

Research Article

Determinants of Market Participation of Artisanal Gold Miners: Evidence from Kumuruk District, Northwest Ethiopia

Teha Romanu Benti^{1,*} , Mihret Fentahun Yeneneh², Hassen Muhammad Aman³, Abdurazak Sale⁴, Sadik Hisa Dawd⁵

¹Natural Resource Economics and Management, Assosa Agricultural Technical and Vocational Education Training College, Assosa, Ethiopia

²Land Administration, Assosa Agricultural Technical and Vocational Education Training College, Assosa, Ethiopia

³Natural Resource Management, Assosa Agricultural Technical and Vocational Education Training College, Assosa, Ethiopia

⁴Natural Resource Economics and Policy, Assosa Soil Laboratory, Assosa, Ethiopia

⁵Natural Resource Management, Assosa Agricultural Technical and Vocational Education Training College, Assosa, Ethiopia

Abstract

In Ethiopia as well as most other regions of the world, the artisanal mining industry was mostly ignored, because of there are a number of factors limiting the performance of Ethiopia's artisanal mining market participation. So the purpose of this study was to determine the extent of market participation of artisanal gold miners in the Kumuruk District, Northwest Ethiopia. The respondents were chosen using a two stage sampling procedure in order to accomplish this. The initial phase involves the deliberate selection of Seven Assosa District gives rise to Kumuruk District. Five kebeles were chosen at random from the sixteen kebeles in the second stage. From the provided sampling frame, 200 respondents were chosen using a systematic random sampling technique. Tools used to analyze the data included Stata14 version and SPSS version 21 statistical software. The results of descriptive statics show that gold producers and brokers were found to be important gold market mediators at mining gate and that eight market catchments were present in the study area. Additionally, the Heckman two stage econometric estimation procedure was used to identify factors that limit gold market participation decision and gold sale weight of the artisan gold miners' households in the study area. Informational resources, age, proximity to the market, prior mining experience, years of schooling, and household size all have a favorable and significant impact on gold market involvement. The amount of gold that each responder provided served as the depend ant changeable. Age, years of schooling, ownership of mining equipment, availability of non-mining income, cost of transportation, and informational resources were all significantly and favorably correlated with the amount of gold supplied for sales. This implies that a rise in any of these factors will result in a rise in the amount of gold offered for sale. According to the survey, efforts should be taken to open more places of sale. In order to increase market participation, mining areas should establish a direct market channel with the National Bank of Ethiopia. Additionally, youth participation in mining operations should be encouraged in order to minimize transportation expenses. Encourage the government to set up a revolving and collateral fund, and encourage microfinance institutions to open branches close to artisanal miners.

*Corresponding author: teharomano12@gmail.com (Teha Romanu Benti)

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Keywords

Artisanal Gold Miners, Commercialization, Mark Participation, Quantity Supply, Binary Probit Model

1. Introduction

1.1. Background of the Study

Not all mining is done by large companies deep below ground or with expensive machinery in large open pits. Worldwide, millions of people labor with primitive tools, picks, shovels, and pans to extract valuable natural resources from the Earth, without much education [13]. Artisanal mining refers to “mining by individuals, groups, families or co-operatives with minimal or no mechanization, often in the informal sector of the market”. In the Ethiopian context, this definition fits the reality of ASM [4]. Throughout Ethiopia's earlier stages of civilianization, artisan mining served as the country's main industry for the production and processing of minerals and rocks. It involves nonprofessionals primarily using manual labor to extract minerals such as gold, gemstones, tantalite, salt, clay, industrial and construction minerals, and rocks. Currently, artisan mining is seen as the main source of employment for job seekers from across the nations who are comparatively disadvantaged in the labor market (e.g., unskilled, low skilled, women, disabled, etc.). As a result, the number of people entering this industry appears to be steadily rising. Over five million people are thought to benefit directly or indirectly from this mining industry, according to certain official reports. In addition to giving rural residents access to alternate sources of income, artisan mining is thought to play a significant role in boosting their standard of living, reducing poverty, and boosting export revenue. But businesses operate in an unpredictable environment; that is, they don't have access to sufficient technical support, lack fundamental infrastructure, and frequently deal with unjust market prices. People are frequently using antiquated mining methods while working in hazardous and unhygienic environments. Because legally established associations have a limited level of development in the subsector, the mineral sector's contribution to GDP does not surpass 2% [11]. Ethiopia's gold export and the amount that is supplied to the national bank of Ethiopia for export declining [3].

For many poor people, artisanal mining is their only source of income. Ethiopians living in isolated rural areas without many options for a farm based livelihood. The AM sector possessed the capacity to inherently empower marginalized and susceptible groups. Participate in the updated Ethiopian Accelerated and Sustainable Development to End Poverty Plan (PASDEP), which spans five years. Locally, it might give the miners a means of subsistence and respectable

employment, and it might increase demand for locally produced goods, services, and different kinds of infrastructure. Furthermore, the export of high value minerals and metals could significantly boost Ethiopia's foreign exchange earnings and tax revenues, encourage foreign direct investment (FDI), and advance Ethiopia's commitment to the internationally recognized Millennium Development Goals (MDGs) if a mutually beneficial environment was established for the formalization of the ASM sector. There are several challenges in the way of achieving this national goal. Two of these issues are the lengthy marketing channel and the large market margin between the producer (Artisanal Miners) and the end user, which have been determined to be signs of an unhealthy market. Marketing has historically been viewed as either exploitative or ineffective, especially when there are large price discrepancies between the company and the consumer. This idea is primarily motivated by a basic topic in economic science: what distribution structure would best distribute goods and services throughout society, with the goal of obtaining the best possible price [8].

According to the Ministry of Mines and Energy's (MMP) estimate of the Ethiopian Geological Survey, Ethiopia produces a wide range of minerals, including tantalum, gold, silver, gem stones, soda ash, kaolin, construction materials (especially colorful dimension stones), and mineral water. The two major are based gold mines were Sakaro, which was mined by private firms, and Lega Dembi, which is located in the Sidamo District of Southern Ethiopia. It was estimated that these mines produced roughly 5 tons of gold annually. Ores of the VMS were also found in the country's organic mines located in the Western and Northern Greenstone Belts, which are the finest gold mining reserves. In comparison to other western regions of the nation, the Assosa zone has the highest gold availability, per three geological studies [15].

Ethiopia has many gold deposits, and placer gold mining has been going on for at least 3,500 years. It all began when Egyptian traders traveled up the Red Sea and into what would later become Ethiopia to trade gold. Placer deposits have yielded gold mostly to about 78 tons of gold are mined annually by artisanal miners. The government believes that, with enough investment, gold production might reach 40 tons annually, making it the material with the greatest potential for mining investment. The amount of gold resources estimated by a recent survey grew to 500 tons. At current pricing, production may increase to 40 tons annually from slightly over four tons the previous year, bringing in almost

US\$1.7 billion for the nation [7].

The goal of market involvement is to raise the income level of subsistence miners and reduce poverty by integrating them into the inputs and output markets of mineral goods. The percentage of commercialized output from total gold production is referred to as market orientation, commercialization, or participation. There hasn't been much research done on market participation, but the main concerns raised by the literature are: whether or not miners decide to participate in the market and what the weights of sales are at the same time; institutional factors that influence market participation; and the impact of government policies on market participation decisions [6]. Finding the elements at the mining level that affect or improve market involvement is crucial because it might provide guidance for different policy options that would support and improve a more commercial orientation. It might also result in rural residents' incomes being higher. In order to support the rural market economy, various commodities organizations, governments, and other key players may need to adopt additional measures, some of which may be revealed by addressing the factors that determine each individual miner's commercial orientation [1]. Finding the factors that affect market access is necessary to determine how to get small-holder producers to participate in the market more [12]. Therefore, the purpose of this study was to examine the market involvement rates of artisanal gold miners in the Kumuruk District of North West Ethiopia.

1.2. Statement of the Problem

In Ethiopia as well as most other regions of the world, the artisanal mining industry was mostly ignored. Over 100 million people worldwide make their living either directly or indirectly from artisanal mining [16]. The strategic assessment of the Ethiopian mineral sector final report states that a number of factors limit the performance of Ethiopia's mining market system, including the overabundance of intermediaries, the absence of both vertical and horizontal coordination, the lack of integration of miners into the marketing system, the absence of market facilities, the poor linkage between research and extension, the poor quality of extension services that ignored marketing development, the restricted availability of credit, and inefficient handling, including issues with storage and transportation. Moreover, insufficient government interventions, a lack of institutions to research, assess, plan, and carry out market growth, a weak legal framework for enforcing contracts, and awareness of laws and rules governing the market were some of the fundamental issues to be highlighted. It is crucial to identify the mining level variables that affect or improve market involvement. Since this would provide details for alternative policy approaches that would encourage and strengthen improved commercial orientation. It might also result in rural residents' incomes being higher. Taking care of the factors influencing each miner's

commercial orientation may provide more insight into actions that various commodities organizations, governments, and other stakeholders may do to support the rural market economy [1]. This study differs from previous research in that it aims to identify the market margin constraints that miners are facing and to integrate them into the markets to increase their market participation. Specifically, the study looks at the factors that influence market participation among artisanal gold miners in the study area.

1.3. Objective of the Study

1.3.1. General Objective

The study investigated the determinants of market participation of Artisanal Gold Miners in Kumuruk District North-west, Ethiopia.

1.3.2. Specific Objective

- 1) To identify and show the existing gold marketing channels of the study area.
- 2) To examine socio-economic factors affecting gold miners market participation.
- 3) To examine socio-economic factors affecting quantity of gold supplied to the market in the study area.

1.4. Research Questions

The thesis attempted to answer the following research questions:

- 1) What are the existing gold marketing channels in Kumuruk Woreda?
- 2) What are socio-economic factors affecting participation of artisanal gold miners in the Kumuruk Woreda?
- 3) What are socio-economic factors affecting quantity of gold supplied to the Market in the study area?

1.5. Significance of the Study

This study focuses on the factors that influence market participants and the amount of gold supplied to the market as well as the existing marketing chain [14]. The study's findings might also be useful for planners, decision makers, and other development stakeholders who support mining either directly or indirectly. Furthermore, it is crucial to document the supply potential and the main production constraints in order to design suitable intervention measures for the study segment in the area that can improve the role of artisanal miner's participation, income, and employment opportunity, as well as be advantageous for artisanal gold miners in the study area. This is because the important gold marketing channels were not well identified. In addition; the study would ideally act as a Launchpad for more in-depth research in the area.

2. Research Methodology

2.1. Description of the Study Area

Kurmuk woreda, the study area, is one of the seven administrative zones of Assosa. The Woreda is located between 9025' and 1000' North and 340 30' and 34045' East on the extreme western part of the area, Sherkole Woreda to the north, Assosa Woreda to the south, Homosha Woreda to the east, and Sudan to the west are its borders. Most of the Woreda's topography more than 85% is plain. Kurmuk Woreda is 757 Kms away from the capital city of the country, Addis Ababa and 96 kms away from the regional and zonal administrative city Assosa [9]. The Woreda is primarily lowland, with 16 kebeles making up its 1400 km² area. Assosa and Kurmuk are connected by a major road. An essential route connecting Ethiopia and Sudan is this one.

Kurumuk Woreda's agro ecology is 85% lowland and 15% midland. Its altitude reaches up to 1337 meters above sea level, enabling the cultivation of a wide variety of crops. The region is distinguished by one distinct dry season that runs from November to February and one very long wet season that runs from March to October. The Woreda receives 1000 mm of rain on average each year, with the greatest amounts falling in July and August. The majority of this rainfall falls between May and September. The Woreda has minimum and maximum temperatures that vary from 130 to 190 degrees Celsius and from 260 to 350degrees Celsius, respectively. The coldest months are June through November, with August being the lowest; the hottest months are January through May, with a high in March [9].

As per the findings of the 2023 population and housing census, there were 7,596 people living in Kurmuk Woreda (male = 10,159 and female = 9,597), of whom 986 were urban dwellers and 1,670 were rural people, the majority of whom were Berta [2].

The Woreda covers an area of 1400 km; of that, 7615 ha are used for arable cultivation, 33491.07 ha are covered in forest, and the remaining portion is eroded soil. A variety of crops can be grown, but the main grains farmed in the region

and those that take up the majority of the cultivated land are sorghum, maize, and okra. Cash crops are the primary reason for growing oil crops like Niger seed, soybean, and sesame. The primary economic activity is agriculture, which is followed by conventional gold mining. The livelihood of the people of the study area mainly depends on crop production, traditional gold mining and livestock production [9].

2.2. Methods of Research Design and Data Collection

2.2.1. Research Design

Two stage sampling method was employed; Assosa zone has seven Woreda from these seven Woreda, Kumuruk Woreda was selected purposefully because of its wide area coverage of Artisanal gold mining and based on their settlement pattern in the area. Secondly; Kumuruk Woreda has 16 Kebeles of which eleven (11) Kebeles have wide area coverage of gold mineral, from eleven (11) Kebeles, five (5) Kebeles was selected randomly, such as, Agobela, has total population is 1399, Fematseri has population 507, Horazahabi, 603 kurmuke, 1085 and Dulshitalo 1230 with in these five Kebeles. Total of 4824 house hold heads participate in Artisanal Gold mining. In this study, a simplified formula provided by [17] was used to determine the required sample size at 95% confidence level, 0.5 degree of variability and 7 % level of Precision.

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = number of sample size
 N = total number of population
 e = margin of error or degree of accuracy desired

$$n = \frac{4824}{1+4824(0.07)^2}=200$$

Therefore, the sample size of the study was 200 from the five Kebeles of study site (Table 1).

Table 1. Sample size.

Sample kebele	Name of kebeles	Total number of households	Proportionally allocated sample households	percentage
1	Agobela	1399	1399/4824*200=58	0.29
2	Fematseri	507	507/4824*200=21	0.12
3	Horazahabi	603	603/4824*200=25	0.13
4	Kumuruk	1085	1085/4824*200=45	0.23
5	Dulshitalo	1230	1230/4824*200=51	0.23
Total		4824	200	1

Sources: Kumuruk Woreda Administrative Office, 2023

2.2.2. Sampling Technique

Identification of respondents are based on secondary data that are census of all the artisanal gold miners documented of the Kebele was obtained from Woreda mineral and Energy agency, then systematic random sampling procedure was used to select units directly from the given sampling frame. 58, households from Agobela, 21 from Fematseri, 25 from Horazahabi, 45 from Kumuruk and 51 from Dulshitalo were selected for this study, under target population (4824). Finally, the researcher was selected 200 artisanal gold miners households heads, based on probability proportionality of the size of the household's miners in the selected kebeles.

2.2.3. Primary Data Collection Methods

Field observation

Before conducting the main survey, observations was made of all the visible artisanal gold mining areas to learn about the mining processes, the experience of the miners, the gold production system, 22 family members who are involved in the gold mining as well as to note demographics like age and sex. Informal communities' discussion was held to gather general household survey. The purpose of the questionnaire was to gather data on the household's history, the market, credit availability, the extension Service, the number of family members engaged in marketing, and other related topics. The questionnaire was first written in English, and then it is translated into Biretta and "Amharic." The questionnaire was pretested on a small sample of randomly chosen homes before the full survey was sent out. Enumerators received training on data collection procedures and questionnaire content.

Talks in focus groups People have a greater chance of revealing their genuine feelings and comprehension of a subject when they talk to each other about how they see things. This approach was employed to obtain a collective perspective of the participants. Focus group discussions are usually more interested in the ways that people talk about particular subjects as a group than as individuals.

Key informant interview

Interviews with key informants would involve officials involved in the practice of artisanal gold mining, including development agents, Woreda, and zonal experts from the Agricultural, Mineral, and Energy Agency. During the interview, details about the study's goals are investigated. Secondary Data was obtained from Books, journals, papers, government and non-government reports, manuals, online website surfing, and officially gathered statistics from the local Woreda offices were all employed as secondary sources of information in this study.

2.3. Data Analysis Techniques

2.3.1. Descriptive Statistics

This data analysis technique compares the socioeconomic

and institutional features of the households of Artisan gold miners in the research areas using percentages, means, variances, and standard deviations.

2.3.2. Analysis Using Econometrics

Heckman has created a two steps model for estimate processes that accounts for bias in sample selectivity. When there are two choices to be made, like participation and supply weight [5]. Two step estimating process is suitable. The "participation equation," the first stage of the Heckman two stage models, aims to identify the variables influencing participation choice. This formula was employed to create a selectivity phrase called the "inverse Mills ratio" and add it to the "outcome equation" of the second stage, which outlines the factors influencing the weight of the gold supply. The Mill's ratio in reverse is a variable used to manage sample selection bias [5]. The Mills ratio is added to the gold supply equation in stage 2's second phase, and the equation is estimated using Ordinary Least Square (OLS). The hypothesis that the participation equation is governed by an unobserved selection process is validated if the coefficient of the "selectivity" factor is substantial. Specification of the Heckman two-step procedure, which is written in terms of the probability of gold market participation (GMP) and marketed gold supply weight, WGMS is:

The participation Equation/the binary probit equation

$$Y^* = Z\alpha + v_i \quad (1)$$

The link between the observed binary Y and an unobserved variable Y* is made with a simple measurement equation:

$$Y_i = 1 \text{ (GMP) if } Y^*_i > 0 \quad (2)$$

$$Y_i = 0 \text{ (GMP) if } Y^*_i < 0$$

The Heckman procedures assumes that the error term of the selection equation to be normally distributed and the expected value of the substantial equation error term given the error term of the selection equation is linear.

$Y_i = 1$ (if a miners participated)

$Y_i = 0$ (if a miners did not participate)

Where: Y* is the latent dependent variable which is not observed

Y_i the observed dependent variable

Z is vectors that are assumed to affect the probability of sampled miner's household gold market participation

α -is coefficients

i- Indicates the observation

V_i - random term for the selection equation

In the second stage of estimation, OLS estimation procedure would be used to identify determinants of market supply level (quantity of supply) by taking those farmers who

participated in the market margin. The estimation model is given as follows.

The observation equation/the supply equation

$$WGS = Y = \beta_0 + \beta_i X_i U_i$$

Y is the variable representing weight of gold supplied/sold,

Yi is observed if and only if GMP = 1.

Xi is a vector of miners' characteristics relevant in explaining the level of market participation,

X1 = quantity of gold supplied/sold (in Kg)

X2 = Age of the miners (in years)

X3 = Level of Education (in years)

X4 = Sex of the Household Head (male =1, Female =0)

X5= Marital Status (married =1, otherwise =0)

X6= Household Size (in numbers)

X7= mining experience (If yes =1, No =0)

X8 = Ownership of mining equipment (If yes =1, No =0)

X9 = Access to non - mining income (If yes =1, No =0)

X10 = Miners' association (If yes =1, No =0)

X11 = Means of information (If yes =1, No =0)

X12 = Transport cost (in Kumuruk)

3. Result and Discussion

The sampled artisanal gold miner households' general features were described using descriptive analysis. The decision of artisan gold miners' households to engage in the gold market and the amount of gold supplied by the head of a sampled miner's household to the national market as well as the markets in Assosa, Kumuruk, Famaxere, Dulshitalo, and Horazahabi were determined by means of econometric analysis.

3.1. Participants and Non-Participants in the Gold Market

Out of 200 homes that were sampled for gold mining, 85% were found to be market participants since they were selling gold at the time of the survey, with the remaining 15% not selling at all. Compared to nonparticipating homes, the mean family size of gold market participating households was higher. The t-test data for the market participants' and non-participants' family sizes are displayed in Table 2 and were found to be significant at a probability level of less than 1%. As anticipated, marketable gold surplus was higher in miner households with bigger family sizes in adult equivalent than in miner households with smaller family sizes. This suggests that the size of a miner's family in adult equivalent can have a direct impact on their involvement in the household gold market. The average number of years that market participants and non-participants had spent mining gold was calculated to be significant at the 5% probability level, coming in at 14.20 and 20.73, respectively. In terms of quantity supplied, the average weekly quantity supplied (in gold) The weight of each family of sampled miners who participated and those who did not was shown to be statistically different at the less than 1% probability level, weighing 14.6 and 2.85 kg, respectively. The weekly mean quantity delivered for each participating household is thirty one. In comparison to nonparticipating households, the mean weekly value of gold delivered to participating households was more than five times higher (Table 2). The most crucial factors in figuring out how many people participate in the gold market. The independent sample test, which was estimated to be significant at less than 1% significance level, also showed that there is a statistically significant difference in the mean value of financial income from non-mining sources between participating and non-participating sampled mining households. The financial income of participating sampled miner families was 1.75 times greater than that of non-mining sampled miner households (Table 2).

Table 2. Socio-economic characteristics of gold market participants and non-participants.

Variables	Mean value of variables for		
	Participants	Non participant's	t-value
Age	50.89	49.40	-0.520
Family size	6.31	5.40	-1.922*
Experience in gold production	14.20	20.73	2.952**
Quantity of gold produced per week	14.6	2.85	-7.638*

Sources: own survey, 2023

3.2. The Sampled Households' Socioeconomic and Demographic Characteristics by Location

Average family size, amount, experience in producing gold, and distance from the gold market of gold produced each week per household and annual revenue from sources other than mining were discovered to vary throughout the regions and to be significant at a significance level of less than 1%. (Table 3) Agobela, Dulshitalo, Kumuruk, Horaz-

habi, Famaxere and the average household size are 7, 6, 5, 5, and 5 in that order. According to the survey results, miners in Dulshitalo (20.35 years) had greater experience mining for gold than the studied gold producers in Agobela, Kumuruk, Horazahabi, and Famacere. In Agobela, Dulshitalo, Kumuruk, Horazahabi, and Famaxere, the percentage of illiterate people was, in that order, 70%, 72.5%, 85%, and 72%. The study area's median level of education (7 upto12 years) and higher level (>12 years) were both significantly greater at Kumuruk than they were elsewhere (Table 3).

Table 3. Socio-economic and demographic characteristics of sampled household (mean).

Variables	Sample Locations (mean)					F -value
	Agobela	Dulshitalo	Kumuruk	Horazahabi	Famaxere	
Age	46.21	43.47	51.95	53.18	44	2.91***
Family size	7.2	6.1	4.95	4.8	5	11.58*
Experience in gold production	13.35	20.35	13.8	13.47	13.4	5.64*
Quantity of gold produced	15.72	8.75	11.5	10.54	10.14	3.074**

Sources: own survey, 2023

The chi-square test indicates that there was a significant difference in the educational level of sampled mining households among the study locations at less than 10% significance level.

Table 4. Socio-economic characteristics of sample household by location (%).

Variables		Sampled miner households (%)					Chisquare value
		Agobela	Dulshitalo	kumuru k	Horazahabi	Famaxere	
Sex	Male	77.5	80	87.5	77	22	1.44
	Female	22.5	20	12.5	13.2	33.5	
Education level	Illiterate	70	72.5	77	85	72	18.136***
	Read and write	17.9	41	12.5	28.5	7	
	1-6 grade	53.6	48	4	33.3		
Marital status	7-12th grade	37.5	35	45	37.5	35	3.158
	>12th grade	12	10	18	15	9	
	Single	2.5	10	2.5	22.12	14	
	Married	97.5	90	97.5	92.4	93	

Sources: own survey, 2023

*, ** and *** represents 1%, 5% and 10% significance level

3.2.1. Service Access

Table 5 shows that the most crucial elements that support gold production and productivities that is, marketable surplus and, eventually, miners' income are credit availability, market knowledge, and extension.

3.2.2. Getting Credit

As per the survey findings, the percentage of sampled miner households in Agobela, Dulshitalo, Kumuru and, Horazahabi, and Famaxere that had access to credit was 11.5%, 20%, 33%, 11.7%, and 12%, respectively. At the one percent probability level, it was discovered that there was a considerable variation in the sampled locations' access to gold production credit. According to Table 5, the percentages of sampled miner households in Agobela, Dulshitalo, Kumuruand, Horazahabi, and Famaxere are 79%, 88.5%, 85%, 90%, and 67%. Despite their lack of credit using experience, they needed credit. The survey's outcome shows that 21.83% on average of the selected miner households at the Gold Gate had gold accessible credit for production.

3.2.3. Obtaining an Extension

The study's findings showed that only 40% of the selected

gold producers received gold production extension services, with significant regional variations, despite the nation's massive and widespread expenditure in promoting extension services. According to the locations, the percentage of miner households in Agobela, Dulshitalo, Kumuruk Horazahabi, and Famacere that had access to gold production extension services was 70.5%, 32.5%, 17.5%, 37.5%, and 44.1%, respectively (Table 5). At a significance level of less than 1%, it was determined that there was a significant difference in the sample locations' access to extension services.

3.2.4. Obtaining Market Data

The survey's findings showed that producers of artisanal gold mining have access to a range of sources of market data (Table 5).82.1% of the studied mining households as a whole, on average, had access to current gold market prices.80 percent, 82.5 percent, 80 percent, 77 percent, and 67 percent of people in Agobela, Kumuruk, Dulishitalo, Famexere, and Horazahabi, respectively, were found to be aware of the price of gold. The results of the Chisquare test showed that there was no statistically significant variation in the sampled Artisanal gold miners' households' access to knowledge about the gold market across the sample locations.

Table 5. Sampled miner household access to services.

Variables		Agobela	Kumuruk	Dulshitalo	Famaxere	Horazahabi	Chisquare value
Access to credit	Yes	11.5	20	33	11.7	12	6.4*
	No	79	88.5	67	71	69	
Access to extension	Yes	70	32.5	17.5	37	44.1	11.5*
	No	30	67.5	82.5	30.5	31	
Access to market information	Yes	80	82.5	80	77	67	7*
	No	20	16.2	17.5	17	18	
	Friend/other traders	40	22.5	25	22	33	
Source of market information	Personal observation	40	55	37.5	24	11	1.75
	Consumers	40	55	37.5	44	57	
	Extension agent	0	0	0	0	0	

Sources: own survey, 2023

3.2.5. Market Accessibility

The availability of infrastructure affects the miners' household's performance as well. Because gold is a store of wealth, you can diversify your exposure to having all of your assets valued in a single currency. As a measure of market accessibility, the average distance to well-regarded market centers was examined (Table 5). The survey's findings

showed that convenient access to gold market hubs was available to roughly 61.2% of the sampled miner families in the mining area. Among the survey areas, Agobela had the highest estimated percentage of sampled miners with easy access to the gold market (67% of respondents), followed by Dulshitalo (66.7%). According to Table 5, the average distance between the gold market center and the gold producers in Dulshitalo was comparatively greater. The F test statistics

validated that, at a significance level of less than 1%, there was a difference in access to the gold market center among the sampled locations. The function of actors Participants in Gold Marketing: Their Positions and Connections this study

examines several gold markets. Participants in the exchange functions between the ultimate consumer and the producer were identified. Producers, producer cooperatives, and consumers for the gold market were these.

Table 6. Sample miner households with average distance to gold market.

Distance	Sample locations					F-value
	Agobela (%)	Dulshitalo (%)	Kumuruk (%)	Famaxere (%)	Horazahabi (%)	
Less than 1km	67	66	50	54	45	
1-2km	19	25.6	35.6	25.6	20	3.19*
Greater than 2k	14	7.7	14.4	13.5	9	

Source: survey result, 2023

3.2.6. Gold Marketing Participants, Their Roles and Linkages

In this study, different gold market participants were identified in the exchange functions between producer and the final consumer. These were: producer, producer cooperative and consumers for gold market.

3.2.7. Catchment for Gold Marketing

Significantly differ according on consumer preferences, the type of gold sold outlet, and the distance from the gold market, and the amount of excess output each home. The

number of marketing outlets that the sampled gold producers employed during the study period is displayed in Table 8. 85 percent of the studied mining households overall had one gold sale. In both Kumuruk and Horazahabi, the percentage of sampled families with two gold sales outlets was about equal. Additionally, the survey results show that, with the exception of the homes in Karazahabi and Kumuruk, none of the sampled miner households had any gold sales outlets. The proportion of sampled families with two gold sales outlets was roughly equal in Kumuruk and Horazahabi. Furthermore, the survey results indicate that none of the sampled miner families had any gold sales outlets, with the exception of the residences in Karazahabi and Kumuruk.

Table 7. Count of gold sales outlets for illustration handmade gold miner.

Number of market out lets	Agobela (%)	Kumuruk (%)	Dulshitalo (%)	Famaxere (%)	Horazahabi (%)
One	85	74	74	65	83
Two	0	37	0	0	37.5

Sources: own survey, 2023

Table 8. The research area's primary gold marketing catchment, broken down by location sample.

The major gold marketing channels	Sample locations				
	Agobela (%)	Dulshitalo (%)	Kumuruk (%)	Horazahai (%)	Famaxere (%)
I. Producer→ Agent	21	4.7	23.7	25	20
II. Producer→Cooper→ Agent	-	-	10.4	0.81	-

Sources: own survey, 2023

Customized gold mining apparatus

The primary target market for gold marketing is Producer-Agent: According to Table 8, this channel represents 21%, 4.7%, 23.7%, 25%, and 20% of the total gold sold each week in Agobela, Dulshitalo, Kumuruk, Horazahabi, and Famaxere, respectively. The channel proved to be the shortest of the gold channels discovered in the gold gate during the survey period.

Producer, cooperative and broker

The catchment was unique for the gold mining cooperatives in Kumuruk and Horazahabi (Table 8), accounting for 10.4% and 0.81% of the weekly total gold marketed in Kumuruk and Horazahabi, respectively, throughout the survey period. Since Kumuruk Producers have access to a comparatively greater number of gold sale out lets that can result in better prices, this channel was determined to be the least significant gold sale out let for them.

3.3. Econometrics Result

Results of the Heckman two-stage analysis' regression STATA version 14 was used to conduct the econometric analysis for the Heckman two step estimation procedures. The endogeneity issue and selectivity bias were managed by

using the Heckman two-step process, which produced reliable and objective parameter estimations. In the first stage, the model forecasts each household's likelihood of engaging in the gold market; in the second stage, it examines the factors that influence the amount of gold supplied to the market. In order to enable the inverse Millis' ratio to accurately forecast [10] recommended including a selection variable in the selection equation that is thought to significantly influence the participation decision, but not the amount of involvement. In order to accurately predict the inverse Mill's ration, this study used the distance to the gold market center as a selection variable in the probit model/participation equation. It was found that this variable affected the decision made by miner households to participate in the gold market, but it had no discernible effect on the level of participation.

The binary probit equation

Also known as the participation equation, presents the findings of an estimation of the variables that are anticipated to influence a household's participation in the gold market. The model accurately predicted 86.66% of the sampled miner households to fall into the market participant and non-participant groups.90% of the model's correctly projected participants and 76.66% of its correctly predicted nonparticipants were, respectively, anticipated.

Table 9. Estimation result of the Binary probit model.

Variables	Coefficient	P. value	Marginal effect
Constant	-0.64	-1.83	
Quantity of gold produced	0.023	0.054	0.021
Age	0.20749	0.000***	0.164
Years of education	0.11 2	0.000***	0. 0.059
Sex of the household head	-0.29	-0.613	-0.02
Marital status	-0.0166	0.0308	0.0075
Household size	0.161	0.000***	0.101
Mining experience	-0.042	- 0.000***	-0.069
Ownership of miners equipment	0.1944	0.476	0.0075
Access to non-mining income	0.27	0.344	0.0025
Miners' association	0.1497	0.986	0.0075
Means of information	0.1429	0.000***	-0.0006
Transportation cost	0.59	0.0472	0.055
Distance near to market	-0.0168	0.000***	0.027

Sources: Survey result, 2023

Dependent variable= Household market participation (HHMP), number of observation (N) =200, Prob>chi13 = 0.000, significance level at 10% probability level.

Calculation Outcomes of the Selection Formula:

Six of the 12 explanatory variables in the model's selection equation were shown to be related to the likelihood of gold market participation. Table 9 lists these factors: age, education level, family size, prior experience producing gold, in-

formational medium, and proximity to market possesses strong and favorable relationship. The miners' degree of market participation will increase by 0.1 for every additional piece of information they obtain about the market's location, product prices, and supply and demand conditions.

Table 10. Model of supply equations.

Variables	Coefficients	St.error	p.value	Marginal effect
Constant	-2.93	4.05	-.722	
Age	0.103	0.22	0.033	0.213
Years of Education	.171	0.5	0.000***	0.180
Sex of the head	-0.448	1.59	0.932	0.712
Marital status	-0.128	2.59	2.59	0.48
Household size	0.120	0.27	0.000***	0.069
Mining experience	0.013	0.069	0.884	0.0613
Ownership of mining equip	2.195	0.456	0.000***	4.16
Access to non-Mining income	.442	0.66	0.000***	0.0001
Farmers' association	8.04	1.51	0.69	1.04
Means of information	1.04	1.51	0.69	0.120
Transportation cost	-4.16	0.456	0.000***	0.105
Sav.Cult.	184	2.01	.091	1.041
Mills lambda	-0.212	0.031	0.001	0.120

Source; Computer Analysis 2023 Quantity of gold supplied for sold in kg by individual respondents was used as the dependent variable. Number of observation (N) =200), Model size parameter=13 * and *** represents significance level at 1% and 10% probability level, respectively

Thirteen variables total; five of them differ considerably from zero. The amount of gold supplied for sales was significantly and positively correlated with age (p<0.05), years of education (p<0.10), ownership of mining equipment (p<0.01), access to non-mining revenue (p<0.05), transportation costs, and informational methods (p<0.10).

Inverse Mills Ratio: The significant and negatively signed lambda term indicates a negative correlation between the error terms in the main and selection equations. Therefore, lesser marketable gold excess is typically linked to (unobserved) factors that increase participation.

In a different world the model's output indicates that the household marketable gold surplus of artisan gold miners is negatively and statistically significantly impacted by the Lambda (Inverse Mills Ratio) or selectivity bias correcting factor. This finding implies that there don't seem to be any unreported variables that could influence the likelihood that household artisan gold miners will decide to enter the market as well as the weight of marketable gold. The inverse mill's ratio's positive sign, however, indicates that there are uniden-

tified variables that are favorably influencing both the decision to participate and the weight of gold that is marketed.

4. Conclusion and Recommendations

Various strategies and tactics were used to gather, examine, and evaluate data in order to maintain the reliability and caliber of the study. The study's conclusions then demonstrate that the ageing of the mine workers in the study region may have a detrimental effect on output. Hence, there is not much gold available for purchase or market involvement. The majority of miners still work for subsistence, only going to markets to sell their goods. Due to poor roads and information; they preferred selling at the mining gate or village market. This led to higher transportation costs and a poorer miners' return because of brokers' exploitation. Following critical analysis of the market presentation as it exists today eight gold marketing cases from producers to consumers was discovered by the research. The models' positive and negative significant associations suggested that a unit rise or drop

in the variables would increase or decrease the amount of gold supplied for sale. Greater transportation costs drive up transaction costs, which in turn impacts market participation. Put another way, the more transportation costs, the more expensive and time consuming it would be to deliver the product to the best market pricing. The primary issues that the respondents in the research region encountered were the high cost of transportation, the inability to obtain non-mining revenue, which is the main obstacle that the artisanal gold miners in the Kumruk district confront, and the poor road system connecting their miners to the various markets.

Based on the study's findings, the following actions are suggested to increase the amount of gold provided to the market and the market participation of artisanal gold miners. The research suggests that it is necessary to upgrade the roadways. Encourage the creation of additional retail locations in mining regions to reduce transportation expenses and encourage market involvement. To bring fresh blood into the system, youths should be encouraged to engage in gold production and subsequently market involvement. Establish a direct market channel with the National Bank of Ethiopia. By providing credit facilities, miners' financial situation should be improved. Create a system that integrates marketing research, Extension services, and marketing information.

Abbreviations

AEMF: Association of Ethiopian Microfinance
 AGM: Artisanal Gold Miner
 AM: Artisanal Miner
 AsARC: Assosa Agricultural Research Center
 SNNPR: South National and Nationality Peoples Region
 BGRS: Benshangul Gumuz Regional State
 BGRSBoFED: Benishangul Gumuz Regional State Bureau: of Finance and Economic Development
 CSA: Central Statistics Authority
 SACCO: Saving and Credit Cooperative
 PASDEP: Plan for Accelerated and Sustainable Development to End
 NMM: Net market Margin
 MoME: Ministry of Mine and Energy
 MoD: Minerals Operation Development
 MIS: Marketing Information System
 MFIs: Microfinance Institutions
 MEDC: Ministry of Economic Development and Cooperation
 masl: Mass Above Sea-Level
 KWOA: Kurmuk Woreda Office of Agriculture
 ILO: International Labor Organization
 Ha: Hectare
 MDGS: Millennium Development Goals
 GoE: Government of Ethiopia
 GMP: Gold Market Participation
 QSM: Quantity Supplied to Market
 SAM's: Strategic Assessment of Ethiopia Mineral Sector

SPSS: Statistical Program for Social Science
 St: Standard
 USD: united States of America Dollar
 VMS: Volcanogenic Massive Sulfide
 WGMS: Weight of Marketed Gold

Author Contributions

Teha Romanu Benti: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Mihret Fentahun Yeneneh: Project administration, Software, Supervision, Visualization, Writing – review & editing

Hassen Muhammad Aman: Resources, Visualization

Abdurazak Sale: Methodology, Writing – review & editing

Sadik Hisa Dawd: Software, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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