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MINE CLOSURE OPERATION IN COVID-19 ERA: AN IMPERATIVE FOR SUSTAINABLE WELLBEING AND DEVELOPMENT

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Abstract

Mine closure is an integral part of a mine operation activity aimed at environmental sustainability and wellbeing of mining areas or communities. This study sought to assess the impact of mine closure operation on environmental sustainability and wellbeing in Azara Barytes mines of Nasarawa State. A systematic sampling technique was adopted in selecting respondents. Primary data for the study was collected using a well-structured questionnaire administered to 175 respondents within Azara town. The town consists of Unguwan Kabawa, Unguwan Lungu, Unguwan Buga, Unguwan Waje, and Unguwan Rimin Sabo, which were administered 35 samples of the questionnaire each. Data was analysed for 162 retrieved samples of questionnaire using descriptive statistics in form of tables and percentages. Results indicate that Azara town has the dominance of males (64.2%) and 50% of the respondents were married. 77.9% were within the age group of 25-40 and 36.4% constitutes the businessmen and women. Also, Logit regression technique was used to test for the magnitude of changes in economic activities, level of income, degradation of arable land and population movement out of the mining communities, which coefficients turned out negative. Findings indicate that mine closure is an important issue in mining areas with far reaching economic and social implications on all mining stakeholders. The study recommends thus: mine closure must be planned before mine operation cessation, and implemented as soon as the operation commences because it has the inherent effects of slowing down socio-economic activities in the mines and all the attendant benefits there from, thereby affecting the community in many adverse ways as to exacerbate the adverse impact of covid-19 on the environment.

Keywords: Covid-19, Livelihoods, Mine Closure, Mining, Wellbeing

1. Introduction

Mining is an integrated and multi-faceted activity that proceeds in distinct phases, with each of the phases exerting distinct impact on the environment (Environmental Canada, 2001 and MMSD project 2001). With regards to the small scale, artisanal and open cast type of operation of Azara area Barytes mines of Nasarawa State, it is an age-long activity and the second most important economic activity after agriculture, which significantly supports the local economy through instant gratification in ready employment and income generation to the people. The operation is an important safety net that employs all manner of people in its fold, including school-aged children, the youths, the aged, and child bearing and lactating women, who are engaged in various activities in the mines, with far reaching implications on the development and wellbeing of the area especially in the wake of the current Covid-19 pandemic that is progressively ravaging the world, with several unprecedented side effects that adversely affect humanity on its various strides (Dahiru, 2017).

As an important driver of socio-economic and physical environmental changes, mining operation is a rallying endeavour for many of its beneficiaries/stakeholders and the mainstay of the mining concerns. The operation has many dependants, aside from the mining outfits themselves, the mines host communities, and the State, with each deriving some form of benefits in the operation, and hence, the eventual closing of a mine operation in an area is often viewed with mixed reactions by the different mines operation stakeholders, as it affects the stakeholders in many different and important ways (Ivanova, 2015). Since mining is one of the most environmentally devastating of all the primary activities on the face of the earth, there is the need for environmental best practices and impact mitigations in all the stages of the mine life cycle operations, and proper mine closure plan (Environment Canada, 2009). This is aimed at ensuring that all aspects of the operation are carried out with the highest form of ethical considerations and regard for environmental sustainability, which is consistent with the desires and general aspirations of the people (Solomons, 1995).

Worldwide, mine closure is one of the most critical aspects of Mine Life Cycle Activities (MLCA) affecting mining concerns, mining communities, and mining countries in different crucial ways, and hence the need to properly plan and manage it (World Bank, 2018). Mine closure is a period in time when extracting activities of a mine have ceased, or are significantly reduced. This is generally associated with reduced employment levels, which can have significant negative effects on local economy. It is also the period when the majority of mine reclamation is completed, making the land safe and useful again. This is important to mines areas and the people, as it helps to stem down the adverse socio-economic and physical environmental impact of mining and allow the people to engage in other worthwhile activities that could ameliorate both the hardship occasioned by the closure operation and the hardship due to the corona disease (Fernandez, 2020; Comargo, 2014; Aragon, Rudy, and Toewz, 2015). Mine closure always has significant impact on the well-being of its host communities, which are often exacerbated in developing countries, due to their limited/poor coping strategies, poor financial, human and institutional capacities for charting alternative development pathways. Mine closure affect mining areas and deny governments of revenues, thereby affecting their abilities to adequately serve their constituents, and hence the need for governments and communities to understand and plan early enough for its eventualities (Oliveira, 2016).

Mine communities need to develop and adopt livelihood activities and other productive assets that will last beyond the life of the mines and generate income for future generations. This is necessary in cushioning the effects of the operation's harsh realities, especially in crucial periods of pandemic, as in the current global covid-19 era (Fernendez, 2020; Churchill, 2015; Fourie and Brent, 2006). Mining communities often have become dependent on the infrastructure and facilities provided through the local mines. In many areas with long history of mining, much of the housing and other social amenities like electricity, hospitals and schools were owned by mines (Hoadley and Limpitlaw, 2008; Gibson, 2006). This is also true for some minerals rich cities of Nigeria like Enugu, Jos, and Port Harcourt (Dahiru, 2017; Malo, 1999). Although mining closure is one of the toughest

mining environmental sustainability challenges, it nonetheless, provides an opportunity for the industry to demonstrate its commitment to sustainable development through responsible closure, which is indispensable in ensuring mining environmental sustainability and the overall sustainable development of economic minerals rich areas of the world (Katrine*et al*, 2018).

This study is hinged on the sustainable Livelihood strategy/frame work, which Chambers and Conway (1992) describe as the ability of a people to convert their assets/endowment into positive livelihood outcomes essential for the survival and wellbeing of their generations. The adoption of this theory in this study is apt because it shows a sustainable livelihood to comprise of the assets or activities which can cope with; recover from stress and shocks; offer opportunities for the next generation; and contribute net benefits to other livelihoods at the local and global levels in the short and long-term frames (Chambers and Conway, 1992). This is an all-time important theory from its tenets that can apply to all conditions, especially in post covid-19 pandemic era. This approach is concerned with the true understanding of people's strengths (assets or capital endowments) and how they are converted into positive livelihood outcomes, believing that no single asset is sufficient enough to yield all the desired livelihood outcomes for the people. This is particularly true for the poor, whose access to any asset tends to be very limited, and hence they have to seek ways of nurturing and combining their assets in innovative ways to ensure their survival. From the forgone therefore, mine closure operation is to the mine communities what innovative livelihoods approach is to the poor, who must constantly seek to convert their assets into positive means of improved livelihoods for continuous survival and wellbeing atall times (Van-Heerden, 2016).

According to Anon (2017), mine workers depend on their employment for survival and wellbeing, and hence any development that slows or stops the operation affects them adversely. This is seen in the case of mine closures which also affects the surrounding mining communities as well, and hence the need for the proper planning of mine on the part of stakeholders to transit into that period of reduced or zero activities, post mine closure proper. If not properly planed and efficiently carried out, mine closure may pose significant challenges to the mining industry, government, the environment, national and local economy, and the surrounding mine communities as well. This shows that mine closure, whether temporary or permanent, is an issue that needs to be addressed well ahead of time with responsibility towards all the stakeholders.

In attempt to generate locally relevant guidelines for the socio-economic aspects of mine closure in South Africa for mining practitioners, Stacey, Naude, Hermanus, and Frankel (2019), commissioned two studies, the first of which examined the closure dynamics of 36 mines in Mpumalanga and Kwa Zulu-Natal areas in 2006, using cotenant analysis, and a follow-up study in 2007, focusing on Mpumalanga mines area, confirmed some of the results of the first study. The study contained broad guidelines for mine closure covering social and labour planning, job creation, the use of mine infrastructure, developmental incentives, and environmental rehabilitation. Both projects cited problematic social aspects of closure such as confusion in the management of social (as opposed to environmental, engineering, or other

physical) risks; inappropriate training for self-employment; the failure of job creation schemes; the illegal occupation of houses; and the vandalism of infrastructure and facilities. They also undertook a third study to generate locally relevant guidelines for closure, taking into account local and global developments in the field, including existing closure toolkits. The studies found that mine closure in the context of developing countries differs from that which occurs in developed countries, in that alternative socio-economic and environmental options are limited in the former. Yet building the foundations for sustainable local economic development is a pressing concern in developing countries requiring creativity, cooperation and leadership (Van-Heerden, 2016; ICMM, 2012).

2. Materials and Methods

2.1 Description of Study Area

Azara, the study area is located in Awe LGA of Nasarawa State, Nigeria. It lies about 110 km South-East of Lafia (the state capital) on an approximately 1,535.5km^2 expanse of well drained land (Offodile,1976; Obaje, 2006). The area falls within 08^{0}15' and 08^{0}30'E longitude, and 09^{0}04', and 09^{0}23' N latitude on the northern tip of Awe LGA.

Due to the location of the study area in the tropical sub-humid climatic belt, the mean annual temperature is high. The highest temperature is recorded from January to March. A single maximum temperature is achieved in the month of March when maximum temperatures can reach 39^{0}C. Minimum temperature on the other hand can drop to as low as 17^{0}C in December and January. The onset of rain begins in the month of April which brings about a noticeable decline in temperature in the study area. Rainfall ceases by the end of October when a further decline in temperature in the area is made possible in November/December by the coming of the harmattan winds. The relative humidity in the study area rises from February to a maximum of about 88% in July. Steady rains commence in April, when the relative humidity will be at about 75% (Ishaya *et al.*, 2018).

The soil parent materials in the area are derived from cretaceous sandstones, siltstone, shale, limestone and ironstone of undifferentiated basement complex. These rocks are frequently overlain by gravely lateritic iron pans probably formed in the late tertiary era which are associated with concretion gravels and accumulation of alluvial deposits in "rivers flood plains". In the study area, the vegetation type is dominantly characterized with southern guinea savanna and some elements of northern guinea savanna with interspersion of grassland, tree savanna, fringing woodland or gallery forest along the valleys (Chaanda*et al.*, 2010 in Ishaya*et al.*, 2018).

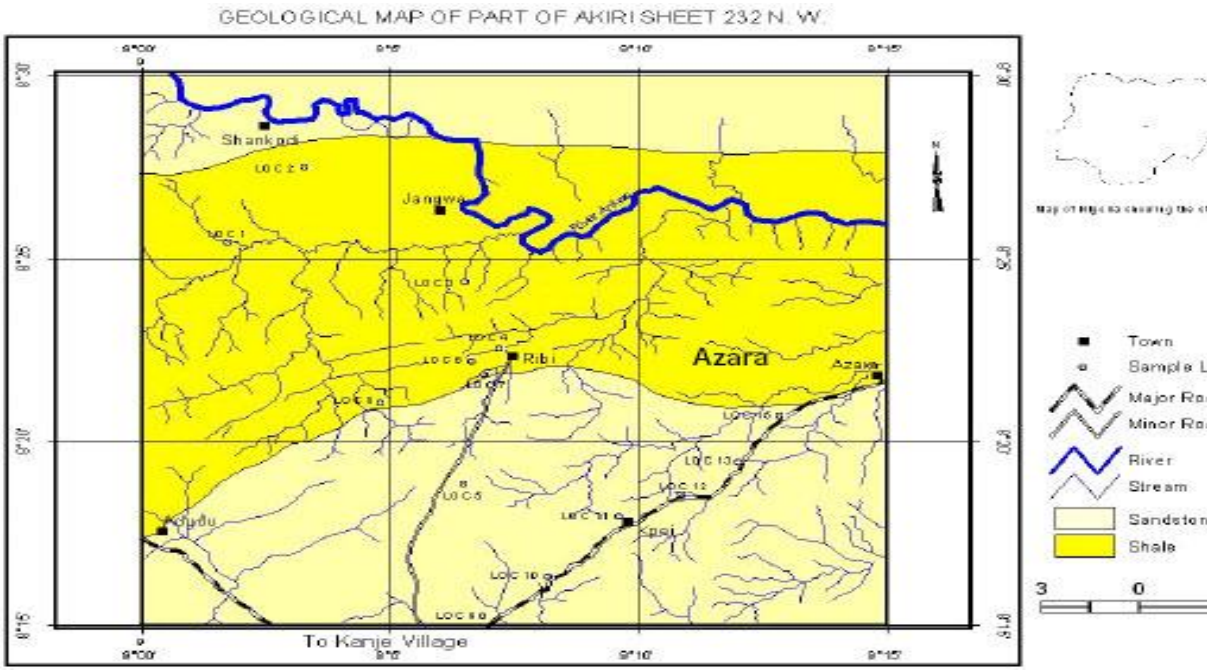

Figure 1: Geological Map of Part Of Akiri Sheet 232N.W Showing the Study Area
Source: Cartographic Lab., Department of Geology & Mining, University of Jos

2.2 Procedure of Data Collection and Analysis

The study utilized both primary and secondary sources of data. A well-structured questionnaire was designed to obtain information on; (i) the demographic and socioeconomic characteristics of respondents and (ii) dimension of livelihoods affected by closure of mines. A probability sampling technique was adopted in administering 175 samples of questionnaire to 175 respondents. This method allows for equal chance of being selected from the population.

Azara town is made up of five (5) areas (unguwa); Kabawa, Lungu, Buga, Waje, Rimin Sabo. Each of the five areas was administered 35 samples of questionnaire by field assistants. The study employed both quantitative and qualitative methods of data presentation and analysis. Simple percentages were used to determine the frequency of occurrence of particular responses in relation to questions raised in the questionnaire. Logit model was also used to test the magnitude/strength of the livelihood characteristics.

2.3 Model Specification

A Logit model is used to verify the strength of the livelihood characteristics on the mines. Adopting the work of Achia, Wangombe & Khadioli (2010), this study specifies the following Logit regression equation:

$$logit\ (p) = \left(\frac{p}{1-p}\right) = \delta_0 + \delta_1 CIN + \delta_2 CEA + \delta_3 PMT + \delta_4 ALD \quad .....(2.1)$$

Where, p is the probability that an individual was poor as a result of a mine closure, using *INC* as a proxy (where *INC* = 1 if individual is poor, and 0, otherwise).

INC = income level (<30,000 = poor, >30,000 = not poor) at time t.

CIN = change in income (as a result of closure of mines)

CEA = change in economic activities (slow-down in economic activities)

PMT = population movement out of the communities.

ALD = arable land degradation

While δ_0 is the constant parameter, and δ_1, δ_2, δ_3, δ_4, are the parameter estimates of the explanatory variables.

The a priory expectation of the model is that δ_1, δ_2, δ_3, δ_4, <0

3. Results and Discussion

3.1 Demographic and Socio-Economic Characteristics of the Respondents

The demographic and socio-economic characteristics of the respondents in the sampled settlement are presented in Table 1.

Table 1: Demographic and socio-economic characteristics of the respondents

Characteristics	No.	%
Gender		
Male	104	64.2
Female	58	35.8
Total	162	100
Age		
<25	17	10.4
25-30	49	30.4
31-35	36	22.2
36-40	41	25.3
>40	19	11.7
Total	162	100
Marital Status		
Single	67	41.3
Married	81	50.0
Divorced	7	4.3
Widow	4	2.5
Others	3	1.9
Total	162	100
Education		
Primary	117	72.2
Secondary	22	13.6
Tertiary	5	3.1
Non Formal	10	6.2
Others	8	4.9
Total	162	100
Occupation		
Farmer	29	17.9
Business	59	36.4
Miner	27	25.3
Artisan	6	3.7
Civil Servants	41	16.7
Total	162	100
Number of Dependants		
None	32	19.8
1-2	51	31.5
3-4	56	34.5
5-6	13	8.0
7 and above	10	6.2
Total	162	100

Source: Fieldwork, 2021

From the analysis in Table 1, the dominance of males (64.2%) over females (35.8%) signifies that the respondents were mainly male. An age range of 25-30 to 36-40 accounted for 77.9% of the respondents. The sampled respondents obtained at least one form of education (primary and secondary levels accounting for 85.8%), except 6.2% that had no formal education. This implies that the literacy rate is low and that could be attributed to the remoteness of the area and high concentration on mining business in the town. 36.4% of the sampled respondents are businessmen and women (trading) while those in mining business constitute 25.3%. Mine closure and cessation will hit hard on the town

considering the number of the residents that are into mining activity and related businesses that depends on the mining operations.

3.2 Dimension of Livelihoods Affected by Closure of Mines

The dimension of livelihoods affected by closure of mines as reported by respondents in the sampled settlement is presented in Table 2.Table 2 indicates that 71.7% of the respondents experienced downward change in their income status/earning due to mine closure as it negatively affected them. More than half (55.3%) of the respondents had their monthly income brought down as a result of closure of mines in the mining communities, a development that will affect them adversely. This makes them and their families vulnerable and the entire community more distressed

Table 2: Dimension of livelihoods affected by closure of mines

Characteristic	No.	%
Change in income		
Seriously Affected	41	25.3
Affected	116	71.7
Not Affected	5	3.0
Total	162	100
Effect on Monthly Income		
No	66	40.7
Yes	96	55.3
Total	162	100
Improvement in Income		
No	95	58.6
Yes	67	41.4
Total	162	100
Change in Economic Activities		
No	56	34.6
Yes	106	65.4
Total	162	100
Change in Population Mobility		
No	35	21.6
Yes	127	78.4
Total	162	100
Arable Land Degradation		
No	32	19.8
Yes	130	80.2
Total	162	100
Hectares of Land Degraded		
100-199	34	21.0
200-299	35	21.6
300-399	44	27.2
400-499	36	22.2
500 and above	13	8.0
Total	162	100

Source: Fieldwork, 2021

With regards to any possible improvement in the income of the respondents, 58.6% did not notice any improvement in their income long after these mines were closed. 65.4% of the respondents agreed that the closure of mines is responsible for the slowdown in economic activities in the town, while 34.6% respondents opined that

the closure of mines did not slowdown economic activities in the town. This could be attributed to the different forms of occupation and sources of income of the respondents.The population movement in the mines as shown in Table 2, indicates that 78.4% agreed that the population of the mining communities decreased greatly as a result of closure of mines. The reason is not far-fetched as most of the residents would have relocated for other economic ventures or other nearby mining sites to fend for themselves. Prior to its closure, there was high population movement within the mines because of the high spate of activities within and around the mines.80.2% of the respondents agreed that several hectares of arable lands were degraded and left unattended to by the mining companies. Also, the adjoining streams in the area were affected by mining activities by way of pollution. The environmental consequences are enormous and could hinder the operation of other viable economic activities such as fishing and irrigation farming in the communities.This study evaluated changes in the mines environment and its socio-economy in terms of its disposable income and changes in population size; aggregate demand; economic activities; land cover change/extent of land degraded in the Covid 19 era.

3.3 Logistic Result

Table 3: Logistic regression on mine closure and livelihood

		B	S.E	Wald	Df	Sig.	Exp(B)
Step 1[a]	CIN0.050	0.053	0.185	0.082	1	0.775	1.054
	CEA	-0.257	0.234	1.202	1	0.273	0.773
	PMT	0.050	0.255	0.038	1	0.846	1.051
	ALD	0.004	0.190	0.000	1	0.985	1.004
	Constant	0.499	0.321	2.421	1	0.120	1.648

a. Variable(s) entered on step 1: CIN, CEA, PMT, ALD

Source: Author's Computation from SPSS 25.0 2021

The Logit result indicates that the coefficients of change in income and population movement within and outside the mining communities, and Arable Land Degraded, have conformed to a priory expectation before and after closure, while the coefficient of change in economic activities has a negative sign as expected. This indicates that the livelihood characteristics of the people have been adversely affected in the mining communities.

In terms of magnitude, change in economic activities appear to have significant effect on the livelihood of the mining communities ($\delta = -0.235$), meaning that the people are less likely to recover from slowdown in economic activities with mine closure, hence the probability of recovery from that is low. This was followed closely by the extent of Arable Land Degradation ($\delta = 0.004$); population movement out of the communities, ($\delta = 0.050$), and change in income ($\delta = 0.53$).

All these outcomes pointed out that whereas individuals in these communities whose earnings are below the minimum wage of N30,000 and with large dependants are more likely to be poor (Achia, Wangombe & Khadioli, 2010).The model analysis revealed that livelihoods in mining communities are affected by changes in income; change in economic activities; population movement, and arable land degradation. And these conditions arefurther exacerbated by the

vagaries imposed by covid-19 pandemic on the people.

4. Conclusion

Occupationally, findings indicate the predominance of businessmen and women especially miners who largely depends on mining activities as their means of livelihood. Age range of 25 to 40 constitutes the bulk of the population of the study area. Also, findings have shown that mines closure has negatively affected the economic wellbeing of the host communities which resulted into decreasing income earnings and declining population mobility into the mining areas. Majority of the residents had to look out for other means of livelihood as a result of the mine closure. Mine closure is one of the toughest mining environmental sustainability challenges that nonetheless, provides an opportunity for the industry to demonstrate its commitment to sustainable development through good and timely planning for responsible closure, essential in the overall sustainable development of economic minerals rich areas of the world, as well as allow the people cope better with the vagaries of challenges like the global novel coronavirus disease. The result of this study have shown that mine closures actually slow down the tempo of socio-economic activities in mines communities, as well as the livelihood and income of the people; revenue to the state and population activities, among others.

5. Recommendations

The study recommends that mine closure must be planned before mine operation cessation, and implemented as soon as the operation commences because it has the inherent effects of slowing down socio-economic activities in the mines and all the attendant benefits there from, thereby affecting the community in many adverse ways as to exacerbate the adverse impact on the environment.

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