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PRODUCTIVITY OF ARTISANAL TIN MINING IN JOS SOUTH LOCAL GOVERNMENT AREA, PLATEAU STATE, NIGERIA

Melodi. M.M. and Mary
arletmelodi@yahoo.com
Mining Engineering Department
The Federal University of Technology, Akure, Nigeria

ABSTRACT: *This study focuses on the assessment of artisanal tin mining productivity in Plateau State, Nigeria. The assessment is carried out in order to understand the level of productivity in place at the visited sites of work by the artisans, to identify the key constraints to on-site artisanal mining based on the views of the artisans to be able to proffer possible solution to the problem. The method of data collection was through the administration of well-structured questionnaire to fifty (50) respondents and the analysis of data acquired was carried out using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel. Findings from this study reveal that the miners were largely indifferent on the risk worthiness of artisanal mining activities despite a mine work experience of 12.1 years. Artisanal tin miners in the study area largely self – sponsor (76.0%) themselves in the mine operations, hence the discouragement to pay tax and royalty to government. Both Loto-mining and open cast methods were used as methods of mining. Assessment of operation productivity indicated that a typical artisanal tin miner work almost every day of the week (6.73 days) while they also work 11 hours per day. With 28.2kg production per week, tin mining productivity by the artisans was 4.19 kg per day. Artisanal miners' experience ($P<0.01$), gender of artisan ($P<0.10$) and age of artisan ($P<0.05$) were all positively related to production output; while hours of work per day ($P<0.05$), marital status of artisan ($P<0.05$) were negatively related to artisanal mining output in the study area. The mean male production output was significantly higher than the production of female production output. Poor product pricing (68.0%), poor organized market (68.0%), issues with nearby communities (96.0%), issues with employers (56.0%) and inadequate technology (92.0%) were the notable production challenges encountered during artisanal mining.*

KEY WORDS: productivity, artisan, tin mining, mining output, production output

INTRODUCTION

Background of the Study and Statement of Problem

Large influx of several foreign and indigenous mining companies and artisanal followed the discovery of tin in the Jos Plateau (Mallo and Aluwong, 2012). The current practice of artisanal mining of tin which started around 1904, is engaged in mining of various grades of tin which at the present economic value, presents a good source income to the artisanal miners. The mining activity involves the arbitrary sinking of pits for the exploitation of the tin mineral. Artisanal tin mining activity in Jos Plateau is largely rudimentary and non-regulated. Artisanal and small-scale mining of solid mineral resources is one important livelihood activity that can help to reduce poverty and achieve economic renewal through the development of non-mining income generating opportunities. The vast economic potentials of the mining sector in Nigeria where government holds all mineral rights has been widely reported (Merem et al., 2017).

Effort should be made through the ministry for sensitization and enlightenment campaign on the negative consequences of artisanal mining.

Artisanal mining activities are also an informal procedure, which though have found to cause severe environmental disruptions, have also been linked with economic benefits (including employment opportunities, tourism, technology advancements and accessibility to both native and migrant populations) (Canavesio, 2014). The informal mining activities are characterized by low productivity, a lack of capital, poor technology, hazardous working conditions, land degradation, and pollution (Emel, Huber, and Makene, 2011).

Situated at about 1900 m above sea level, the region of Jos Plateau Tin mining is characterized by granite. Macleod et al. (1971), Ajayi (2008) and Turner (1976) noted that the geological relief feature of Jos Plateau is similar to lithological formations composed of the basement complex, biotite granite and new basalts. Jos Tin-Mining Region is located in the northern and central parts of Jos Plateau State, north central geo-political region of Nigeria. It is bounded approximately by latitudes 8°00'55" N and 10° N, and longitude 8°00'22" E and 9°00'30" E and the locations of the samples collected according to Gyang and Ashano (2010) were latitude 9°30' N and 9°33' N and longitude 8°53' E and 8°59' E. This aim of this study is to investigate the productivity of artisanal mining in Jos South Local Government Area of Plateau State; while the specific objectives are to describe the artisanal miners' profile, assess the various mining operations, productivity of artisanal mining operation, and identify the challenges encountered during artisanal tin mining.

RESEARCH METHODOLOGY

The methodology of research used in this study involved on the spot assessment and field measurements of the study area using various tools which include Camera for photo-documentation, Field notebook and writing materials. Interviews were undertaken at the study area, which involves verbal communication with the artisanal miner. Interview is to know the various method use and positive and negative effect and production of loto tin and open pit mining on Jos south. A well-structured questionnaire was adopted in gathering information (data) at the study area. SPSS and Microsoft excel which was used to analyze the rating giving by percentage and frequency of the respondent through the data received from questionnaires.

RESULTS

Artisanal Miners Profile

Table 1a: Artisanal Miners profile

Profile Items	Freq. (n=50)	Relative Freq. (%)
Age (Years)		
< 18	18	36.0
18 - 25	6	12.0
25 – 35	12	24.0
35 – 50	10	20.0
Above 50	4	8.0
Gender		
Male	38	76.0
Female	12	24.0
Marital status		
Single	24	48.0
Married	15	30.0
Separated	2	4.0
Divorced	1	2.0
Widowed	8	16.0

72%

Table 1b:Artisanal Miners Profile (contd.)

Profile Items	Freq. (n=50)	Relative Freq. (%)	Other statistics
Religion			
Islam	28	56.0	
Christianity	20	40.0	
Traditional	2	4.0	
Employment Status			
Self employed	26	56.0	
Employed	10	20.0	
Part time	8	16.0	
Full time	6	12.0	
Years of experience as artisanal miners			Mean = 15.89
Education level			
Primary school cert	15	30.0	
JSS 3	10	20.0	
SSCE	5	10.0	
ND Holder	7	14.0	
Graduate	13	26.0	
Engagement on site			
Digging pits	26	52.0	
Loto mining	13	26.0	
Loading sack into truck	26	52.0	
Washing of materials	15	30.0	
Security officer	14	28.0	
Others	3	6.0	
Tribe			
Hausa	23	46.0	
Berom	22	44.0	
Others	5	10.0	

The profile of artisanal tin miners in the study area is presented in Table 1a and 1b. Age distribution of the artisanal miners indicates that they are largely young people (72%) who still

have adequate energy for the work. The average life expectancy in Nigeria is 53.4 years (World Fact Book, 2016). This shows that artisanal miners are relatively young. This might tend to make miners more energetic and productive in their mining operation.

A proportion of 75% of the respondents are males. The risks and hazards involved in the artisanal mining have a chance of dissuading female from active participation in the job. Female participants largely work in washing of the ore and transportation. This may imply that male miners in the study area are more available to effectively take crucial decisions, especially on mining activities. A proportion of 48% of the respondents are not married, while 32% were married. Being married and having the opportunity to increase the family size may afford them the opportunity of getting family labour to be used on the mining sites (Oseni and Adams, 2013).

Religion distribution of respondents indicates the fair prevalence of the Islam religion (56.0%) on the study area, while the Christianity adherents followed with 40.0%. A proportion of 56.0% of the respondents are self-engaged; working on the site as artisanal miners, while 16.0% were involved artisanal mining as part time engagement. Income diversification is an important strategy for rural households to manage drought risk (Wan *et. al*., 2016) and reduce the exposure to several sources of uncertainty that affect mining (climatic factors, pests and diseases, price and policies related to small scale mining, marketing and trade uncertainties. An increase of income diversification could be considered as a response to avoid these uncertainties. Amine and Fatima (2016) opined that diversified mining is a major strategy to conquer many challenges faced by miners and to respond to opportunities. It improves miners' nutrition, and more dynamic miners can diversify income generation from artisanal mining to meet changing consumption patterns as consumers become rich and urbanization develops rapidly. The diversification can also allow miners to increase revenue by supplying products to potential export market.

A mean of 15.89 years was noted as the mean mining experience of an average miner in the study area. Experience, they say is the best teacher. It is believed that the longer a person stays on a job, the more likely the person becomes an expert in the job. A lot of risks and uncertainties characterize artisanal mining. Hence, to have the enough competence needed to grip all the vagaries of mining, an artisanal miner must have stayed on the job for quite some time. For instance, a miner who has been participating in mining for, say, 10 years is likely to be more knowledgeable about the pattern of rainfall, location, resource control than a miner who is just coming into mining irrespective of their level of formal education.

Sixty percent of the total respondents in this study never had any formal education beyond SSCE, while 14% had ND and 26.0% were graduates. The implication of this is that with the higher degree of literacy among artisanal miners, they may likely better appreciate government policies and other relevant information and also more readily and willingly adopt new innovations in mining. Loading sack into truck (52.0%) and digging pits (52.0%) dominated the engagements of respondents on the site. This might not be unconnected to the demanding nature of scouting for right location and digging to it.

Artisanal Mining Operation

Table 2:Assessing the various mining operations

Items	Freq. (n=50)	Relative Freq. (%)	Other statistics
Risk worthiness of artisanal mining activities			
Yes	24	48.0	
No	26	52.0	
Years of work in mine			Mean = 12.1
Means of financing operation			
Self-sponsored	38	76.0	
Cooperative	12	24.0	
Payment of royalty regularly to government			
Yes	11	22.0	
No	39	78.0	
Payment of tax to government			
Yes	5	10.0	
No	45	90.0	
Mining method used in operation			
Loto-mining	23	46.0	
Open cast	27	54.0	

Risk worthiness of artisanal miners was evaluated in this study (Table 2). Not much difference was noted in the responses retrieved from the respondents (48.0% yes, 52.0% no). Deaths and fatal injuries were often involved in artisanal tin mining. Some also lose their lives while fetching mineral stones inside a pit, and then it suddenly collapse, closing in on them. The pits became death traps, as they could collapse at any time, killing as many as five or more miners inside. In addition to the death consequences is the devastating effect which artisanal mining has on the environment. Open-pit mining, also known as surface mining, destroys the land. Landscapes are often left riddled with deep gullies and abandoned pits. The mean artisanal work experience was 12.1 years.

This implies the characteristics use of hand tools and implement in artisanal mining is balanced with adequate experience in attaining productivity and profit. Self-financing was the major source of artisanal mining financing. The lack of structure and illegality of the activities of the miners may account for the possible difficulty in sourcing for assistance from formal lending bodies. A proportion of 22.0% and 10.0% identified that they pay royalty and taxes respectively. Very low commitment was noted among the artisans to the payments of taxes and royalty.

Table 3:Production characteristics

Items	Freq. (n=50)	Relative Freq. (%)
Mining method used in processing		
Milling	16	32.0
Sluicing	13	26.0
Washing with calabash	12	24.0
Others	19	38.0
Method of dewatering the mine		
Using water pump	27	54.0
Creating water channel ways	23	46.0
Ever recorded mine accident		
Yes	12	24.0
No	38	76.0
Type of accident		
Worker injury	24	48.0
Implement damage	17	34.0
Instability / collapse	9	18.0

Mining processing method for tin ore after extraction includes milling, sluicing and washing in calabash; while method of dewatering the mine involves the use of water pump and creating of water channel ways (Table 3). These are the results of exposure and experience of individual artisanal miner. This studies further revealed that worker injury (48.0%) and implement damage (34.0%) were the major accidents recorded (76.0%) in mines.

Artisanal Mining Operation Productivity.

Table 4:Artisanal tin mining productivity

	Freq. (n=50)	Relative Freq. (%)	Other stat.
Days of work in a week			Mean = 6.73
Hours of work per day			Mean = 10.76
Unit of measurement of product			
Tonnage	4	8.0	
Kilogramme	46	92.0	
Quantity of weekly output (kg)			Mean = 28.2
Productivity (output in kg per day)			Mean = 4.19

Artisanal miners work for approximately 7 days of the week (6.73 days), while they also work for 11 hours (10.76 hours) per work day to earn a mean weekly processed tin of 28.2 kg (Table 4). Having not acquired any form of professional training, the informal miners lack the expertise and also the equipment needed to enable them decipher the location of these solid mineral. Hence they arbitrarily dig the ground in search of the minerals, and by this they might need to work for long hours and many days.

Table 5: Determinants of Production Output (linear functional form)

	B	Std. Error	t.	Sig. (p. value)
Constant	56.231	21.437	2.633	0.012
Experience***	0.791	0.187	4.239	0.000
Days of work per week	-3.136	2.532	-1.238	0.223
Hours of work per day**	-2.215	1.033	-2.145	0.038
Gender *	7.665	3.801	2.017	0.051
Marital status**	-9.338	4.608	-2.027	0.050
Age**	2.662	1.204	2.211	0.033

***, ** = significant at 1% and 5% respectively
Linear Form is given by
$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + e$ ---------- (i)
Dependent Variable: Y is Quantity of tin ore mined (Kg)
Independent variables: X_1 is artisanal miners' experience, X_2 is Days of work per week, X_3 is hours of work per day, X_4 is gender of artisan, X_5 is Marital status of artisan and X_6 is age of artisan
R^2: 0.716
Adj. R^2: 0.513
F – Value: 6.672
P – Value: 0.000

The result of linear regression analysis in Table 5 presents that artisanal miners' experience, gender of artisan and age of artisan were all positively related to production output; while days of work per week, hours of work per day, marital status of artisan were negatively related to artisanal mining output in the study area.

Moreover, years of mining experience was noted to increase significantly ($p<0.01$) at 0.791 unit as output increases at 1 unit. As days of work per day decreases by 3.136 unit ($p>0.05$) and hours of work per day decreases by 2.215 unit ($p<0.05$), output increases by 1 unit. This implies that shorter hours of works per day and shorter days of work per week has a chance of increasing output from artisanal mining.

As artisanal miners get married and get occupied with marital matters and responsibilities, output from production decreases significantly at 5% level. Age of artisan was noted to be positively and significantly related to production output. This might not be unconnected to the fact that older artisans likely will have a greater exposure and experience in handling marketing bargaining, getting family labour for assistance as so on.

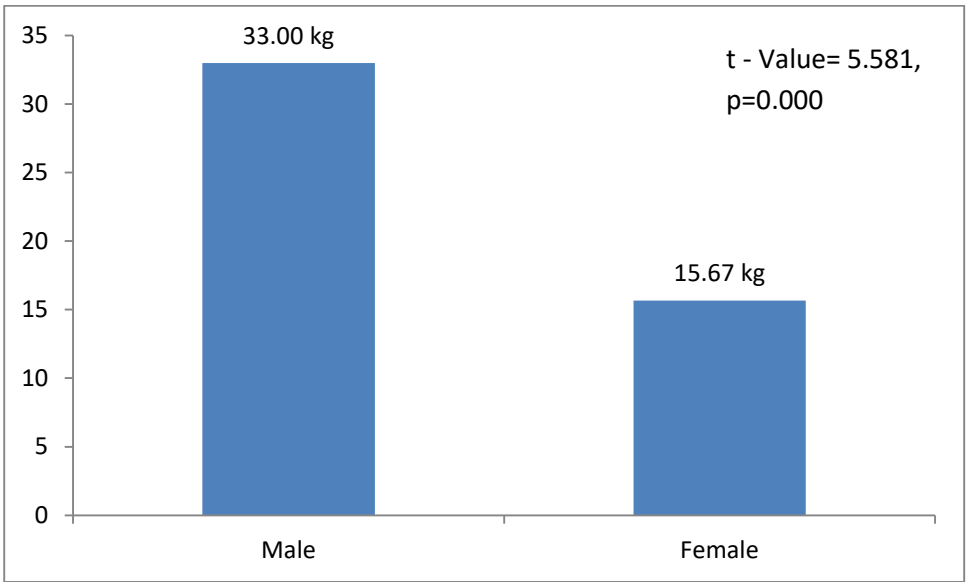

Figure 1: Mean output across the gender of tin artisanal miners

As presented in Figure 1 above, the mean male production output was significantly higher than the production of female production output. This may imply that male miners in the study area are more involving in the effective daily production which requires much physical energy, especially on mining activities.

Challenges Encountered during Artisanal Mining

Table 6:Production challenges

Constraints	To what extent		
	Major Freq. (%)	Minor Freq. (%)	None Freq. (%)
Poor product pricing	24 (48.0)	10 (20.0)	16 (32.0)
Poorly organized market	27 (54.0)	7 (14.0)	16 (32.0)
Issues with nearby communities	30 (60.0)	18 (36.0)	2 (4.0)
Issues with employers	12 (24.0)	16 (32.0)	22 (44.0)
Inadequate technology	38 (76.0)	8 (16.0)	4 (8.0)

Poor product pricing (68.0%), poor organized market (68.0%), issues with nearby communities (96.0%), issues with employers (56.0%) and inadequate technology (92.0%) were the notable production challenges encountered during artisanal mining (Table 6). Most social and environmental problems associated with artisanal mining stems from the fact that the sector is predominantly unregulated and operate outside the legal sphere. The illegality and lack of regulation often mean that improving artisanal mining will necessarily confront some challenges and this subsector will be difficult to operate in and many of the potential benefits could be lost (Maconachie and Hilson, 2011).

CONCLUSIONS

Productivity is in essence the backbone that makes or breaks a company, as it is the key-determining factor in performance and success. Artisanal tin mining operations is energy

sapping; implying that this economic activity is young male dominant who can work for almost the 7 days of the week and 11 hours daily earning an average of 4.19 kg per day. While risk in production is often considered as not much to be worried about by the artisans, there is no substantive payment to government obtained from artisanal tin mining. Significant determinants of the quantity of tin mined by the artisans in this study include experience at work, hours of work per day, gender, marital status and age of the artisans. This study confirmed the production constraints confronting artisanal mining of tin to include; poor product pricing, poor organized market, issues with nearby communities, issues with employers and inadequate technology.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Non-governmental organizations and donors for large-scale miners engaging with artisanal miners in order to help formalize the sector and boost productivity all round;
2. Commercial miners also helping to train miners and invest some capital in the formalization process;
3. Further work could be undertaken to understand better the significance and economic contribution of artisanal gold production;

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