represent potential outcome variable and X_i potential explanatory variables. Given a model specification, the latent outcome variable Y_i^* can be linked to an observable dependent variable Y_i through $Y_i^* = \beta_i X_i + \varepsilon_i$ and

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

where X_i represents a vector of explanatory variables, β_i stands for vector of coefficients, while ε_i is a stochastic disturbance term. We are interested to identify the mean effects of the treatment (in our case, access to technology or not) on a host of outcome variables $Y(T_i)$. Given $Y(1)$ be outcome variable when $T=1$ and $Y(0)$ be outcome variable when $T=0$, the average treatment effect of the treatment on the treated (ATT) is: $\tau_{ATE} = E(\tau) = E[Y(1) - Y(0)]$ and following Cungiara and Darnhofer (2011) can be estimated as $\tau_{ATE} = E\{Y_{1i} - Y_{0i} \mid T_i = 1\} = E\{E\{Y_{1i} - Y_{0i} \mid T_i = 1, p(X_i)\} - E\{Y_{0i} \mid T_i = 0, p(X_i)\} \mid T_i = 1\}$

$\tau_{ATE} = E(\tau) = E[Y(1) - Y(0)]$ where Y_1 and Y_0 are values of the outcome variable of interest for CS recipients and non-recipients, respectively; i refers to the households. Accordingly, τ_{ATE} (i.e., the differences in the outcomes of the treated and of the control group) can be said is due to access to CS (Caliendo and Kopeinig, 2008).

confounders. Most of these methods try to do so by creating pseudo-experimental settings. The goal is to create a setting where among subjects sharing same explanatory variables, the treatment exposure is independent of outcome variable conditional on the explanatory variables (X_i). Regression adjustment estimation and inverse propensity score weighting are among the most commonly adopted methods. Given a properly specified model, the regression adjustment (RA) technique can adequately identify the causal effect of a given treatment by comparing the outcome variable for treated individuals with similar observable covariates as that of untreated individuals. For example, a RA model of the following form could be estimated: $Y_i = \beta_0 + \beta_1 T_1 + \beta_i X_i + \varepsilon_i$ where Y_i is the outcome variable (in our case, yield), β_0 is a constant, β_1 is the coefficient of T_1 (in our case “use of machinery”), X_i stand for a host of other controls while β_i are the corresponding coefficients. ε_i is idiosyncratic error term. On the other hand, the inverse probability weighting (IPW) technique relies on a propensity score (i.e., the conditional probability of receiving a given treatment) to estimate the causal effect of the treatment³. Both of these approaches rely on some restrictive assumptions. While RA requires a correctly specified model, the IPW requires a correct estimation of the propensity score. Given that both approaches assume unmeasured confounders, if there is misspecification of the model or improper estimation of the propensity score, they will fail to sufficiently control for confounders (Chunhao et al., 2013).

The doubly robust technique, on the other hand, leads to a more precise inference by offering protection against some of the potentially incorrect assumptions of these methods. The DR estimator, by combining the features of RA and IPW, is robust to misspecification of either the outcome equation or the propensity score (the treatment equation). Hence, relying on the DR estimator, one can estimate the ATT (i.e., $E[(Y_{1i} - Y_{0i})|T = 1]$) as follows:

$$\hat{\Delta}_{DR} = n^{-1} \sum_{i=1}^n \left[\frac{T_i Y_i}{e(X_i \hat{\beta})} - \frac{\{T_i - e(X_i \hat{\beta})\}}{e(X_i \hat{\beta})} m_1(X_i \hat{\alpha}_1) \right] - n^{-1} \sum_{i=1}^n \left[\frac{(1 - T_i) Y_i}{1 - e(X_i \hat{\beta})} - \frac{\{T_i - e(X_i \hat{\beta})\}}{1 - e(X_i \hat{\beta})} m_0(X_i \hat{\alpha}_0) \right]$$

where $e(X_i \hat{\beta})$ is the postulated model for the true propensity score $e(X_i) = E(T|X)$ fitted through, for example, a logistic regression, and $m_1(X_i \hat{\alpha}_1)$ and $m_0(X_i \hat{\alpha}_0)$ are postulated models for the true regressions fitted through least squares $E[Y|T=1, X]$ and $E[Y|T=0, X]$. In addition, to increase efficiency, following the approach by Linden (2017) and Rosenbaum and Rubin (1983), we use a propensity score stratified into 5 quintiles. According to Rosenbaum & Rubin (1983), stratifying the propensity score into quintiles could reduce bias by about 90%.

³ Given the exogenous explanatory variables X_i , propensity score can be estimated as $P(x) = \Pr(T = t|X = x)$ and the corresponding conditional outcome variable as $\mu t(x) = E[Y|T=t, X=x]$. However, for PSM to work, unconfoundedness (i.e., $E[Y(t)|T, X] = E[Y(t)|X]$) and overlap assumptions should be maintained. An Inverse Probability Weighting (IPW) assigns a weight of $1/\text{propensity score}$ for the treated individuals and a weight of $1/(1 - \text{propensity score})$ for comparison individuals. $P(x) = \Pr(T = t|X = x)$ (Angrist and Pischke, 2009, pp. 213–216).

2. Survey findings

2.1. Profile of sampled gold miners

Most of the respondents (64%) were individual miners while the rest were more organized miners (19% MSE, 5% cooperatives, and 12% SSSM). Overall, 76% of miners are males. Male composition of Individual Miners were (94%), Cooperatives (85%), SSSM (79%), and MSE (71%). Across all miner types, members with 26 – 35 age group were the most important. This age group constitute for 44% of individual miners, 65% of MSE, 52% of Cooperatives, and 60% of SSSM. Younger members (with age group of 18-25 years) seem to have lesser role in all miner types. The exception is individual miners where one-third is within this age group. On average, three-quarters of miners are married. While almost all of the more organized miners have access to mobile phone, only about 55% of individual miners have access to mobile phone. Regarding the education level of individual miners (for which we have data), the majority (78%) had a maximum of 8 years of schooling with 52% having a maximum of 6 years of schooling. On average, about one-third of miners migrated from other areas. Nearly 48% of the respondents were followers of the Protestant religion while about 33% of the respondents are followers of the Ethiopian Orthodox Christian religion and the Muslim constituted about 20% of the respondents. Overall, gold miners interviewed have about 6.8 years of experience⁴. In relative terms, with about 9.2 years of experience, cooperative miners stayed longer in gold mining business as compared to individual (7.9 years), SSSM (7.7 years), and MSE (2 years) (Table 2).

Table 2: Background information of miners (in %) by types of miners

Type of miner	unit	Individual	MSE member	Cooperative members	SSSM	Overall
Survey cover	%	64.6	18.5	4.5	12.3	100.0
Male (organized)	Share (%)	94.1	71.2	84.6	78.9	75.6
Average age of members						
18-25	Share (%)	30.1	4.9		1.5	3.1
26 - 35	share	43.8	64.7	52.0	60.3	61.5
36 - 45	share	18.8	28.4	40.0	30.9	30.8
46 - 60	share	7.3	2.0	8.0	7.4	4.6
Married members	share	60.7	80.8	78.1	60.3	73.3
Position of representative (organized)						
Chairman	%		64.7	68.0	89.7	74.0
Deputy chairman	%		19.6	4.0	2.9	11.7
Secretary	%		4.9	8.0		3.6
Accountant	%		3.9	4.0		2.6
Cashier	%		2.0	8.0	1.5	2.6
Other representatives	%		4.9	8.0	5.9	5.6
Total	%		100.0	100.0	100.0	100.0
Own phone (of representative for organized)	%	54.8	100.0	100.0	98.5	70.6
Religion (of representative organized)						
Orthodox Tewahido	%	36.0	21.6	52.0	38.2	31.3
Protestant	%	20.2	69.6	12.0	27.9	47.7
Catholic	%	0.6				
Muslim	%	39.6	7.8	36.0	32.4	20.0
Traditional faith	%	2.3	1.0		1.5	1.0
Other (specify)	%	1.4				

⁴ For the organized miners, we considered experience of the representative during interview

Total	%	100.0	100.0	100.0	100.0	100.0
Education level (years of schooling)						
Illiterate (0)	%	11.2				
Elementary (1-6)	%	41.0				
Junior-High (7-8)	%	25.8				
High school (9-12)	%	21.4				
Tertiary (>12)	%	0.6				
Total	%	100.0				
Experience in gold mining	years	7.9	2.0	9.2	7.7	6.8
Share of migrant members (for organized)	%		9.8	50.0	60.6	32.6
Migration status of representative	share migrants		8.8	28.0	63.2	30.3

Source: survey data, March – April, 2022

2.2. Technological aspect of gold mining

The extraction of gold from the ore involves digging and excavating the land (mining), crushing and separation processes of the gold from ore (crushed material processing). From the beginning and before the assessment, it was generally assumed that ASM utilizes rudimentary mining and processing equipment and methods; that they do not get trainings on improved mining and processing methods and methods for recovery of minerals from mining wastes; that they do not have adequate information on various types of mining and processing equipment; that there are no trainings on assessment of ore reserves and grades; that they do not have the capacity to attain market demanded quality, they did not have access to the right quality test methods and equipment. The assessment in the survey was to investigate the status of these technological aspects of the miners and the extent to which various types of tools and equipment were used in gold mining and processing in Ethiopia and the extent of the technological training and awareness of miners on state of the art-technologies.

Shovel, iron bar, batia are the traditional tools that are extensively employed by all miner groups while the use of the other traditional tools considerably varies across the mining groups. Only about a third of the miners stated to have used the relatively modern mining machines even though there is variation across the mining groups. MSE and SSSM groups seem to use more of modern machines as reported by 83% and 79% of the respondents respectively. In contrast, individual miners (10%) and cooperatives (32%) seem to rely on modern machines. Interestingly, majority of the mining groups including individual and cooperative groups reported to have information on the existing and the state-of-the-art processing, mining machines, and quality testing methods and equipment.

Table 3: Tools and mining machines in gold mining

Type of miner	unit	Individual	MSE	Cooperative	SSSM	Overall
No of observation	number	356	102	25	68	551
List the hand tools used						
Shovel (Akafa)	% yes	85.7	92.2	96.0	100.0	89.1
Dijino (Iron bar)	% yes	90.5	90.2	96.0	55.9	86.4
Mattuck (Domma)	% yes	18.3	67.7	52.0	51.5	33.0
Pulley (Bekera)	% yes	36.5	8.8	76.0	27.9	32.1
Batia (Wooden/metal/Plastic)	% yes	100.0	100.0	100.0	100.0	100.0
Rope	% yes	69.7	12.8	92.0	54.4	58.3
Torch	% yes	58.7	6.9	84.0	64.7	51.0
Local ventilation tool (traditional blower)	% yes	29.8	7.8	76.0	25.0	27.2
Hammer (Medosha)	% yes	24.4	24.5	64.0	32.4	27.22

Traditional Sluice box	% yes	3.7	2.9	16.0	13.2	5.26
Sacks (madaberia)	% yes	70.5	21.6	88.0	47.1	59.35
Jerycan	% yes	58.7	37.3	92.0	66.2	57.17
Axe (metrebia)	% yes	11.5	21.6	48.0	32.4	17.6
Bush knife(Konchera)	% yes	17.4	26.5	84.0	30.9	23.77
Others (specify)	% yes	6.5	1.0	40.0	13.2	7.8
Do you use mining machines in gold mining or production?	% yes	10.1	83.3	32.0	79.4	33.2
Do you have information on any of the existing and state of the art mining machines?	% yes	49.2	75.5	60.0	80.9	58.4
Do you have information on any of existing and state of the art processing machines	% yes	40.2	66.7	48.0	80.9	50.5
Do you have information on existing and state of the art quality testing methods and equipment?	% yes	98.9	65.7	80.0	76.5	89.1

Source: survey data, March – April, 2022

Of the total sampled gold miners, only 33% use machines for gold mining while 36% use machines for processing. Machine utilization for gold mining and processing is the least among individual gold miners, but the highest among special small scale and SMEs (see figure 1). Gold mining machines used by the sampled gold miners include excavator, dump tracker, dozer, jack hammer and metal detector. Nearly all heavy machines like excavator, dozer and dump tracker are used by organized gold miners mainly SMEs and SSSM, whereas light machines like metal detector and jack hammer are used by individual gold miners. The scale of operations of gold miners has implications on types of machines to be adopted by different miners. Most SSSMs use excavators in Oromia regional state and only very few individual miners use heavy machines for gold mining indicating that they are using traditional tools for gold mining (see Table 4).

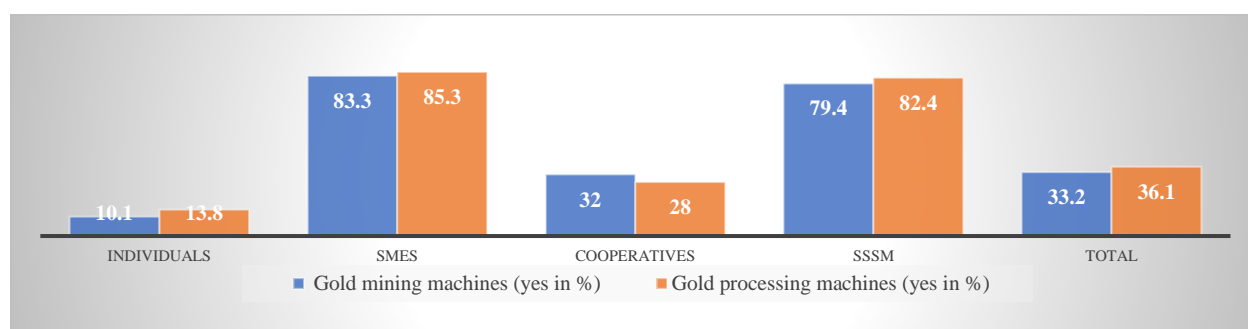


Figure 1: utilization of machines/technologies in gold mining/production and processing

Table 4: utilization of gold mining machines, by types of miners and regions (share in %)

Machine type	type of miners				Regions				
	Individuals	SMEs	cooperatives	SSSM	Oromia	Gambella	Benishagul	S.West	Total
Excavator	0.3	54.9	12.0	67.7	60.3	19.2	0.7	0.0	19.2
Dump Tracker	0.3	1.0	0.0	23.5	3.5	7.7	0.0	0.0	3.3
Dozer	0.0	0.0	0.0	10.3	3.5	1.7	0.0	0.0	1.3
Metal Detector	3.9	0.0	16.0	8.8	0.0	2.8	11.8	2.6	4.4
Jack Hammer	9.6	6.9	12.0	19.1	2.6	2.8	36.0	0.0	10.3
Others	4.2	6.9	8.0	14.7	0.0	6.6	15.4	0.9	6.2

Source: survey data, March – April, 2022

Most heavy machines used for gold mining are access through renting. For instance, over 87% of excavators used by SSSM are obtained via rental services (see table 5).

Table 5: if use gold mining machines, types of ownership (in percent)

Machine type	type of miners				Regions				
	Individuals	SMEs	cooperatives	SSSM	Oromia	Gambella	Benishagul	S.West	Total
Excavator									
Owned	0.0	0.0	33.3	13.0	7.1	5.7	0.0	0.0	6.6
Rented	0.0	58.9	66.7	87.0	58.6	94.3	100.0	0.0	70.7
Joint Venture	100.0	41.1	0.0	0.0	34.3	0.0	0.0	0.0	22.6
Dump Tracker									
Owned	100.0	0.0	0.0	25.0	25.0	28.6	0.0	0.0	27.8
Rented	0.0	100.0	0.0	75.0	75.0	71.4	0.0	0.0	72.2
Joint Venture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dozer									
Owned	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rented	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	100.0
Joint Venture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Metal Detector									
Owned	58.8	0.0	100.0	83.3	0.0	80.0	63.2	100.0	70.4
Rented	35.3	0.0	0.0	16.7	0.0	0.0	36.8	0.0	25.9
Joint Venture	5.9	0.0	0.0	0.0	0.0	20.0	0.0	0.0	3.7
Jack Hammer									
Owned	93.8	100.0	100.0	41.7	0.0	38.5	100.0	100.0	78.4
Rented	6.3	0.0	0.0	58.3	0.0	61.5	0.0	0.0	21.6
Joint Venture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: survey data, March – April, 2022

In all the sampled regional states, most of the heavy-duty mining machines are obtained over the last five years. For instance, 40% of excavators were purchased in 2021/2022 (2014 EC), indicating that recently utilization of machines for mining activities has been increasing. Average costs of acquiring gold mining machines various across types of miners and regional states depending on the size, types and year of manufacturing. Similarly, rental costs of the machines vary across types of miners and regional states depending on the capacity of the machines, year of manufacturing of the machines. For instance, the rental prices of excavators vary from 10,316 Birr per day for individual miners to about 28,000 Birr for SSSM. Region wise, rental costs of all gold producing machines are the most expensive in Gambella and the least expensive in Benishangul Gumuz indicating high regional variation in rental costs of gold mining machines.

Other than mining tools and machinery, the use of gold processing tools and equipment varies with the type of miners. Individual gold miners do not use modern gold processing technologies such as modern sluice box, shaking tables, water truck, while very few use pan wet mill (0.3%), ball mill (1.7%), Crusher (7.9%) and water pump (3.7%). None of the organized miners use pan wet mills for processing gold. Similarly, SMEs and cooperatives do not use shaking tables and water truck for gold processing. However, large proportion of SMEs and SSSM employ water pump for gold processing in Shakiso woreda of Oromia regional state (see table 8).

Table 6: share of gold miners using gold processing machines (in %)

Processing machines	Type of miners				Regions				
	Individuals	SMEs	Cooperatives	SSSM	Oromia	Gambella	Benish..Gumuz	South West	Total
Ball Mill	1.7	0.0	12.0	7.4	1.7	1.1	7.4	0.0	2.5
Pan wet mill	0.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.2
Crusher	7.9	8.8	8.0	13.2	7.8	1.7	26.5	0.0	8.7
Water pump	3.7	76.5	12.0	72.1	81.9	25.3	1.5	0.0	26.0

Modern Sluice box	0.0	0.0	4.0	52.9	1.7	19.2	0.0	0.0	6.7
Shaking table	0.0	0.0	0.0	2.9	1.7	0.0	0.0	0.0	0.4
Water truck	0.0	0.0	0.0	1.5	0.0	0.0	0.7	0.0	0.2

Source: survey data, March – April, 2022

Type of ownership of gold processing machines varies across the machine types, miner types and location of the miners. Most ball mills are owned by the gold miners mainly in Gambella and Benishangul Gumuz. Similarly, most water pump and modern sluice box are owned by gold mining cooperatives and SSSMs. However, most crushers are rented across types of miners and regional states due to high costs of acquiring it (see table 9).

Table 7: Ownership or rental of gold processing machines (in percent)

Processing machines	type of miners				Regions				Total
	Individuals	SMEs	cooperatives	SSSM	Oromia	Gambella	Benishagul	S.West	
Ball Mill									
Owned	85.7	.	66.7	80.0	.	100.0	81.8	.	80.0
Rented	14.3	.	33.3	20.0	50.0	0.0	18.2	.	20.0
Pan wet mill									
Owned	.	.	.	100.0	.	50.0	.	.	50.0
Rented	100.0	50.0	.	.	50.0
Crusher									
Owned	6.9	0.0	0.0	44.4	22.22	33.33	8.11	.	12.24
Rented	86.2	100.0	100.0	55.6	77.78	0	91.89	.	83.67
Joint Venture	6.9	0.0	0.0	0.0	0	66.67	0	.	4.08
Water pump									
Owned	69.23	43.59	100	96	51.58	95.65	33.33	.	65.28
Rented	15.38	55.13	0	4	47.37	0	66.67	.	32.64
Joint Venture	15.38	1.28	0	0	1.05	4.35	.	.	2.08
Modern Sluice box									
Owned	.	.	100.0	100.0	100.0	100.0	.	.	100.0
Shaking table									
Owned	.	.	.	50.0	50.0	.	.	.	50.0
Rented	.	.	.	50.0	50.0	.	.	.	50.0
Water truck									
Rented	.	.	.	100	.	.	100	.	100

Source: survey data, March – April, 2022

Costs of acquiring modern gold processing machines vary by type of machines and across miners and regional states. For instance, cost of water pump varies from about 20,450 Birr for individual miners to over 550,000 Birr for SSSM where such high variation is mainly due to the capacity of water pump. Similarly, there are variations of costs of acquiring ball mills and modern sluice box. Regional variations for costs of acquiring gold processing machines are also significant for most gold processing machines (see table 10).

Table 8: Cost of acquiring gold processing machines

Processing machines	type of miners				Regions			Total
	Individuals	SMEs	cooperatives	SSSM	Oromia	Gambella	Benishagu	
Ball Mill	213,583.3	.	320,000.0	288,000.0	2,000.0	3,250.0	340,555.6	256,125.0
Crusher	237,650.0	.	.	356,250.0	287,500.0	183,533.3	416,666.7	296,950.0
Water pump	20,454.6	33,585.7	494,000.0	550,112.5	80,678.0	548,630.4	17,000.0	301,937.1
Modern Sluice box	.	.	600,000.0	957,685.2	208,500.0	990,276.2	.	948,018.1
Shaking table	.	.	.	100,000.0	100,000.0	.	.	100,000.0

Source: survey data, March – April, 2022

The daily rental costs of gold processing machines across gold miners and regional states differ. For instance, daily rental price of water pump varies from 350 Birr for individual miners to about 2000 Birr for SSSM due to differences in capacity of water pumps as SSSM needs large capacity pumper.

Nearly for all types of producers, the proportions of miners who are aware of the best technologies outweigh those that have actually used them. For the MSE miners, the proportion of technology users is greater than those aware of the best technologies (see figure 2). These groups of miners use some form of technology and need to be advised on the best mining technologies to improve effectiveness.

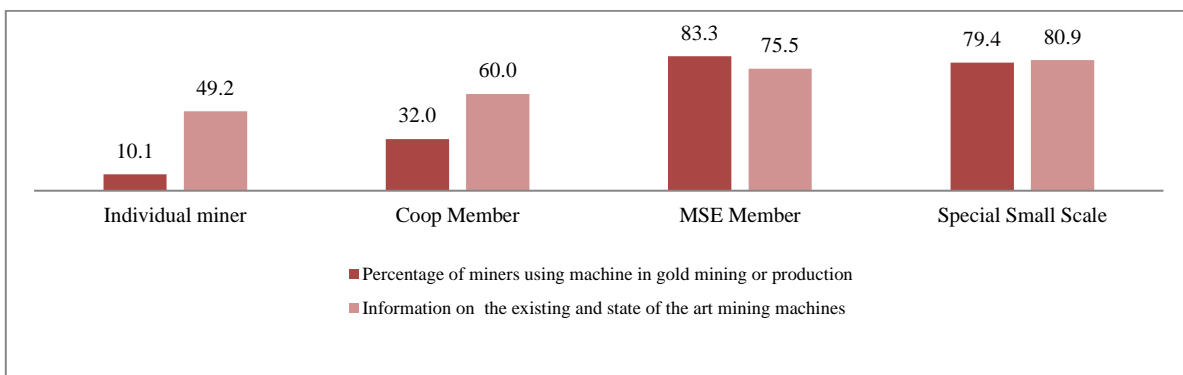


Figure 2: Machine usage and information on machine availability by type of miners (%)

We observe huge disparity among producers with respect to their demand for technology. Micro and small enterprises show an exceptionally high expressed demand for excavator (85%) followed by demand for crusher (11%) while 45% of the cooperatives prefer access to ball mill followed by excavator (25%). Individual miners demanded mainly three machines: crusher (21%), excavator (18%) and metal detector (15%).

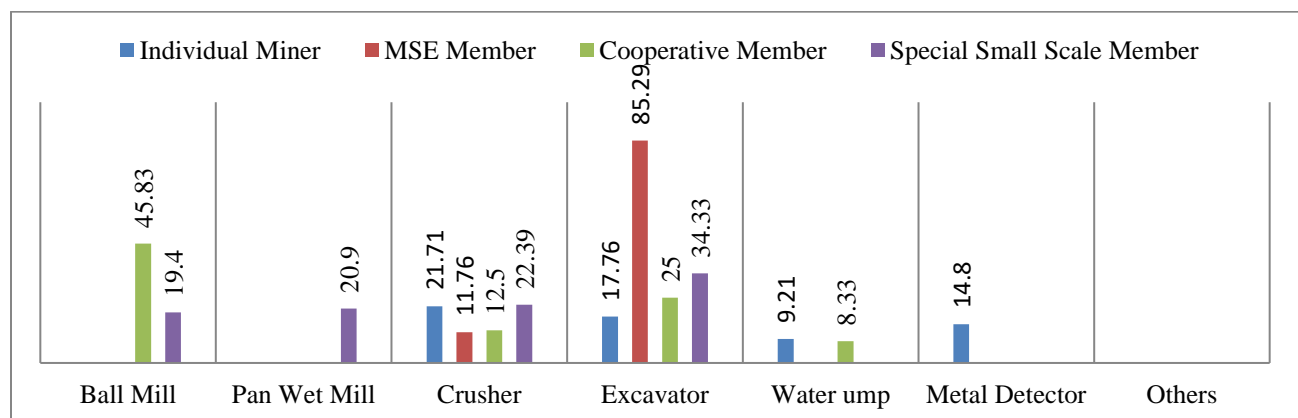


Figure 1: Future Demand for Technology by Miner Type

Majority of the sampled miners (61%) in the study area, with the exception of SSSM (nearly 53%), reported that they have access to extension services at woreda level.

Availability of extension services across regions is reported by 87, 85 and 75 percent of miners in Oromia, South West and Gambela regions, respectively.

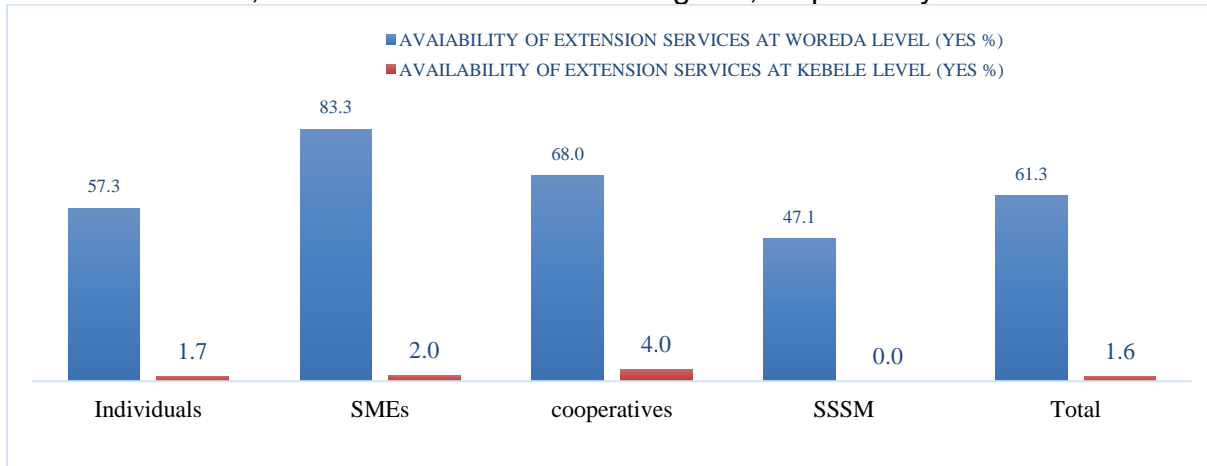


Figure 4: Availability of mineral extension services at Woreda and Kebele levels (share in %)

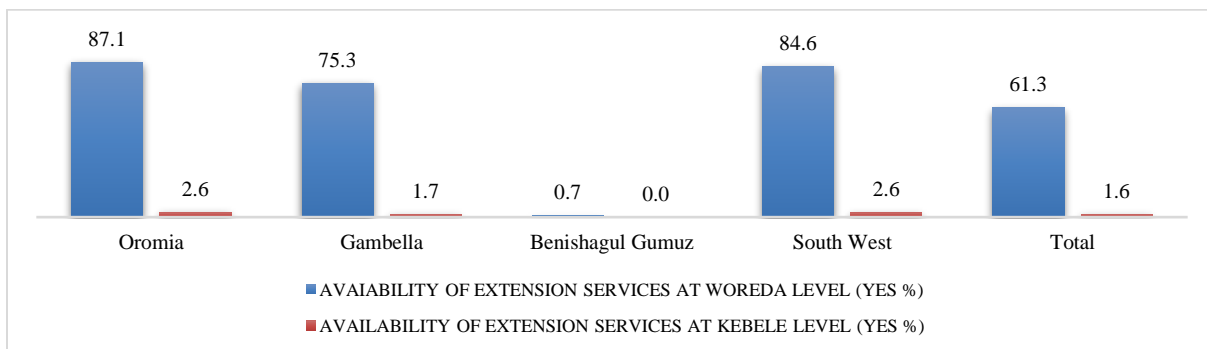


Figure 5: Availability of woreda/kebele level mineral extension services (share in %) by region

There are significant variations in trainings received by gold miners across regional states and types of miners. Of the sampled miners, only 20 percent have received trainings where large proportion of SMEs (about 64%) took the training but only 2% of individual miners received any form of training (see figure 25). Regionally, about 70% of the sampled miners from Oromia region received training while none of the sampled miners from Benishangul Gumuz received any training on mining and processing (figure 26).

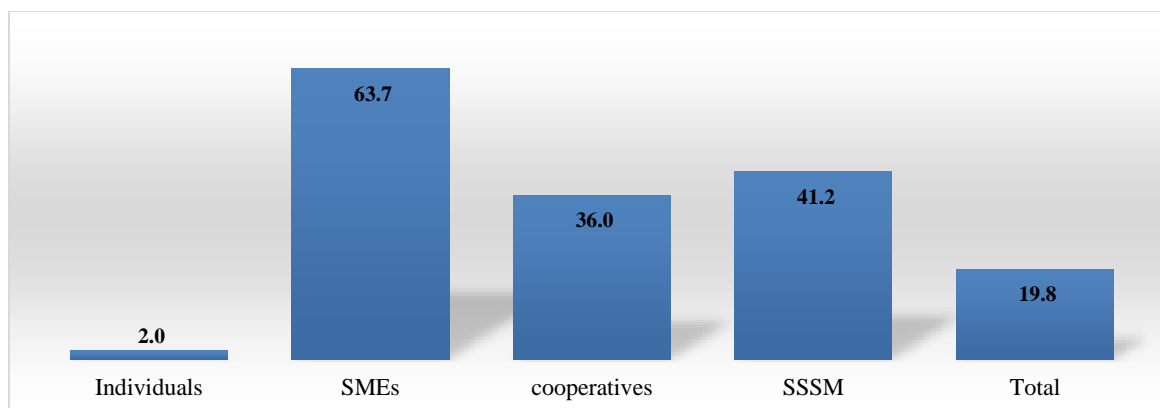


Figure 6: share of respondents who have received training (in%), by type of miners

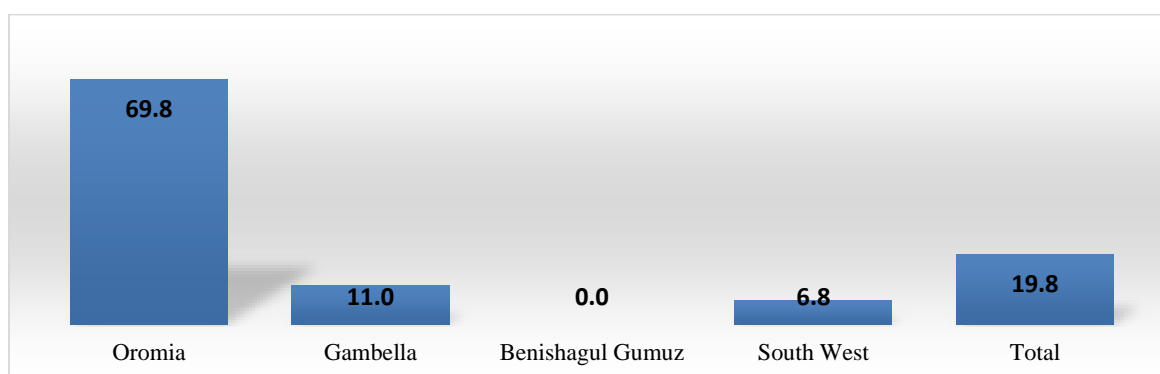


Figure 7: share of respondents who have received training (in%), by region

The types of training received by the miners were: training on mining and processing methods(51%), training on recovery of minerals from mining wastes(32%), training on quality testing methods and equipment(14%), and assessment of mineral potential(3%). In almost all regions, higher proportion of miners received training on mining and processing methods. In South West region, none of the miners received training on quality testing methods and assessment of mineral potential.

Table 9: Type of training received by regions

Region	Type of training received				Total
	Assessment of gold potential	Mining and processing methods	Recovery of minerals from mining wastes	Quality testing methods and equipment	
Oromia	2	39	29	11	81
	2.47	48.15	35.80	13.58	100.00
Gambella	1	10	4	4	19
	5.26	52.63	21.05	21.05	100.00
South West	0	6	1	0	7
	0.00	85.71	14.29	0.00	100.00
Total	3	55	34	15	107
	2.80	51.40	31.78	14.02	100.00

Source: survey data, March – April, 2022
percentages

Note: first row has frequencies and second row has row

Table 18 shows the duration of training in days, where nearly 37 and 22 percent of miners received two- or three-days training while about 14, 11 and 8 percent of miners received

5 days, 4 days and 1 day training, respectively, which shows that most trainings are only for few days.

Table 10: Duration of training in days

Duration of training (in days)	Freq.	Percent
1	9	8.26
2	40	36.70
3	24	22.02
4	12	11.01
5	16	14.68
6	1	0.92
7	3	2.75
Others	4	3.67
Total	109	100.00

Table 19 summarizes the reasons for not receiving training. Large proportion of miners (45%) reported that lack of responsible body to provide trainings is the main reason for not receiving training. About 24 percent of non-trainees reported lack of information as a reason for not participating in trainings and similar percent (24) reported that they were not selected for the training.

Table 11: Reasons for not receiving training

The reason for not going through training	Freq.	Percent
Lack of information	106	23.98
Lack of money	3	0.68
Not ready for training	4	0.90
No need for training	16	3.62
No responsible body to provide trainings	201	45.48
Not selected for training	104	23.53
Other (specify)	8	1.81
Total	442	100.00

Source: survey data, March – April, 2022

The survey data revealed that the most severe problems facing gold miners in the study woredas is lack of appropriate gold mining and processing technologies. The available technologies are outdated and the recent ones are expensive to purchase and highly complex to operate. Thus, this calls for provision of appropriate gold mining and processing technologies as per the demand of gold miners by types of miners and by regions/woredas, on the one hand, and provision of basic skills on how to operate the machines and to undertake some basic maintenances. Over 77% of the surveyed gold miners mentioned that lack of appropriate gold mining technology as the top three constraints that hinder gold mining in the selected regions (see figure 29).

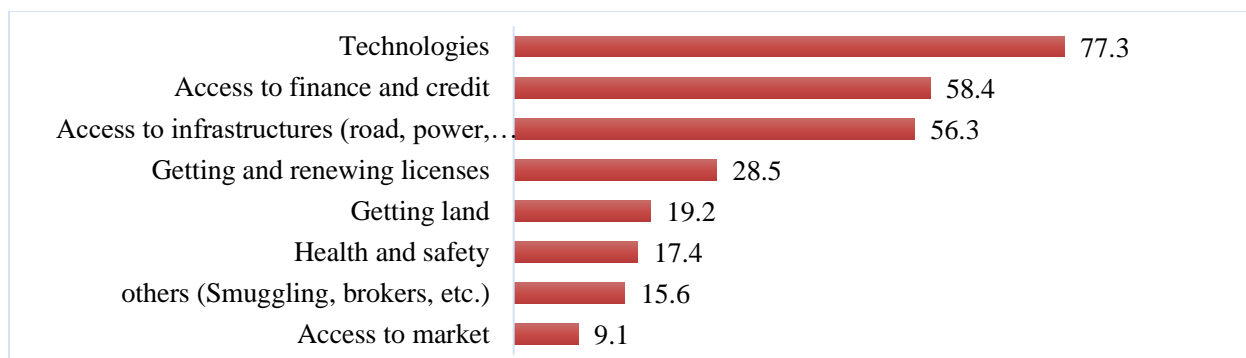


Figure 2: share (%) of respondents mentioning the top three constraints in gold mining

2.3. Economic Aspect of Artisanal and small scale gold mining and processing

Previous studies indicate that the contribution of ASM to national economy is not significant but has considerable potential to be exploited. The contribution of ASM to the local economy is not known for certain. The costs and benefits of the mining activity has not been gauged. The subsector is poorly financed. There are a great deal of stumbling blocks that hamper financing. Intervention of the Ministry of Mines is nonexistent in this matter. It is reported that the market for mineral products is distorted. For gold there are well-established market linkages. Given these shortfalls, it requires to study the actual contribution of the subsector, the determinants to the low performance of the subsector. the opportunities, the contributions and the effects to the local economy, the costs and benefits of the mining subsector, the marketing links including the need for establishment of market centers, the prevailing mechanisms of smuggling applied, the smuggling level, the mechanisms to be adopted to mitigate such activities, the extent and shortfalls of financing, novel ways of providing financing for miners, and the potential for value-addition.

2.3.1 Outputs and Inputs

Monthly gold production considerably varies across the mining types. Individual miners reported a production of 18 grams per month. The monthly production figures are substantially larger for the relatively organized miners: 73 grams/month for MSE, 193 grams/month for cooperatives, and 260 grams/month for SSSM. MSE, and SSSM prefer to operate during dry season than rainy season even though most individual and cooperatives operate throughout the year. Interestingly, most miners use motor bike as a major means of transport from residence to mining sites. Except for SSSM that uses vehicles, traveling on foot is expressed as the second most important mode of transport to mining sites.

Table 12: Gold production related issues

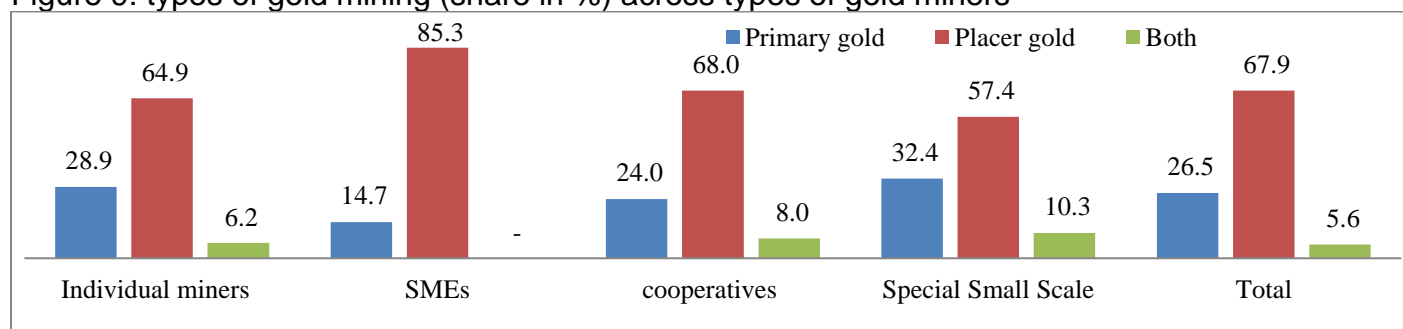
Type of miner	unit	Individual miners	MSE	Cooperative	SSSM	Total
During the last 12 months, did you produce gold?	%yes	97.5	81.4	96.0	83.8	92.7
If yes, average monthly production of gold?	grams	18.0	73.4	192.7	259.7	62.2
Is gold mining your primary occupation?	%yes	95.2	69.6	64.0	69.1	85.8
During the last 12 months, in which season did you mine gold?						
Dry seasons	%	32.6	79.4	32.0	77.9	46.8

Rainy seasons	%	14.6	2.9		2.9	10.3
Throughout the year	%	51.7	12.8	64.0	14.7	40.5
Only few weeks	%	0.6				0.4
Other, specify	%	0.6	4.9	4.0	4.4	2.0
Means of transport to mining site from residence						
On foot	%	39.0	33.3	20.0	2.9	32.7
Motor bike	%	56.2	66.7	76.0	51.5	58.4
Other vehicles	%	3.9		4.0	45.6	8.4
Other	%	0.8				0.5

Source: survey data, March – April, 2022

The two types of gold mining, placer gold mining and primary gold mining, share the miners unequally. Figure 9 indicates that all type of gold miners mostly engaged in mining placer gold with the highest percentage in SMEs (85%) followed by cooperatives (68%) and individual miners (65%). On the other hand, the percentage of SSSM engaged in placer gold mining is relatively lower indicating that SSSM also mine primary gold by digging deeper. Surprisingly, about 29% of individual miners are engaged in primary gold mining, which is higher compared to SMEs and cooperatives implying that individual miners also dig deeper in search for gold.

Figure 9: types of gold mining (share in %) across types of gold miners



Among all miners a sharing modality of production output takes place in differing proportions. The sharing arrangement could be 30 % of the output for the miners and 70% for land owners or 40-60 or 50-50 respectively as shown below

Table 13: production sharing modality and arrangements (share in %)

Sharing arrangements	Individual	SMEs	cooperatives	SSSM	Total
30-70	42.11	7.84	62.5	37.5	33.8
40-60	11.4	64.71	12.5	7.5	23.47
50-50	42.11	21.57	12.5	32.5	34.27
Others	4.39	5.88	12.5	22.5	8.45

Source: survey data, March – April, 2022

Land size

There is considerable variation in total land size for mining across miners. The reported average land size is 0.8 ha for MSE, 1.2 ha for cooperative, and 5.3 ha for SSSM. The miners stay in a particular location at least for 16 months (individual), 7.2 month (MSE), 24 months (SSSM), and 28 months (cooperatives). Almost all organized miners operate with land under licence. About 0.6% of individual miners claim to have a mining licence.

Table 20 also shows that land under licence is mainly obtained from government in the case of cooperatives and SSSM and from own holding in the case of MSE.

Table 14: Experience in gold mining and access to land

Type of miner	unit	Individual	MSEs	Cooperative	SSSM	Total ⁵
Experience in gold mining	years	7.9	2.0	9.2	7.7	6.8
Total size of land for mining	hectare	NA	0.8	1.2	5.4	2.4
Cost of acquiring the land	Birr	617.6	19,785.3	1,270.0	69,576.5	12,705.8
Primary decision maker on this land						
Myself	%	62.6	1.0		32.4	44.7
The association/coop	%	2.0	9.8	88.0	2.9	7.4
The MSE	%	8.4	89.2	4.0		16.7
The SSSM	%				55.9	12.3
Others	%	27.0		4.0		17.6
The owner or SSSM manager	%			4.0	8.8	1.3
For how long have you operated in this location/site?	months	16.0	7.2	28.2	23.7	15.9
Proportion of mining land allocated for gold mining?	Percent	6.1	49.5	30.6	50.3	20.7
Total area for which you have issued license	ha	1.0	0.8	1.4	3.1	1.6
Where did you get the land on which you are licensed?						
My own holding	%		51.5	8.3	16.4	34.0
Obtained from government	%	50.0	14.9	91.7	75.4	44.7
Rented/contracted from private holders	%		30.7		4.9	18.1
Open access	%	50.0			1.6	1.1
Communal land	%		3.0			1.6
Others	%				1.6	0.5
Total	%	100.0	100.0	100.0	100.0	100.0
If contract, for how long?	years	0.3	0.8	0.4	1.8	0.6

Source: survey data, March – April, 2022

Working days

The average number of working days slightly vary across type of miners where cooperatives spent the highest number of days per month (27.6 days) on gold mining whereas micro and small enterprises (MSEs) spent the least number of days per month (19.5 days) on gold mining. Similarly, average working months per year is the highest for cooperatives (8 months) while MSEs spent least months per year on gold mining. Most of MSEs (70%) and SSSM (73.5%) use daily laborers whereas only 7% of individual miners use daily laborers. Salary of daily laborers varies across types of miners based on the location and types of daily workers (see table 23).

Table 15: labor inputs used in gold production and processing and related costs

Labor inputs	Individual	MSEs	cooperative	SSSM	Total
Average working days (in #) per month	23.1	19.5	27.6	24.1	22.7
Average working months (in #) per year	7.5	5.2	7.9	7.0	7.0
Seasonal variation in actual mining days per year	77.3	92.2	68.0	86.8	80.8
Average working days (in #) per seasons in most busy seasons	71.3	57.6	36.0	60.9	65.9
Average working days (in #) per seasons in slack seasons	45.0	46.5	13.2	41.3	43.4
Do you employ daily laborers for gold mining (yes in %)	7.0	69.6	24.0	73.5	27.6

⁵ The total land (in ha) is only for organized gold miners as private miners have no fixed place to mine gold

Average wage for daily laborers (Birr)	98.2	263.0	173.7	448.5	293.4
Do you use contractual labor (% of yes)	0	4.9	0	35.29	5.26
Average number of contractual laborers per season	NA	4.60	NA	8.13	7.52
Average monthly salary for contractual labor (Birr)	NA	5,060	NA	6,443.3	6,205
Do you use permanent labor (% of yes)	0.56	14.71	8.00	22.06	6.17
Average number of permanent laborers	1.0	1.9	9.5	6.7	4.4
Average monthly salary for permanent labor (Birr)	4,500.0	3,767	4,750.0	10,193.	6,703

Source: survey data, March – April, 2022

Other inputs

In addition to labor inputs, gold miners use several inputs in gold mining including chemicals, water, fuel, spare parts for various machineries and sacks for gold mining and processing. These inputs are used among all types of gold miners (individuals, cooperatives, SMEs and SSSMs). The amount of these inputs used by gold miners is presented in the following table 24.

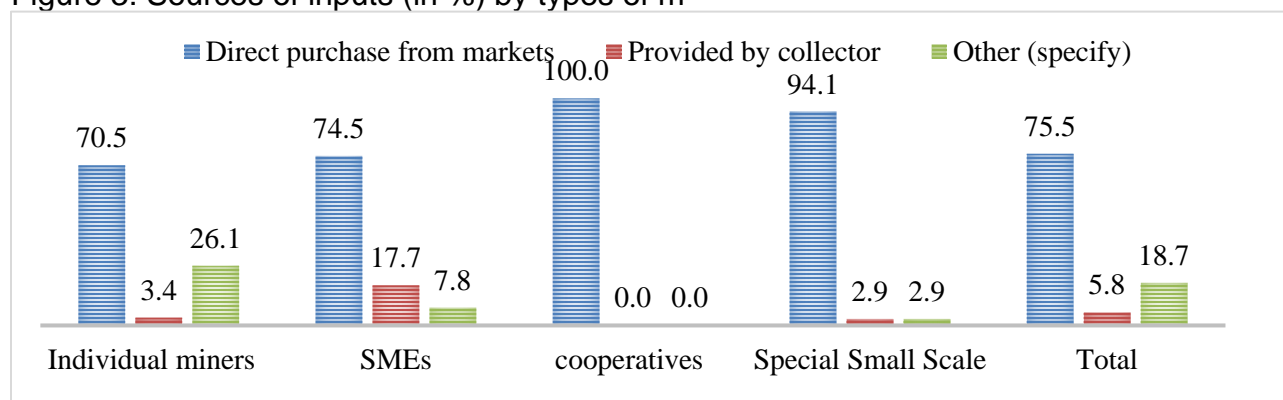
Table 16: Average amount of other inputs (per month) used in gold mining and processing

Other inputs	Individual miners	SMEs	cooperatives	SSSM	Total
Chemical (in liters)	20.1	4.8	1,198.5	1,413.5	242.7
Water (in liters)	3,295.8	31,886.0	23,400.0	19,889.7	11,526.9
Fuel (in liters)	21.5	2,844.4	339.0	21,080.7	3,162.6
Other inputs (like spare parts)	20.1	0.0	159.4	4.8	20.5

Source: survey data, March – April, 2022

These inputs are directly purchased from local markets and only limited number of inputs is supplied by gold buyers (or collectors). Thus, the gold miners have limited linkages with gold buyers/collectors in terms of supply of inputs used in gold mining activities (see figure 10).

Figure 3: Sources of inputs (in %) by types of m



Average monthly costs of other inputs vary by type of inputs and gold miners. For SMEs and SSSM gold miners, the average monthly cost related to fuel consumption is high where that of SSSM is several folds of that of other types of miners. Surprisingly, average costs on water are greater than average costs of fuel for individual and cooperative miners (see table 25). This indicates that scarcity of water is severe in most of the mining sites.

Table 17: Average costs (per month in Birr) of other inputs used in gold mining and processing

Types of other inputs	Individual	SMEs	cooperatives	SSSM	Total
Chemical (liters)	72.8	107.8	197.3	15,068.1	1,935.5
Water (liters)	3,301.7	769.6	24,966.8	11,024.0	4,732.3
Fuel (liters)	1,688.0	57,347.7	24,351.0	361,682.3	57,507.7
Other inputs (like spare parts)	435.2	305.9	9,395.1	2,853.0	1,101.1

Source: survey data, March – April, 2022

There are also expenses related to royalty, which has significant variations among types of miners where SSSM pays the largest average royalty whereas individual miners pay the least. Similarly, income tax related to income from gold mining varies across types of gold miners (see table 26). Gold miners also spent money on basic items like food, shelter, transport and security. The sources of expenditure are mostly own pocket as there are limited access to credit from formal financial institutions due to lack of collateral and remoteness of gold mining sites.

Table 18: Average other expenses and payments related to gold mining

Types of other expenses	Individual	SMEs	Cooperatives	SSSM	Total
Average daily expenses on food per members	341.9	415.8	594.9	1,954.4	566.1
Average monthly expenses on shelter per member	902.1	169.5	700.0	980.1	767.0
Average daily travel expenses to and from mining sites	65.7	293.4	216.4	2,190.1	376.9
Other average monthly expenses (security, health, etc.)	608.0	145.1	2,176.0	18,605.3	2,814.5
Average amount of royalty payment for gold mining	321.2	5,301.7	308,550.3	110,897.1	28,874.6
Average amount of income tax for gold mining	3,729.9	1,966.7	74,368.0	15,772.2	8,094.7
Average amount of any other payment for gold mining (per year)	1,412.7	1,319.5	28,470.0	76,083.2	11,838.3

Source: survey data, March – April, 2022

Access to credit and saving

Miners need saving and credit services to satisfy their financial needs. The perceived availability of traditional and modern financial institutions in the respective locality of respondents indicates the very low level of availability of financial services, and the availability of traditional saving institutions is perceived to be more than that for banks, micro finance institutions and modern saving and credit associations. Despite the perceived availability of either traditional or modern financial institutions in the study area, large number of miners (52%) use bank and micro finance institutions to get financial services while only 12% of the miners responded to use traditional savings.

When the financial institutions are not available in their immediate kebele, miners are required to travel to other nearby kebeles/woredas. For instance, in Oromia region, which has on average the shortest distance to reach the closest possible Idir/Ekub, credit and saving institution and bank or microfinance institutions, miners travel on average 9.2kms, 12.6kms and 11.9kms respectively. On the other hand, miners in Benishangul Gumuz region travel the furthest distance to reach the same finance institutions to the extent of 21.5kms, 26.2kms, and 118.2kms respectively.

Miners who have not borrowed from financial institutions were asked about the major reasons for not borrowing, and the absence of lending institutions became the first major reason. This absence of lending institutions in the study area is probably because of security reasons or due to the very high transaction cost of doing business in these specific study sites. Although this is a preliminary finding, it shows the need for government intervention in creating a business environment conducive both for public and private financial institutions to open branches in these areas.

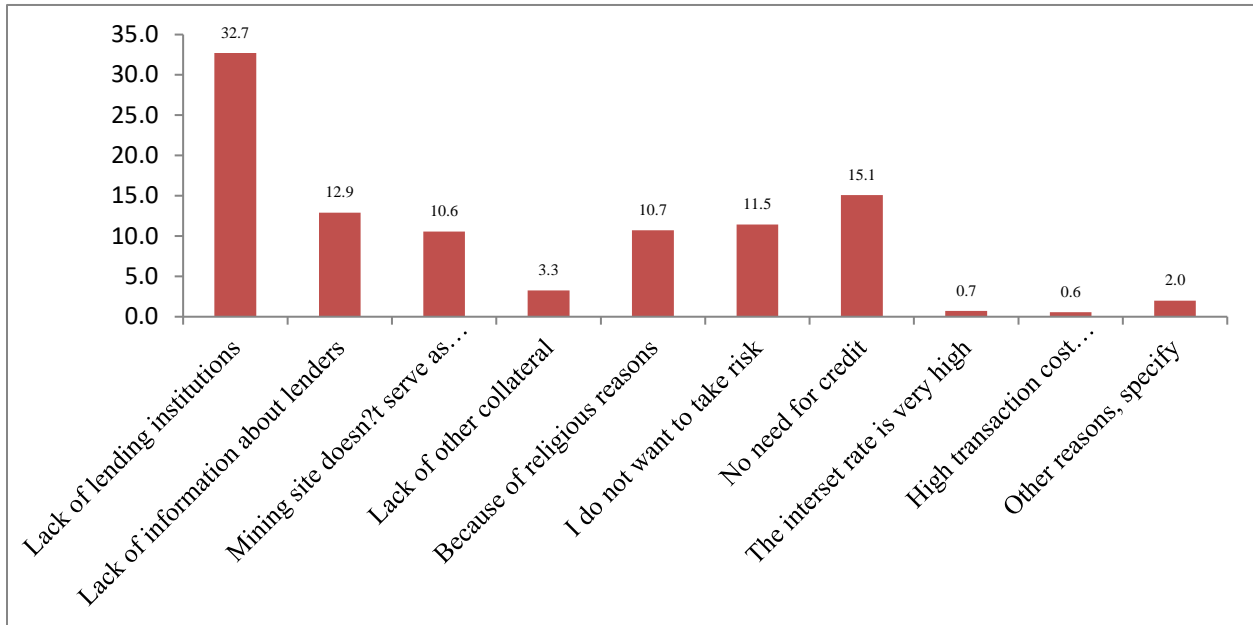


Figure 11: Reasons for lack of access to credit (share in %)

On the other hand, formal financial institutions do not give loan to artisanal, small-scale miners and dealers. Their mining license and land cannot be used for collateral purpose in the financial entities. Unless the miners have other business or permanent asset, getting loan from financial institutions in Ethiopia for artisanal and special small scale gold mining is not an easy task.

Machinery use, production level and productivity

Gold production substantially varies across the mining groups and use of machines. On average, those who use machines tend to produce more as compared to those who do not use machines. The difference is especially visibly larger for MSE and Coop & SSSM groups where the average production is more than double for those that use machines.

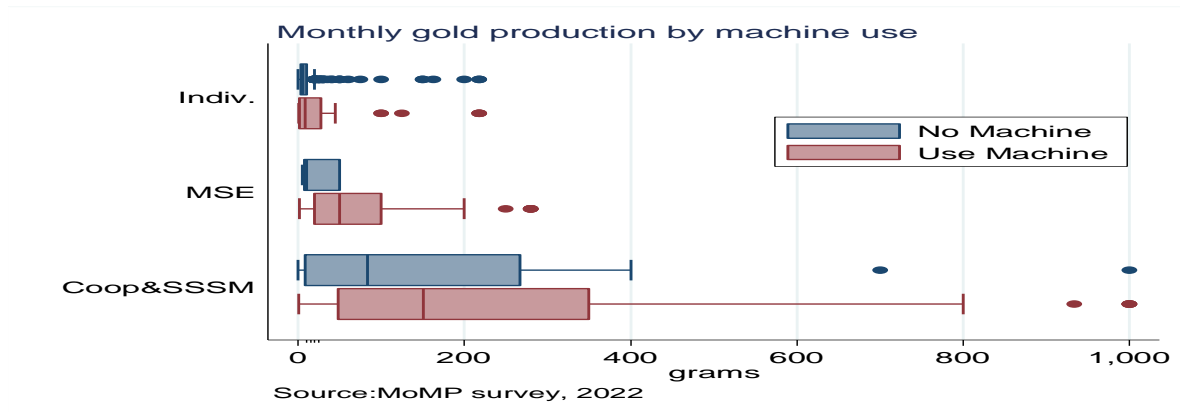


Figure 12: Machine use and gold production by type of miners

The summary results from ordinary least square (OLS) model and the doubly robust (DR) estimates indicate a strong positive effect of use of modern machines on productivity. The first specification in Table 27 presents estimates from OLS model in a less parsimonious setting where in addition to the ‘machine use’ variable, we also control for other important variables including miner characteristics (gender, age, education, religion, marital status,), mining characteristics (land size, distance to mining site), and different technologies (tools, extension service). The OLS-based specification shows a substantially large -i.e., 90% - gold productivity gain for those miners that use modern machines. The OLS estimates also show the causal effect of other variables on gold productivity. For example, it can be seen that land area for mining has a positive association with productivity -i.e., the larger the mining area, the greater the productivity. Interestingly, prices in formal market and informal market seem to affect gold productivity though in different direction. While gold prices in formal markets are found to be positively correlated (the higher prices in formal market, the higher the productivity), prices in informal market are found to be negatively related (the higher prices in informal markets, the lower productivity).

On the other hand, older miners, miner associations with larger members, and miners with access to information on quality testing also seem to have more productivity as compared to their counterparts. While OLS is good, in this case, however, it may fail to control for confounding factors. In line with that, the last columns of Table 27 also present results from the Doubly Robust (DR) estimates. Accordingly, looking at estimates from the Doubly Robust model, interestingly, the parameter estimates confirm the very high productivity gain in using modern machines. The estimates from the DR model, controlling for a range of important variables, indicate a significant positive productivity effect of modern machines use-i.e., 88%.

Table 19: Estimated productivity response to use of machines in gold production

Dependent Variable: log (monthly gold production in grams)				
Independent Variables	Unit	OLS		Doubly Robust ^{†*}
		Coef.	t	Coef. z

Use machine	yes=1	0.907***	3.65	0.879**	2.11
Land size (mining)	log(ha)	0.394**	2.01		
Transport to mining site	log (minutes)	-0.018	-0.04		
Selling price (formal market)	log(birr/gram)	2.518***	3.48		
Selling price (informal market minimum)	log(birr/gram)	-1.432*	-1.91		
average age of members	log(year)	1.019***	3.10		
total members	lot(number)	0.679***	3.07		
shovel	yes=1	-0.333*	-1.86		
Info on quality testing		0.898***	2.78		
Additional controls:					
Miner Characteristics (gender, education, religion, own phone experience, member size, have licence Other indicators (gold quality, mining season, tools) Access (extension service, proximity to selling site) Miner type			yes yes yes		
Constant		-10.009	-1.56		
Number of obs.		245			

Note: *, **, *** indicate significance at 0.1, 0.05 and 0.01 significance levels; robust standard errors

¥ bootstrapped standard errors with 200 replications

Source: survey data, March – April, 2022

Production constraints

Lack of modern technology was reported as the first, second and third major problem for miners in the study area where nearly 36, 20 and 21 percent of the miners reported it as the first, second and third problem (see Tables 36-38). About 27 and 13 percent of miners reported lack of access to infrastructure such as road, electricity etc. and getting license as their first major challenge. Although about 10 percent of the sampled miners reported lack of access to finance as their first challenge, a greater number of miners (36%) put it as the second major problem following lack of access to technology.

2.3.2 Marketing and sales of gold

The average volume of gold sold by each miner type over the 12 months period was about 233 grams with considerable variation across types of miners where individual miners sold the least (140 grams) whereas SSSM sold the largest amount (over 664 grams). Cooperatives had the next sales volume of about 634.6 grams (see figure 13). Of course, this should not be surprising as they are inherently endowed with better financial, human, and physical resources. The transaction of gold is predominantly carried out in cash regardless of the nature of the miners. The practice of electronic payments or credit scheme is almost negligible. This could be mainly attributed to lack of necessary infrastructure and limited awareness of modern methods of payment among artisanal and small-scale miners.

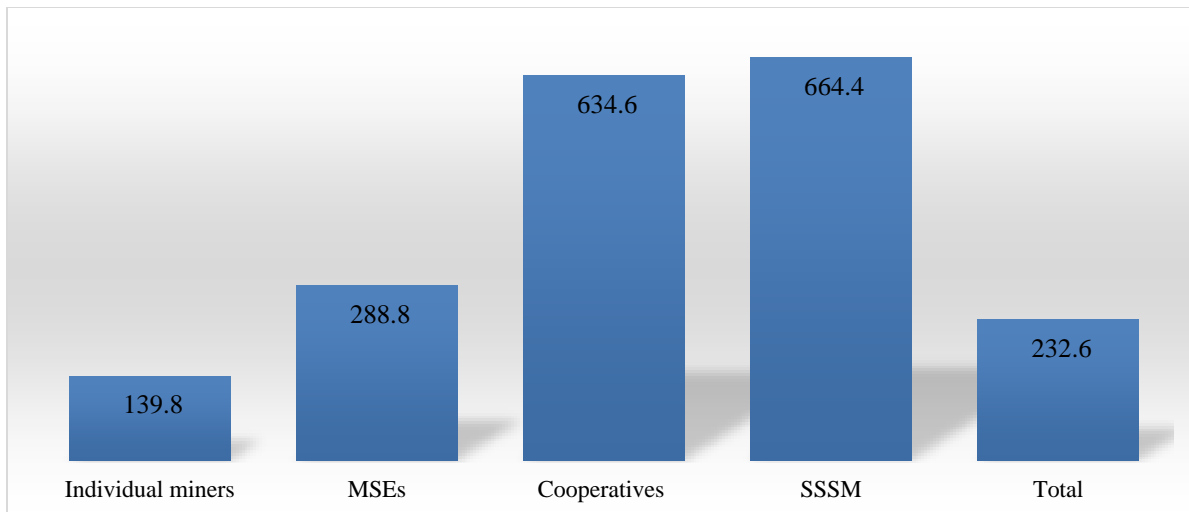


Figure13: Average volume of gold (in grams) sold during the last 12 months, by miner type

In terms of quality, nearly 46% of the total quantity of gold offered for sale by the surveyed miners was 21 Karats (21K). Pure gold, 24K gold, accounts for about 3% while the share of 14K gold is as low as 1% of the total (figure 14). Given the fact that about two-thirds of gold traded locally by the surveyed miners was at least 18K, there are good opportunities to produce high quality gold for local and international markets.

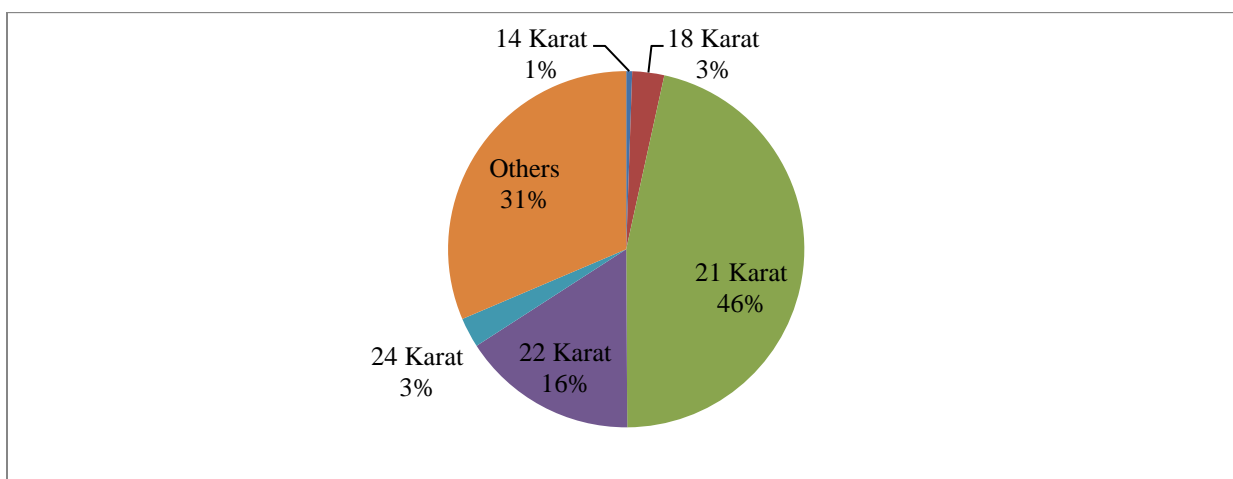


Figure 14: Quality of gold (in Karat) sold by the miners during the last 12 months

One of the main constraints in the transaction of gold is the mechanism of testing its purity. Gold suppliers/buyers in Oromia and Gambella are comparatively better endowed with such equipment. On the contrary, the proportion of miners having these tools is only 7% and 8% in Benishangul-Gumuz region and South-West region, respectively (figure 15). According to the survey result, this problem is more prevalent when the transactions take place in parallel markets or the major suppliers/buyers are traders/collectors.

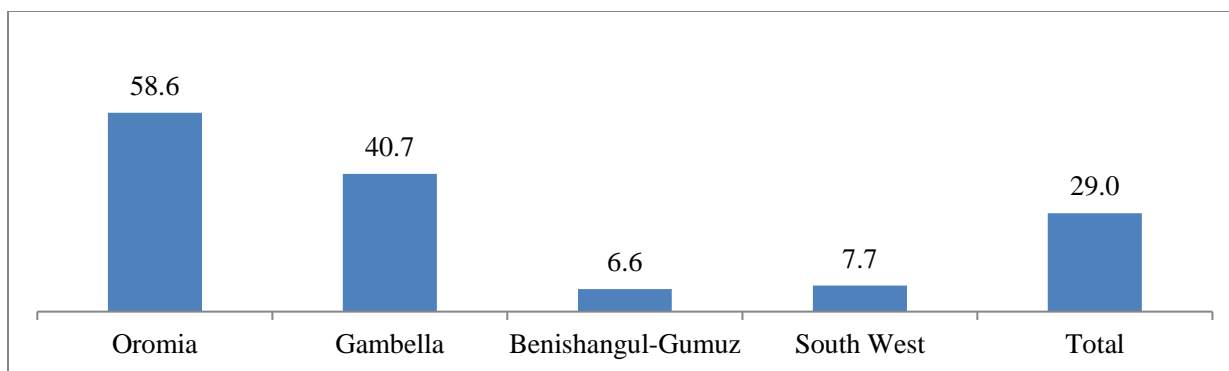


Figure 15: percentage of ownership of gold purity testing equipment/tools among buyers: by region

Globally, there are various tools/equipment used for testing purity of gold. One of the most widely applied instruments is Karat-Meter. Among those buyers who possess gold testing facilities, only 27% of them reported that they use Karat-Meter (figure 16). About 40% of them apply either distilled water or combination of distilled water and mineral or distilled water and Karat-Meter. Still considerable share of miners depends on other testing mechanisms.

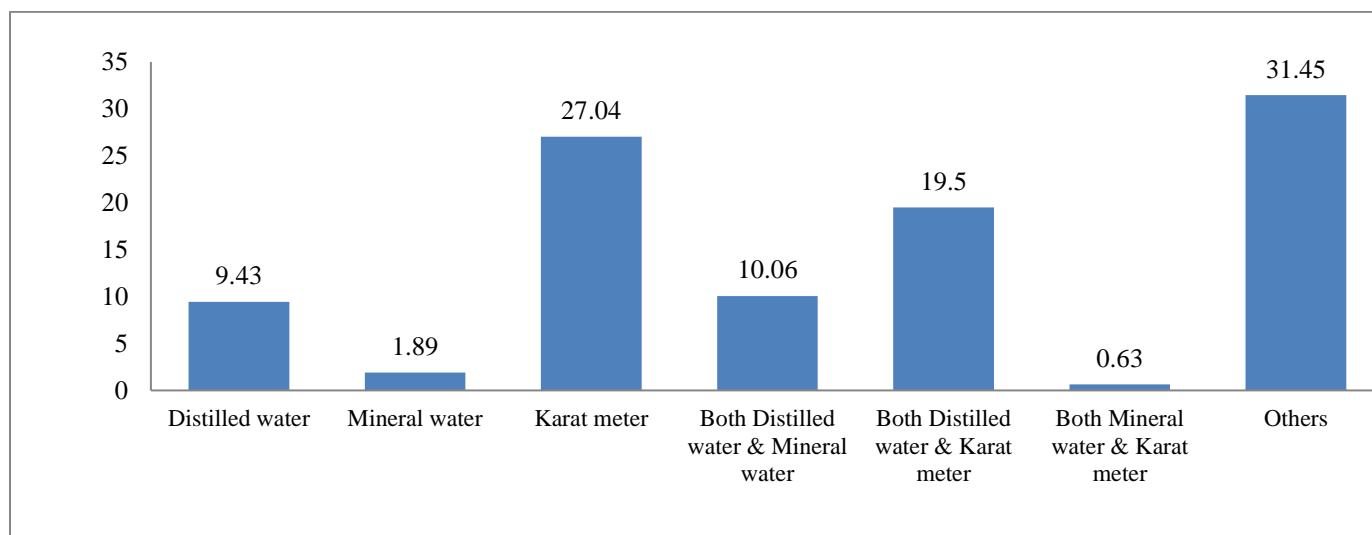


Figure 16: Tools/equipment used by buyers for detecting the quality of gold (in percent)

Evidently, the major buyers of gold tend to vary for each category of miner/seller. The share of gold channeled to collectors/traders accounts for about 91%, 74%, 52% and 12 % for individual miners, MSEs, cooperative miners and SSSMs, respectively. While nearly 80% of the sales of SSSMs are directed to the Bank, sales to the Bank is almost negligible for individual miners. The corresponding figure for cooperatives and MSEs stood at about 48% and 15%, respectively. Except individual miners, other types of miners declare that they have not sold any volume of gold in the parallel market over the 12 months period. Others buyers mainly include other Special Small-Scale miners and mining land owner.

Table 20: Major buyers of gold: by types of sellers/miners (percent of their total sales)

	Individual miners	MSE	Cooperative	SSSM
Bank	-	14.7	48	79.4
Collector/trader	91	73.5	52	11.8
Parallel/black mark	2.5	-	-	-
Other cooperatives	1.4	-	-	1.5
Others	5.1	11.8	-	7.4
Total	100	100	100	100

Source: survey data, March – April, 2022

The most important factor affecting the decision to sell is the amount of gold. Since the Bank does not accept less than 50 grams of gold, it is rational for the sellers to approach other buyers who don't impose such restrictions. The second key factor, as indicated by the respondents, is whether the buyers can make the payments immediately. Sellers are also attracted to those buyers who offer higher prices, those who are close-by, those having good weighing system, those making purchases at the mining site, and those providing advances or those who lend money to the miners/sellers.

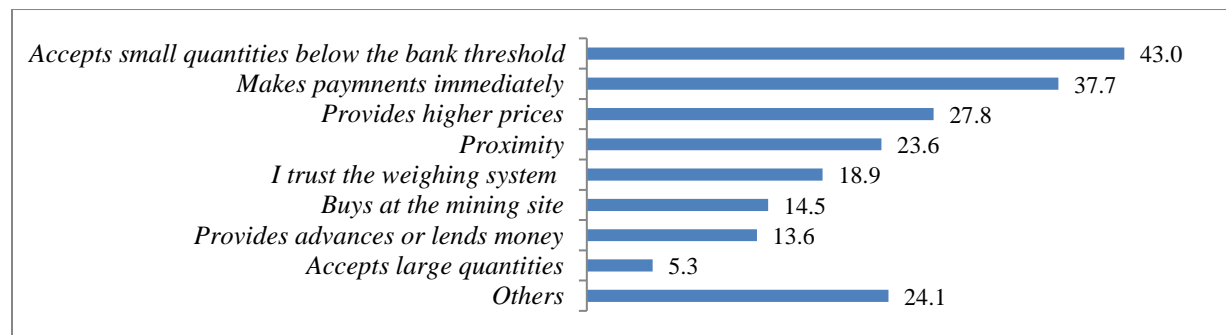


Figure 17: Major reason for the choice of a particular buyer by a seller (in percent)

Given the minimum threshold set by the National Bank of Ethiopia with respect to the quantity of gold, the artisanal and small-scale miners have to make their own decisions when the levels of gold output appeared to be below the fixed amount. The highest share of the respondents (64%) replied that they would sell the amount of gold below the minimum threshold to formal traders while about 17% of them would undertake additional gold mining until they meet the minimum standard in terms of quantity. Fortunately, only 4% of them make sales to informal traders under such circumstances.

Table 21: Miner's decision when the amount produced is less than the minimum threshold

Decisions	% of respondents
Sell the amount of gold below the minimum to formal traders	64.3
Mine additional gold till the minimum is met	17.6
Sell the amount of gold below the minimum to informal traders	4.0
Combine with other miners	1.5
Sell the amount of gold below the minimum to local jewelers	0.2

Others	12.5
Total	100.0

Source: survey data, March – April, 2022

The average selling prices of gold (per gram) in the formal market range from 2242 birr to 2862 birr. The corresponding prices are just 1316 birr and 1544 birr in the informal case. This finding corroborates the extremely limited transactions of gold trading in parallel markets. Geographically, the average selling price of gold in general and 21K of gold (in the formal market) in particular is found to be relatively higher in the South-West region and Oromia region than in Benishangul-Gumuz and Gambella.

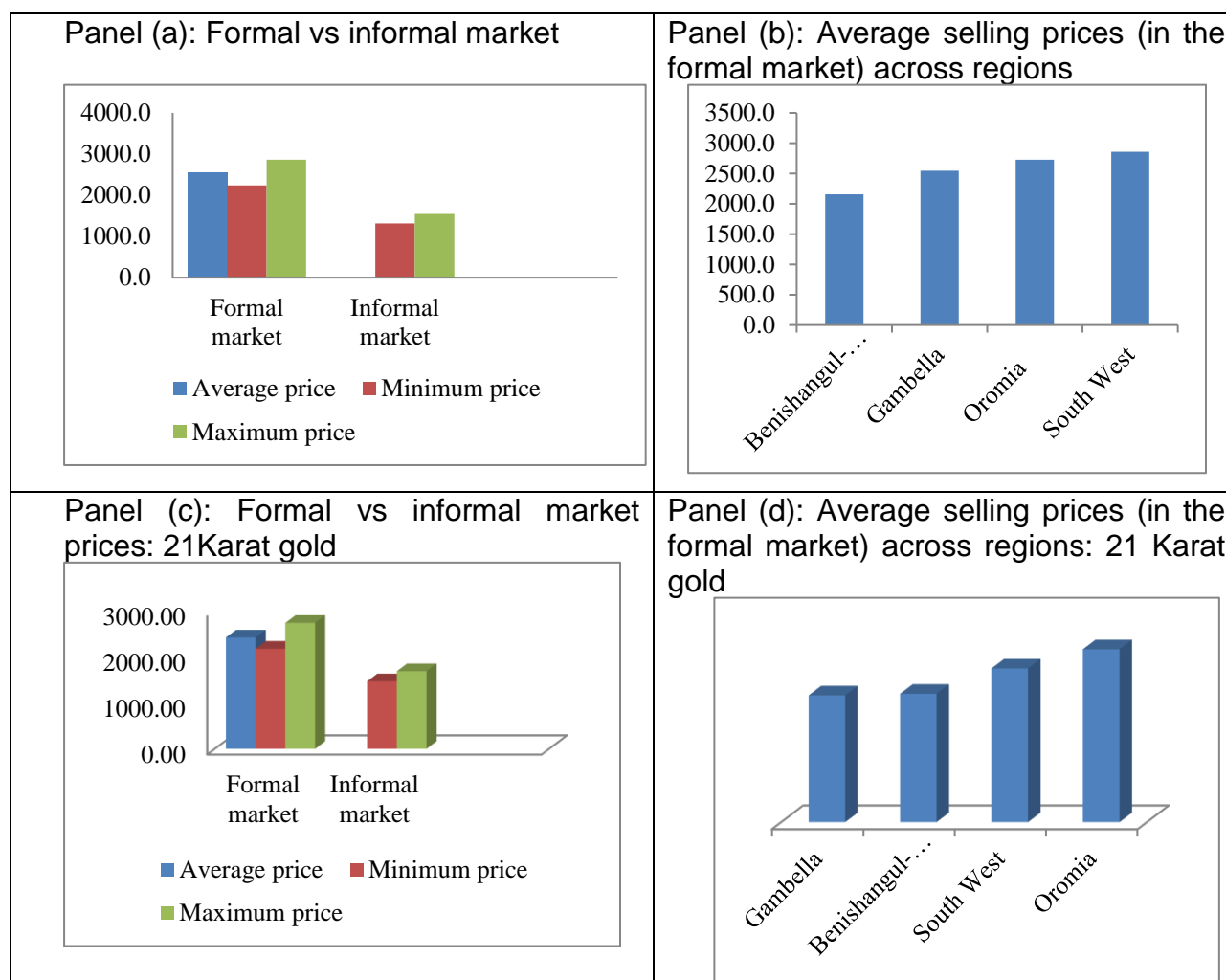


Figure 18: Selling price of gold (birr/gram): formal vs informal markets and regional comparison

On average, about 42% of the miners go to the selling posts on foot. Distance to selling posts, travel costs, and expenditures for security and accommodations are costs incurred by artisanal and small scale. Ease of availability of gold buyers/suppliers to bank at the locality of the miners would likely reduce the inconveniences associated with the transactions of gold. Nearly 60% of the surveyed miners assert that this arrangement is

at least moderately beneficial to miners. In the transaction of gold, both parties need to agree not only on the price but also on the weight. More than 90% of the miners agree that this mineral is weighed by the buyers before making the transactions. However, almost 83% of them indicate that they don't contact other buyers before making the final transactions. More than 60% of the transaction of gold takes place at trader's shop (fixed). Other major sites include local bank (13%), local daily markets (11%), and on farm or at home (11%). The payment structure is predominantly one-time payment whereby the buyers make 100% disbursement at the agreed price.

The gold prices are predominantly fixed by the buyers/ suppliers where the impact of the sellers is almost negligible. In the case of formal transaction involving the local bank, the prices are determined by the bank. However, more than 70% of the surveyed miners perceive that the price they receive from sales of gold is fair. Moreover, about three-quarters of the miners don't have any record of conflict with the buyers/suppliers. For a given gold quality, individual miners receive between 2-7% lesser prices in formal markets as compared to their organized counterparts. Comparison of the maximum price in informal markets also reveals that, given quality, individual miners receive lesser price (at times up to 27%) as compared to the more organized miners. This could be due to either a quantity effect where individual miners may not be able to fulfill the minimum quota requirements or due to a poorer bargaining power.

Challenges of marketing and sales of gold

The political instability and security issue in the country is posing serious impediment both to the production and sales of gold. In addition to the instability at the national level, the key challenges related to marketing of gold include lack of market information (particularly price), the licensing procedures and requirements, the minimum gram threshold set by the bank and the distance to the nearest bank, domestic illicit trade, and cross border smuggling of gold.

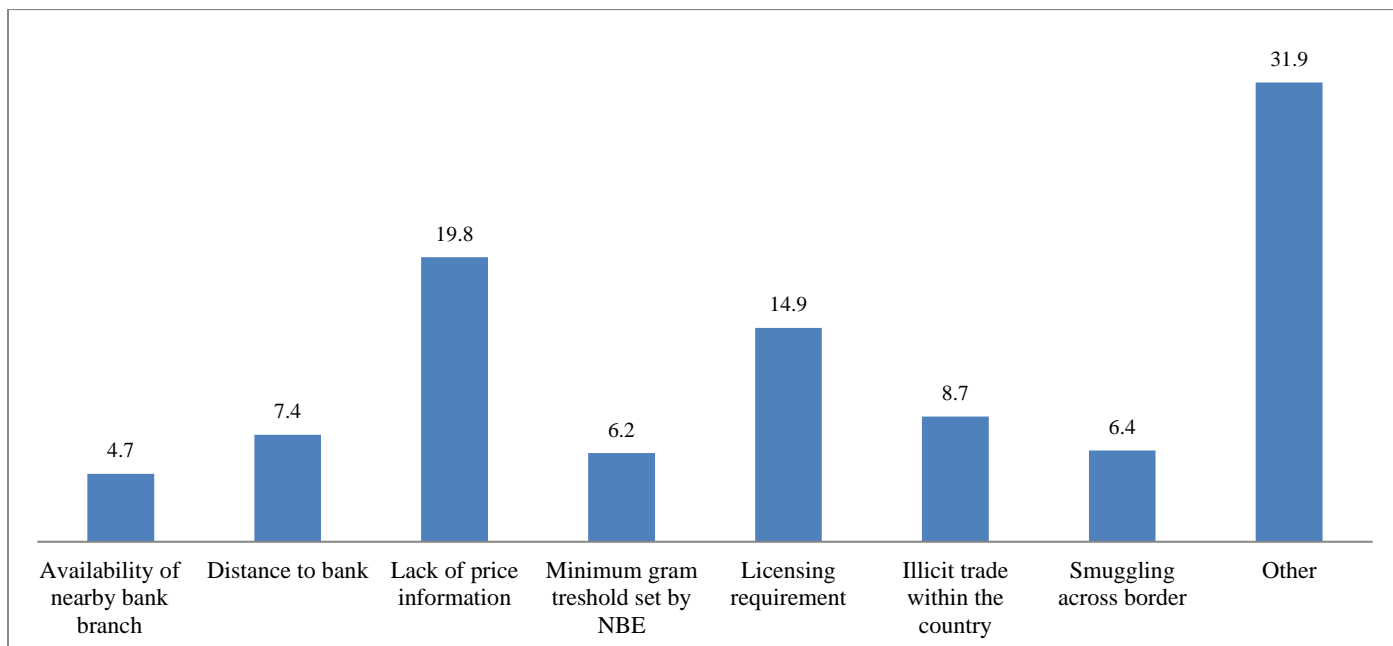


Figure18 : Challenges related to marketing/transaction and value chain of gold (in percent)

2.4 Legal, institutional and organizational aspects of gold mining, processing and marketing

Studies on ASM in Ethiopia indicate that there are related laws and regulations that are inadequate to deal with the sub sectors' problems and inappropriate to address main issues. Laws pertinent to allied sectors can affect the mining sector and particularly in most cases when the laws are not harmonized. Illegal practices and flouting of laws and regulations related to mining, environment, and marketing are reported. Implementation problems and failure of enforcement of the laws and regulation prevail. It requires to identify the applicable laws and regulation that may be inadequate to address problems of the subsector, the laws and regulations that are inappropriate for the sector, the laws and regulations in other sectors that affect operations in the subsector, the type of illegalities of practices in mining, environment, and marketing aspects, the extent of flouting the laws, laws that need harmonization and areas that government bodies fail to implement or fail to enforce. Applicable laws and regulations in the sector and outside the sector, mining , environmental and marketing laws open to be breached and the need for harmonization are sourced from the literature while the inadequacy and inappropriateness of the laws and regulations, the extent to which laws in other sectors affect the subsector, the extent of flouting the laws, the laws and regulations that are not enforced and the extent of failures to implement the rules and regulation have to be sought from surveys. Moreover, it requires to assess the involved national and subnational bodies or institutions and the division of labor between them in monitoring performance, ensuring compliances of various sorts and providing necessary services and assistance to identify gaps in the division of labor and rationalizing responsibilities and coordination role to attain improved performance in environmental management and other compliances. Assessment of the prevalence of these problems was conducted in the baseline study.

2.4.1 Perceptions of miners on existing rules

Existing government regulations related to royalty payments, land size, land use period, and other regulations of both federal and regional governments are perceived differently by different miners. Almost all MSEs consider the existing regulation either as satisfactory or good, while 30% of individual miners considered it bad and 58% of the same considers it satisfactory. Nearly half of the existing miners in general considered the regulations as satisfactory while more than 27% takes it as good. This level of partial satisfaction must not be ignored. Taking appropriate measure based on the perception of miners in terms of either changing the regulation or creating awareness about the existing regulations is essential for effective collaboration with miners.

2.4.2 Institutional and organizational aspects of gold mining, processing and marketing

Stemming from their mandates, tasks such as monitoring performances, ensuring compliances, and providing essential government services and supports to ASMs are

expected to be conducted by regulatory authority along the chain of government structure. Organs in government structure more or less involved in monitoring performance, ensuring compliances, and providing essential government services and support to ASM and small scale mining are Federal Ministry of Mines, Regional Mineral development Agency, Zonal Mine Office, Woreda Mineral Development Office, Kebele Manager, Woreda Land Management and Environment, Woreda Job Creation Enterprise, Security Office and Cooperatives Bureau. The responsibilities are shared along the chain from Federal Ministry of Mines to kebele. What matters, however, is whether the roles played by the various government organs along the chain of its structure are complementary or contradictory as performances of ASM miners in terms of production, productivity, marketing, and growth are affected by performances of these institutions and organizations.

Results from the survey show that almost all of gold miners perceive that their performances are being monitored by government structures at various levels: kebele, woreda, zonal, regional and federal government. Similar to performance monitoring, perceptions on monitoring compliances indicate that woreda mineral desk (69%) and kebele managers (50%) were exercising their role more than the roles played by zonal, regional and federal offices. The role played by zonal mine office in both monitoring the performances and ensuring compliances is less than that of regional agency/bureau. Despite the miners' complaint about the quality of support & services provided to them, 67.4% of the miners report that woreda mineral desk provide them support and service, while 42.66%, 24.2%, 21.5%, 21% and 12% admitted to have been supported and provided service by kebele manager, security office, zonal mining office, regional mineral development agencies and cooperative bureaus respectively. It has to be noted here that individual miners interact more with lower administrative units such as woreda and kebeles and individual miners are not much connected with higher government structure. The quality of services of lower administrative structure highly affects formalization of these miners and their overall performance. About 28% of the miners faced delays in addressing complaint followed by delays in service delivery by the bureaucracy (27%) and weak rule of law (18%). Evidence in this regard show that delays by the bureaucracy in delivering services is prevalent in Sharkole woreda followed by Oddo Shakiso and Dima respectively. Similarly, delays in addressing complaint is more reported in Dima and Oddo Shakiso in the order of magnitude. Miners in Bero believe that there is weak rule of law particularly in their woreda. Lower administrative units including woreda and kebele need to be strengthened and checked so that service delivery shall be improved and the efforts to formalize ASMs will be facilitated.

Conflict experience was reported by 17% of the miners, which is the effect of administration related causes. Among miners who experienced conflict, about half of them were individual miners and less than one third was SSSMs. The experience of conflict by MSEs and cooperatives accounts was minimal. The conflict was reported to be with other miner(s) (can be individual or group), with local community, with local authority, and even with large mining companies, despite differences in percentage. About 43% of the reported conflicts was with other miners (either individual or group), 22% with local community, and about 20% was with local authority. The cause of conflict

revealed that border issue (due to lack of clear demarcation of mining site) is reported as a major cause followed by forceful displacement. The two causes account for about 89% of the conflicts while the remaining weak sources are environmental damage, water shortage and others. It was also reported that almost all of the conflicts were solved through peaceful negotiations though handful cases remain.

Challenges

There are no well-organized documentations on mining in terms of proper mineral prospection, exploration, feasibility study, archive data etc. Absence of such information leads to low integrity among administrative bodies that are responsible in licensing, administrating and marketing mineral products. In addition, there are cross-regional inconsistent requirements for issuing licenses and duration of the validation period of the license.

In addition, government stakeholders at regional, zonal and woreda levels have limited capacity to follow up implementation of laws and regulations that govern the mining sectors. There is weak vertical communication and limited coordination among concerned government stakeholders (mining bureau, trade bureau, environmental protection bureau, etc.). There are no working manuals and guidelines for artisanal and small-scale gold miners. While the country has different mineral exploration and mining proclamations, governing bodies failed in implementing and enforcement of laws. Politically assigned administrative bodies have no know-how of the mining sector. License issuance is not transparent as licensing entity grant license without fulfilling the requirement, criteria and without demarcating mining land boundary. Some artisanal gold miners have no record on the date of license grant, license renewal etc. at the licensing authority. As most gold mining activities in Ethiopia take place near borders, many foreign citizens mine gold without any work permit, mining licenses, accountability in the use of mercury for gold amalgamation, destroying the ecosystem and gold smuggling.

Mining sector has suffered from changing governmental organizational structure, since the establishment of the Ministry that was organized sometime with energy sector, at other times with water and other unrelated sectors in its history. As such Ethiopian mining sector has lacked consistency, across time and across the regional states, in structure, licensing styles and criteria. It was pointed out in previous studies that many institutions, other than the Ministry of Mines and Petroleum, play roles in the ASM sector among which are sub national authorities. Overlaps exist in monitoring and ensuring compliances of various sorts in the sector. The mandate related to the environmental compliances is confusing in which coordination between Ministries, Departments and Agencies requires attention for improvement. Which institutions provide the necessary service and the capacity to provide necessary services to ASM operators lack adequate information. The roles Ministry of Mines, EPA, Job Creation Enterprise and other bodies providing oversight at sub national level must be clearly delineated.

2.5 Social and Environmental aspects of gold mining and processing

The extent of women's involvement in artisanal mining and the kind of service they provide define the role they play in the subsector, which is part of the investigated in this

section. The existence and the extent of gender-based violence (GBV) must be identified and quantified. Whether children are involved in mining and if involved the information on the extent of such involvement are important. Previous studies have shown that there are community benefits and costs with mining, but these have not been well quantified. It requires to properly investigate the positive and negative effects of ASM on mining communities. While it is generally accepted that mining has several environmental effects, greater evidence is required on the level and types of environmental effects. Miners' health and safety are adversely affected by mining; however, existing documents indicate that no accident statistics are kept in AMS sector. The survey attempts to address these issues.

2.5.1 Gender, child labor and community issues in gold mining

Mining operators response on whether there were women in their group and what women's roles were in gold mining indicate that there were some women in mining gold that take part largely in preparing food for miners (31%), washing gold (23%), administrative tasks (25%), Crushing stone (14%), fetching water (11%) and selling gold (10%) with regional differences. On the share of earning from mining gold that accrues to women, 70.2% respondents state that the share is equal while 9.3% of the respondents state that women earn more than male counterparts. The remaining 20.5% respondents state that the share in earning accruing to women was lower than their male counter parts.

The existence of gender-based violence (GBV) on women working in artisanal gold mining was assessed by asking all the respondents in general and only women separately. Both the responses indicate that the frequency of occurrence of sexual harassment, verbal harassment, discrimination in jobs and discrimination in decision making were low. General respondents state the existence of GBV in slightly higher percentage, i.e., 3% sexual harassment, 4% verbal harassment, 8% discrimination in job, and 2% discrimination in decision making, amounting to an overall 15% responses stating the existence of GBV while women respondents admitting the existence of GBV across regions were only 3%. Similar assessment across types of miners indicates that the occurrence of GBV as perceived by the women respondents is similarly low across types of miners.

Whether traditional norms related to involvement of women in mining existed was replied on the affirmative by 15% of the respondents. Among these responses, the negative norms related to involvement of women in mining were those limiting women's role to domestic matters (48%) and restricting the participation of women in mining (10.7%). Those who stated the existence of positive traditional norms that allow participation of women in mining were 35%. Whether there was a skill gap between genders was assessed and 65.5% believe there is no skill gap while 34.5 % believe there is skill gap.

For miners the most frequently mentioned inducement to involvement in mining was "better income as compared to other local activities", followed by "luck of alternative livelihood". Availability of the resource came as the third inducement while family experience followed it. Job satisfaction was the least inducement. Similar pattern is

observed in the reported inducements across regions. In the view of most respondents (94.7%), local communities participate in mining across all regions with differing rates⁶. Overall, the perceived participation rate by respondents is dominantly between 25% and 75%.

The reported negative effects of ASM on communities indicates that “increasing school dropouts” stands out as the most frequented response among all groups. The next in line were “Physical damage on children”, “Proliferation of sex work”, “Drug and alcohols addiction”, “conflict”, “Displacement”, etc. The reported positive effects of ASM on communities were fewer than the negative effects where “Cultural exchange” is the most frequented response among all groups. The next in line were “Job opportunity”, “Knowledge transfer”, “Positive spillover effect”, “better income”, and “Urbanization”.

Responses on whether own child / children participate in gold mining activities was predominantly “No” (91.5%). The remaining 8.5% admit that their own children were participating in gold mining across regions. Among miner types, relatively higher percentage of MSE members has own children in mining. The reported number of children range between one and fifteen. The most frequented number of children participating in mining was “One child” (29.8%). Regional comparison indicates that most of the reported numbers of own children participating in gold mining happened to be in Oromia (46.8%) and Benishangul (36.2%). Children participating in gold mining were reported to have been involved largely in administrative task (34%) and digging holes (34%) followed by washing gold. Digging holes is most frequented in Benishangul (23%) and administrative tasks are most frequented in Oromia (30%). Among these children 64.2% are not in school. The reason for not attending school could not be gleaned from the data. The respondents’ aspiration on the future of their children shows that 41% want their children to be employed in government or private firms, while 28.5% want them to run other business and 28.7% ambition is not specified.

2.5.2 Environmental aspects of gold mining

In artisanal mining washing the ore is the process by which gold is separated from its natural carrier. Among water sources of deep well, river, pond water, tap water, water tank, natural lakes and others, the main source was river (61.89%). By far the second source (14.16%) and the third sources (12.89%) were pond water and water tank respectively. The sources of water used for cleaning varies across regions. The use of river water is highest in Gambella followed, by far, by Oromia and South West Ethiopia Region. On the other hand, the distribution of the sources of water used for cleaning by type of miners indicates that “individual miners”, amounting to 36.7% of all miners, use river water most.

Among the various possible negative effects of gold mining and processing, (pollution of water bodies, air pollution, deforestation, land degradation, land sliding or collapse, soil contamination and others), pollution of water bodies was the number one negative effect

⁶ The highest frequency of stated by miners in Oromia was a participation rate of 70%; in Gambella it was 25%; in Benishangul 50% ; and that for South Western Ethiopia was 50% but with extremely low frequency.

of gold mining on the environment followed by deforestation as the second negative effect. Afforestation, refilling the holes, using environmentally friendly technologies, awareness creation on environmental effect, avoidance of hazardous chemicals, appropriate processing site selection and installing waste treatment plants were suggested by the respondents as the remedial measures in a multiple answer modality. Whether operators know about the environmental effect of the gold mining was answered negatively (over 80%) in the three regions other than Oromia. Responses from Oromia region indicate that there is more (63%) awareness of the environmental effect of gold mining. Awareness of the operators on environmental effect of gold mining by type of miners indicates that those miners organized in micro and small-scale mining enterprises have more percentage (11% of all miners) of aware members than the remaining 7.5% unaware members.

2.5.3 Health and safety aspects of gold mining, processing and marketing

Mining activity inherently entails a number of health and safety risks if they are not managed properly. In fact, the degree to which such adverse health effects are minimized is partly determined by the technology of mining. Despite all the necessary precautions, it is still likely that miners are prone to short-term or long-term health problems arising from gold mining. Exposure to various hazardous minerals, vectors of diseases and transmitters, pathological environment and other mechanical hazards are possible causes for various sicknesses associated with mining. The extent to which these exposures are perceived as causes of health hazards and the occurrences of actual health hazards needs assessment. Respondents were asked whether they have been sick during mining or just after leaving the mining site. The responses were largely “No” in Oromia (92%) and Benishangul (82%) while it was largely “Yes” in Gambella (94%) and South Western Ethiopia (85%). Overall, 55% claim that they have been sick while 45% did not. Those who experienced sickness, the diseases they suffered were 62% malaria, 10% waterborne diseases and 6% respiratory system diseases as shown in Table 76 below. Operators in Gambella region suffered most from malaria and waterborne diseases, followed by South Western Ethiopia region. Most of the respondents (81%) believe that the sickness was not the consequence of mining or the mining environment while 19% believe that the sickness was the consequence of the mining or the mining environment. The responses across regions have similar pattern of higher percentage of the belief that the sickness was not the consequence of mining. The response on whether a health professional has ever confirmed that the sickness was the consequence of mining or the mining environment indicates that only 17% are positive while the rest 83% state that health professional did not confirm that the sickness was a consequence of mining.

The injuries or accidents that occurred, as reported by the respondents, did not include most of the common injuries of eye damages, suffocation, broken legs or arms, lost legs or arms, head injuries, burning, poisoning by chemical, broken hips, backbone pain, and dehydration, with the exception of responses from Benishangul where backbone pain (28%), suffocation (13%), dehydration (10%) and eye damages (6%) were reported. The highest percentages of injuries or accidents that may have occurred do not incorporate the common accidents. Overall, 94% of the respondents do not use protective

equipment. The only where 23% operators reported to use protective equipment was in South Western Ethiopia. The distribution of the use of protective equipment among types of miners indicates that it is rather individual miners (5% of all) that use protective equipment.

The operators were asked whether they get their health status monitored regularly or not. Only 9% of the respondents, mainly from Oromia region, replied that their health status was regularly monitored, indicating that the overwhelming majority of the operators (91%) do not regularly get their health status inspected. The respondents also revealed that not only they do not get their health status inspected, but also there was no organized body for inspection and monitoring of health status in their locality as only 1% of the respondents expressed that an organized health monitoring body exists in their locality. Similarly, there was no regular inspection of mining equipment for safety and there was no organized body for the inspection of the mining equipment. Health service providing facilities were also nonexistent in the study areas.

Challenges related to Gender, Child labor and Community

There is a ground to suspect that Gender Based Violence (GBV) is covertly going on and unless women themselves reported it, it is difficult to identify. This stands as a challenge to address the problem. The other challenges are children's wide involvement in individual mining activities to augment family income and this has impact on their education. Child labor is high in Benishangul Gumuz and as a consequence dropping out of children from school has become a challenge. The gap in providing school feeding and parents need to augment their earning has induced child labor to prevail. In Gambella, a further challenge for persistence of child labor is that children are entitled to the full benefit of the mined gold without any share, which has created a strong incentive to children to remain in gold mining.

Environment related gaps and challenges

In Guji zone it is reported that miners leave open pits in mining sites upon realizing the non-existence of gold in the site without rehabilitating the site. Abandoning the site without rehabilitation is a customary practice of mining machinery owners who entered into product sharing agreement and such unregulated practices occur as a result of the gap in clear guideline and directive from the government side. As a consequence, large abandoned areas of mining sites left open without rehabilitation exist with no responsible individual for this malpractice. We may easily conjecture that such challenges and gaps are relevant to other mining sites as well.

While absence of clear guidelines could be a gap to address certain environmental issues, FGDS in Gambela and Benishangul reveal that there is lack of supports for stakeholders in ensuring the enforcement of existing rules and regulations related to environment. There is failure on the part of the regulator to implement, monitor evaluate and audit the operators with respect to environmental and social impact manuals. The federal environmental protection agency give inadequate attention to the mining sector. Logistics and budget support from Ministry of Mines for training, monitoring, evaluation and environmental auditing and creating awareness on environmental impact is much

needed. Licenses are issued without regulatory guidance on environmental obligations, and lack of support to raise awareness and build the capacities of miners on rehabilitation is the other challenge.

Health and safety related Challenges and Gaps

FGDs in Gambella express that the challenges to health and safety for artisanal miners and for local community are open pits, water body pollution, forest destruction, on the one hand, and the threat of illegal gunmen and criminals in the area. Safety and health issues are neglected. Moreover, producers use mercury (a dangerous chemical) to separate gold from ore without using any protection materials when they mine and process gold. They leave open pits without refilling them after they finish mining in that area, thereby exposing people and animal to lethal chemicals.

3. Summary and the way forward

Whether miners are organized or not, they have used traditional tools like shovel, batia and iron bar for gold mining and processing. Only 33% of sampled gold miners use modern gold mining technologies, of which only 10% of individual miners uses modern technologies and relatively larger proportion of organized miners, mainly SSSM, use modern technologies. As better machines can result in higher level of gold production, getting appropriate and affordable technologies is one of the key challenges facing gold mining sector. Limited access to finance and technical and business skills are conditions perpetuating the shortcomings in accessing technologies.

Addressing market related constraints are challenges that need intervention. Effective transaction of gold requires a mechanism of testing its purity. As it stands now only few miners possess testing equipment and technology. The problem is more prevalent when the transactions take place in parallel markets or the major buyers are traders/collectors. The decision to sell of miners is affected by the amount of gold, readiness of buyers to make the payments immediately, the closeness of the buyers to the sellers in terms of distance, the higher the price buyers are willing to pay, the wielding of weighing facilities, the readiness to provide advance payments and the willingness to lend money to miners. Since the Bank does not accept less than 50 grams of gold, it is rational for the sellers to approach other buyers who don't impose such restrictions. Lack of information on market price needs attention. The licensing procedures and requirements, the minimum gram threshold set by the bank and the distance to the nearest bank, are factors that influence domestic illicit trade, and cross border smuggling of gold.

Effective collaboration with miners requires reorienting the attitude and perception of miners on the existing rules and regulations, which may be effected either by changing the regulation or by creating awareness about the existing ones. There are no well-organized documentations on mining in terms of proper mineral prospection, exploration, feasibility study, archive data etc. There are no working manuals and guidelines for artisanal and small-scale gold miners. Absence of documentation and guidelines leads to low integrated moves among administrative bodies that are responsible in licensing, administrating and marketing products. Inconsistent requirements across regions in

ssuing licenses, setting the period of the validity of the license, and setting rates of royalty and income taxes are areas needing harmonization. Government stakeholders at regional, zonal and woreda levels have limited capacity to follow up implementation of laws and regulations that govern the mining sectors and limited coordination among concerned government stakeholders (mining bureau, trade bureau, environmental protection bureau, etc.) Political assignment of administrative bodies with lack of know-how contributes to low implementation capacity.

The sector certainly needs attention on issues of sustainable development, environmental protection, land use, societal benefit and social security. Women's role in mining sites is mainly supportive activities such as preparing food, while some taking part in washing gold and administrative tasks. General miner respondents perceive the existence of GBV in slightly higher percentage than women miners. While the existence of GBV is admitted the level seems suppressed and could be the tip of the iceberg. It seems appropriate to institute mechanisms for protection of women from GBV. Among negative norms against the involvement of women in mining are limiting women's role to domestic matters and restricting the participation of women in mining. There are perceived skill gaps in some regions (Gambella and Beishangul). The most potent inducement for involvement in ASM is the opportunity to get "better income as compared to other local activities", which is closely related to "luck of alternative livelihood". The dictates of creating equal opportunities to all necessitates removal of traditional norms and skill gaps to enable them exploit better income that other local activities do not offer for women and to cope up with the "luck of alternative livelihood". As a negative effect of ASM, "increasing school dropouts" stands out as the most frequented response followed by "Physical damage on children", "Proliferation of sex work", "Drug and alcohols addiction", "conflict", "Displacement", which are social problems that all call for some intervention. The level of awareness of artisanal operators on the environmental effect of artisanal mining is low, although the extent of awareness varies with the type of miners. MSE miners have more percentage of aware members than unaware members.

The survey indicates that more than half of all the miners across regions (55%) have experienced sickness. The most prominent sickness is malaria, remotely followed by waterborne diseases. The use of protective devices is not the norm and little percentage of the miners use protective devices. The overwhelming majority of the operators do not regularly get their health status inspected as there was no organized body for inspection and monitoring of health status in their localities. The sector requires more focus in providing health services, miners health and equipment inspection facilities. The following are recommended measures to bring about positive changes to the ASM and small scale mining sector.

Production and technology related

- Facilitation and provision of improved gold mining and processing technologies
- Providing Technical and entrepreneurship trainings to ASM and small scale operators.
- Availing credit lines and creating access to formal credit

Market related

- Enhancing access to markets to miners (making markets nearer to miners)
- Addressing sellers' preferences by making transactions at the mining site, providing advances or lending money to the miners/sellers.
- Improving the availability and accuracy of weighing and quality testing facilities
- Standardizing prices and providing price information
- Addressing the selling difficulties for miners associated with quantity thresholds.

Legal and institutional matters

- Modify the regulations or create awareness about the existing ones.
- Organize documentations on mining in terms of proper mineral prospection, exploration, feasibility study, archive data etc.
- Provide working manuals and guidelines for artisanal and small-scale gold miners.
- Harmonize cross-regional issuance of licenses, the validation period of the licenses and royalty and income taxes, the activities of stakeholders (mining bureau, trade bureau, environmental protection bureau, etc.)
- Build capacity of government stakeholders at regional, zonal and woreda levels and avoid political assignment of administrative bodies that lack know how on mining.

Social and environmental issues

- Attending health and safety issues of miners, particularly regarding malaria, waterborne diseases, and lack of protective devices, provision of health status inspection facilities and miners equipment inspection facilities.
- Addressing environmental issues through environment-friendly technologies and enhanced environmental awareness among artisanal and small-scale gold miners.
- Assist women to have a better role in mining.
- Provide improved protection for women against possible GBV
- Protect children in mining localities from dropping out from school and from physical damage

References

- Barreto, M. L., Schein, P., Hinton, J., & Hruschka, F. (2018). The Impact of small-scale mining operations on economies and livelihoods in Low-to Middle-Income Countries. UK Department for International Development, London.
- Biryabarema M. (2019). The potential for beneficiation of industrial minerals in Rwanda. IGC-Report. reference number: F-38422-RWA-1 (<https://www.theigc.org/wp-content/uploads/2019/01/Biryabarema-2019-final-report.pdf>)
- Childs, J. (2014) 'From 'criminals of the earth' to 'stewards of the environment': The social and environmental justice of Fair Trade gold' *Geoforum*, 57, pp. 129-137.

- EEITI (2015) Artisan Mining Operation Its Economic Values, Ethiopia
Ethiopian Extractive Industries Transparency Initiative (EEITI). (2016). Artisanal Mining Operation and its Economic Values, EITI Report, Ethiopia.
- Hentschel T. Hruschka F., and Priester M. (2003) Artisanal and Small-scale mining Challenges and Opportunities, Projekt-Consult GmbH
- Hilson G., S. Mondlane, A. Hilson, A. Tim Laing (2021). Formalising artisanal and small-scale mining in Mozambique Concerns, priorities, and challenges. IGC-Report. Reference number: F-19016-MOZ-1 (<https://www.theigc.org/wp-content/uploads/2021/06/Hilson-et-al-June-2021-Final-report.pdf>)
- Hilson, G., Hilson, A. and Maconachie, R. (2018) 'Opportunity or necessity? Conceptualizing entrepreneurship at African small-scale mines', *Technological Forecasting and Social Change*, 131, pp. 286-302.
- Keili A., Hailu Elias and Kebede Bekele (2021) Artisanal and small-scale mining in Ethiopia:
- M'cleod H. (2019). Priorities for mineral-led industrialisation in Rwanda. IGC Policy Brief 38422. (https://www.theigc.org/wp-content/uploads/2019/10/Mcleod-2019-policy-brief_updated.pdf)
- Mutemeri, N., Walker, J.Z., Coulson, N. and Watson, I. (2016) 'Capacity building for self-regulation of 27 the Artisanal and Small-Scale Mining (ASM) sector: A policy paradigm shift aligned with development outcomes and a pro-poor approach', *Extractive Industries and Society*, 3 (3), pp. 653-658.
- National Bank of Ethiopia (2021). Annual Report for 2020/21. National Bank of Ethiopia, Addis Ababa.
- Sauerwein, T. (2020) 'Gold mining and development in Côte d'Ivoire: Trajectories, opportunities and oversights', *Land Use Policy*, 91, art. no. 104323. Scoping study for a Comprehensive Survey.
- Seccatore, J., Veiga, M., Origliasso, C., Marin, T., De Tomi, G. (2014) 'An estimation of the artisanal small-scale production of gold in the world', *Science of the Total Environment*, 496, pp. 662-667.
- Spiegel, S.J. (2015) 'Shifting Formalization Policies and Recentralizing Power: The Case of Zimbabwe's Artisanal Gold Mining Sector', *Society and Natural Resources*, 28 (5), pp. 543-558.
- SUMM-CIRDI (2019) Ethiopian Artisanal, Special Small-Scale Mining Strategy Roadmap
- World Bank (2016). Ethiopia Mining Sector Development: Policy and Legislative Options Report.

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