Lapai Journal of Economics; Volume 2, No.2; 2018
Print ISSN: 2659-028X
Online ISSN: 2659-0271
Published by Department of Economics, IBB University Lapai, Niger State, Nigeria

Mining of Mineral Deposits and the Impacts on Livelihood in Niger State

Nuhu George Obaje*[1], Mohammed U. Umar[1], Kolawole A. Aweda [1] & T. M. Ozoji [1]

[1]Centre for Applied Sciences and Technology (CASTER)
Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria
*Correspondence Email: nobaje@yahoo.com

Abstract
Niger State is very rich in mineral resources. The geological cover of the State embraces igneous and metamorphic rocks of the Basement Complex and sedimentary rocks of the Bida Basin with a small portion of the Sokoto Basin to the north-west. Mineral deposits of economic to sub-economic quantities are associated with each of the components of the geology of Niger State. Physical site mapping and analysis of structured questionnaires have been used in this study to assess the positive and negative impacts of mining in Niger State. On the aggregate, gold constitutes 70% of the minerals being mined, followed by manganese, tantalite, talc, marble and kaolin. These mineral deposits are mined by different mining organizations (corporate and artisanal) for the benefit of the economy of the State. However, the mining activities also pose serious negative environmental and health impacts. Noteworthy in the positive impacts is the provision of employment (livelihood) to the immediate communities while health complications (sometimes leading to death), soil degradation and surface and ground water pollutions have been documented as the negative impacts.

Keywords: Basin, Communities, Livelihood, Niger
JEL Classification: O22

1. Introduction

Niger State is very rich in mineral natural resources. The geological cover of Niger State embraces the igneous and metamorphic rocks of the Basement Complex and sedimentary rocks of the Bida Basin and a smaller portion of the Sokoto Basin to the north-west (Fig. 1). The Basement Complex in Niger State (and indeed in Nigeria) is made up of the Migmatite-Gneiss Complex, the Schists Belts and the Older Granites (Obaje, 2009). Sedimentary successions in the Bida Basin comprise the Bida Sandstone at the base, followed successively upward by the Sakpe Ironstone, the Enagi Siltstone and terminating at the top with the Batati Formation. Mineral deposits of economic to sub-economic quantities are associated with each of the components of the geology of Niger State. Such economic minerals include: Gold, Manganese,

Tantallite, Lead, Copper, Iron Ore, Talc, Asbestos, Kyanite, Marble, Graphite, Mica, Gemstones, Feldspars, Garnet, etc (Fig. 2). Some of these mineral deposits are being mined by different mining organizations (corporate and artisanal) for the benefit of the economy of the State. Derivation funds should usually accrue to the State and royalties to the mining communities. Furthermore, such mining concerns assist greatly in poverty reduction through the employment they provide for able men, women and youths within and around the communities. However, the rocks containing these mineral deposits and the mineral themselves in their chemical compositions contain varying amounts of major and trace elements (heavy metals) which have positive and negative impacts on the environment, livelihood and food security. This study has documented some of the mine fields in Niger State and has assessed the positive and negative impacts. Noteworthy in the positive impacts is the provision of employment (livelihood) to the immediate communities while health complications (sometimes leading to death), soil degradation and surface and ground water pollutions have been documented as the negative impacts.

2. Review of Literature

2.1 Geology

2.1.1 Basement Complex

Obaje (2009) gave a vivid account of the geology of Niger Province (generally synonymous with Niger State) to be made up of the Basement Complex and the sedimentary rocks of the Bida Basin and a small portion of the Sokoto Basin (Fig. 1). The Nigerian basement complex forms a part of the Pan-African mobile belt and lies between the West African and Congo Cratons and south of the Tuareg Shield. It is intruded by the Mesozoic calc-alkaline ring complexes (Younger Granites) of the Jos Plateau and is unconformably overlain by Cretaceous and younger sediments. Within the basement complex of Nigeria three major petro-lithological units are distinguishable, namely:

1. The Migmatite – Gneiss Complex (MGC)
2. The Schist Belt (Metasedimentary and Metavolcanic rocks)
3. The Older Granites (Pan African granitoids)

The Migmatite – Gneiss Complex (MGC)

The Migmatite – Gneiss Complex is generally considered as the basement complex *sensu stricto* (Rahaman, 1988; Dada, 2006) and it is the most widespread of the component units in the Nigerian basement. It has a heterogeneous assemblage comprising migmatites, gneises, and a series of basic and ultra-basic metamorphosed rocks. They generally occur intricately associated with the Older Granites intruding into them and in some places along with schist belts, but chronologically the Migmatite-Gneiss complexes are oldest (older than Schist Belts older than Older Granites). In Niger Province, migmatite-gneisses are most prominent in Diko, Minna, Suleja and Kagara.

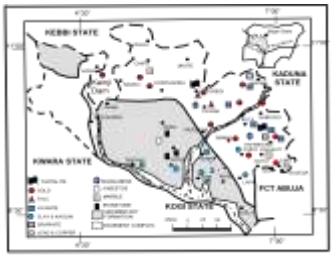

Fig. 2. Geological and Mineral Resources Occurrence Map of Niger State

The Schist Belt (Metasedimentary and Metavolcanic rocks)

According to Obaje (2009), the Schist Belts comprise low grade, metasediment-dominated belts trending N-S which are best developed in the western half of Nigeria (Fig. 3). These belts are considered to be Upper Proterozoic supracrustal rocks which have been infolded into the migmatite-gneiss complex. The lithological variations of the schist belts include coarse to fine grained clastics, pelitic schists, phyllites, banded iron formation, carbonate rocks (marbles / dolomitic marbles) and mafic metavolcanics (amphibolites). The belts are confined to a NNE-trending zone of about 300 km wide. The schist belts have been mapped and studied in detail in the following localities: Maru, Anka, Zuru, Kazaure, Kusheriki, Zungeru, Kushaka, Isheyin Oyan, Iwo, and Ilesha where they are known to be generally associated with gold mineralization (Obaje et al., 2013). In Niger Province, the Zungeru-Birnin Gwari, Kusheriki-Kushaka and the Zuru Schist Belts are encountered.

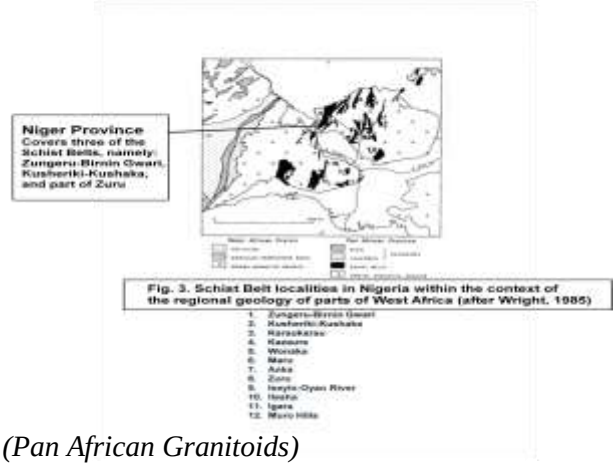

Fig. 3. Schist Belt localities in Nigeria within the context of the regional geology of parts of West Africa (after Wright, 1985)

The Older Granites (Pan African Granitoids)

The term 'Older Granite' was introduced by Falconer (1911) to distinguish the deep-seated, often concordant or semi-concordant granites of the Basement Complex from the high-level, highly discordant tin-bearing granites of Northern Nigeria. The Older Granites are believed to be pre-, syn- and post-tectonic rocks which cut both the migmatite-gneiss-quartzite complex and the schist belts. The rocks of this suite range in composition from tonalites and diorites through granodiorites to true granites and

syenites. The Older Granites occur intricately associated with the Migmatite-Gneiss Complex and the Schist Belts into which they generally intruded. Older Granite rocks therefore occur in most places where rocks of the Migmatite-Gneiss Complex or of the Schist Belt occur. In Niger Province, Older Granites are most noteworthy in Paiko, Minna, Kudna, Kagara and Suleija.

2.1.2 Sedimentary Rocks / Sedimentary Basins

Sedimentary rocks in Niger State belong majorly to the Bida Basin (95%) and a small portion of the Sokoto Basin (5%) to the northwest of the State. Accordingly, the Bida Basin was described as a NW-SE trending intracratonic structure extending from Kontagora in Niger State in the north to the area slightly beyond Lokoja in the south (Fig. 4) (Braide, 1992; Ladipo et al., 1994; Obaje et al., 2013). The sedimentary fill is known to comprise post-orogenic molasse and thin unfolded marine sediments (Akande et al., 2005). Obaje et al. (2013) subdivided the Bida Basin into two portions, namely the Northern Bida Basin and the Southern Bida Basin with the boundary approximating the subdivision shown in Figure 5. In the Northern Bida Basin, four mappable lithostratigraphic units are recognized, namely, the *Bida Sandstone* (divided into the *Doko Member* and the *Jima Member*), the *Sakpe Ironstone*, the *Enagi Siltstone*, and the *Batati Formation*. These are correlatable with the stratigraphic units in the Southern Bida Basin.

In the Southern Bida Basin (which has been studied in more detail, e.g. Ladipo et al., 1994; Akande et al., 2005), exposures of sandstones and conglomerates of the *Lokoja Formation* directly overly the Pre-Cambrian to Lower Paleozoic basement gneisses and schists. This is overlain by the alternating shales, siltstones, claystones and sandstones of the *Patti Formation* (ca. 70–100 m thick in the Koton-Karfi and Abaji axis). The Patti Formation is succeeded by the claystones, concretionary siltstones and ironstones of the *Agbaja Formation* (Fig. 6).

Fig. 4. General extent of the Bida Basin (After Obaje et al., 2013)

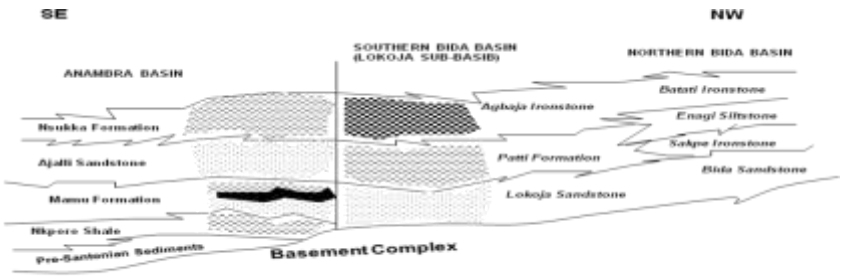

Fig. 6. The formations in the Nothern and Southern Bida Basin are correlatable with those in the Anambra Basin in the south-east.

2.2 Mines and Mining Impacts

Unfortunately there are no accessible documentations on the mines and mining operations in Niger State. A pamphlet of the Niger State Ministry of Mining and Mineral Resources notes that presently there are active mines for Gold at Maiwayo (Katcha LGA), Zumba (Shiroro LGA), at Suleija, Kontagora, Rafi, Agwara, Borgu, Munya and Paiko. Talc mining is on-going at Kagara and Zungeru while Kaolin mining is currently being undertaken in Kutigi and Gbako. There are no information on inactive and abandoned mines and mine sites.

Mining of mineral deposits usually release heavy metals which are high priority pollutants because of their relatively high toxic and persistent nature in the environment. Knowledge of the changing concentration and distribution of heavy metals and their compound in various compartments of the environment is a priority for good environmental management programmes all over the world (Don-pedro et al., 2004). Several workers have investigated the concentration of heavy metals, however, not around mining environments but in coastal rivers and the aquatic lives. Egborge (1991) related the heavy metal pollution of the Warri River to industrialization of the Warri town. Edema (1993) investigated the heavy metal contents of the shellfishes of the Warri River catchments. Ndiokwere (1984) investigated the heavy metal content of the sediments, algae and the Nigerian coastal waters. Ntekim et al. (1993) reported on the distribution of trace metals in the sediments of the Calabar River, while Oluwannde et al. (1983) reported generally on the pollution levels in some Nigerian rivers. Essential heavy metals are generally considered to be less toxic than non-essential metals (Batley, 1983). Metals such as cadmium, chromium, copper, iron, nickel, lead and zinc exhibit aquatic toxicity when present above recommended standard in that they can contaminate surface and ground water bodies, soil, plant, aquatic life and man, through bioaccumulation. Bio-concentration of heavy metals over time in aquatic ecosystem has been reported by Alabaster and Lloyd (1980), Friberg et al. (1986), and Fischer (1987). According to Mason (1991), heavy metals pollution is one of the five major types of toxic pollutants commonly present in surface and ground waters. The environmental pollutants tend to accumulate in organisms, and become persistent because of their chemical stability or

poor biodegradability and that they are readily soluble and therefore environmentally mobile. Unreclaimed mining pits and mine dusts constitute heavy negative environmental and health impacts. However mining also provides employment and other positive socio-economic impacts.

3. Methodological Approach

The following methodological approaches were adopted:

i) Literature search and visitations to Ministries, Departments and Agencies of governments responsible for mining and mineral development in Nigeria in general and Niger State in particular to obtain available information on title holders of mineral properties in the geological terrains of Niger State and the status of mining operations on such titles;
ii) Physical mapping of mining environments;
iii) Preparation, distribution and collation of questionnaires in the selected Local Government Areas of Niger State to obtain data / information on mining activities in the communities and perception of the indigenous communities of the impacts (positive and negative) of the mining activities on their livelihood, with emphasis on health, food and social security.
iv) Analysis of data obtained through the questionnaires
v) Determination of remediation and prevention options for identified environmentally polluted soils and waters for enhanced healthy livelihood and food security

4. Results and Discussion

4.1 Physical Mapping and Background Geology

Physical on-site mapping of ten mine sites was carried at Minna FM Maitumbi, Minna Chanchaga, Kateregi, Kagara, Shikira, Sarkin-Pawa, Zazagar, Kwakuti, Maiyaki and Kutigi (Figs. 7a-i).

Mine Site	**Local Government Area**	**Target Mineral**	**Status**
Minna FM Maitumbi	Bosso	Gold	Active, Corporate
Minna Chanchaga	Chanchaga	Gold	Active, Corporate, Artisanal
Kateregi / Maiwayo	Katcha	Gold	Active, Corporate
Kagara	Rafi	Talc	Active, Corporrate
Shikira	Rafi	Manganese	Active, Corporate, Artisanal
Sarkin Pawa	Munya	Granite	Rested
Zazagar	Munya	Gold, Tantallite	Active, Artisanal
Kwakuti	Paiko	Marble	Active, Corporate
Maiyaki	Lapai	Gold	Active, Corporate
Kutigi	Lavun	Kaolin	Rested

Corporate = Mining undertaken by a licensed corporate entity; Artisanal = Generally communal and self-help engagements.

The gold deposits mined at Minna FM Maitumbi, Chanchaga, Katerigi, Zazagar and Maiyaki are encased in quartz veins and pegmatites within schists and granitic schists. The schists in many places are intruded by granitic bodies trending NE-SW. The talc deposits at Kagara, the manganese at Shikira and marble at Kwakuti are also embedded within schistose basement rocks with intermingling of talc schist with granitoids and migmatite-gneisses. The granite mining and quarrying at Sarkin Pawa and in other places in Niger State are carried out on Pan African Older Granite granitoids. Kaolin deposit in Kutigi occurs interbedded as clay deposits within the Enagi Formation of the sedimentary Bida Basin.

Fig. 7a. Huge pits dug for gold mining in Kateregi and Minna FM Maitumbi

Fig. 7b. Mining generates employment for women and children in Kateregi, Niger State

Fig. 7c. Processing for Gold at Kateregi and Gold recovered after the processing

Fig. 7d. Artisanal mining for Gold in Zazagar within almost vertically inclined schistose rocks (Schist Belt)

Fig. 7e. As with most mining sites, the roads to many mining communities are very encumbering. This road leads to Zazagar mining site.

Fig. 7f. Rested granite quarrying at Sarkin Pawa

Fig. 7h. Kaolin deposit in-situ within the Enagi Formation at Kutigi

i) Talc

ii) Marble

iii) Kaolin

Fig. 7g. Mined talc schist at Kagara(i), in-sutu marble Deposit at Kwakuti (ii), and kaolin deposit resulting from weathering of metasedimentary basement rocks at Kwakuti (iii).

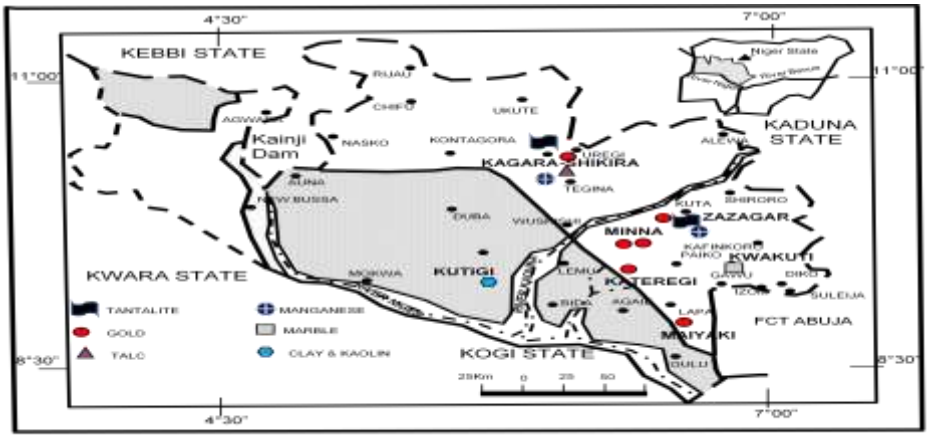

Fig. 7i. Map of localities and minerals mapped in this study

4.2 Respondent Characteristics

Questionnaire analysis shows that 85% of the respondents are male indicating that men dominate the workforce in the mining sector of Niger State (Fig. 8). However, considering the cultural and religious practices in the State, many of the female workers may have refrained from completing the questionnaires or did not return the completed questionnaires.

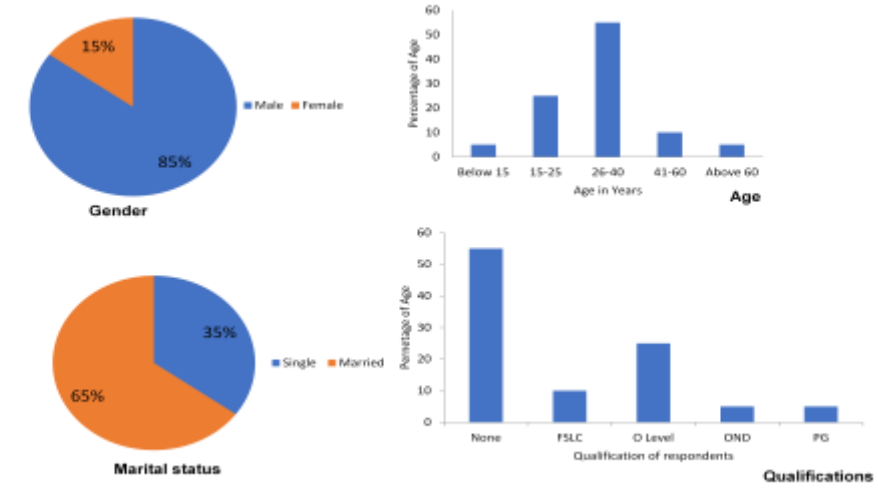

Fig. 8. Pie and bar charts showing the gender, ages marital status and qualifications of respondents at selected mining sites in Niger State

Sixty percent (60%) of the respondents vis-à-vis the workers engaged in mining activities in Niger State are in the age range of 25-40 years (Fig. 8), followed by 15-25 years old constituting about 28%. It should be noted that children below the age of 15 years constitute a significant 5%. This equally applies to the elderly of 60 years and above in age. Sixty five percent (65%) of the workers are married while 55% have no formal education. A significant 29% possesses the O'Lvevel qualification.

Sixty percent (60%) of the workers adduced mining as their major occupation followed by farming practiced by 30% of the workers as their major occupation (Fig. 9). On the other hand, 45% are engaged in farming as a minor occupation with civil servants constituting about 10% in this category. An overwhelming 53% are self-employed in the mining enterprise of Niger State while 32% are engaged by a third party, normally a corporate entity. Eighty six percent (86%) of all the mine sites studied engage between 11-40 workers with mines having less than 10 worker making up the remaining 14%.

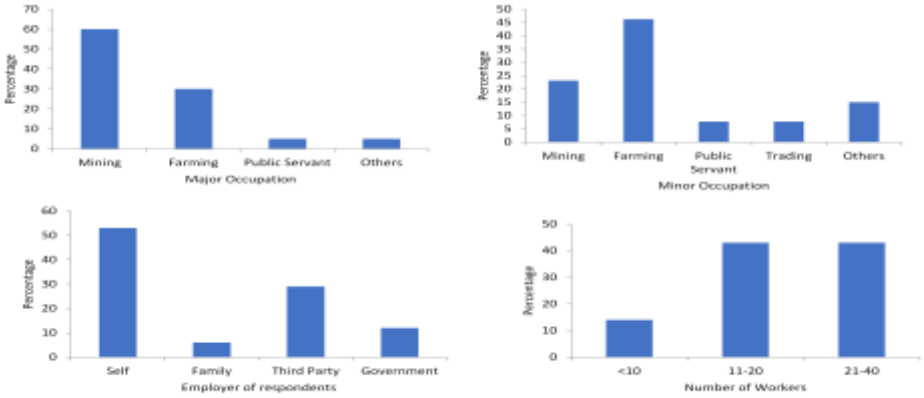

Fig. 9. Bar charts showing the major occupations, minor occupations and employers of respondents as well as the number of workers at selected mining sites in Niger State

4.3 Socio-Economic Impacts

Perception of respondents as to the percentage of workers from the community engaged in the mining business relative to the total population of inhabitants shows that in 17% of the cases, about 90-100% of inhabitants in the community are fully engaged in the mining activities (Fig. 10). These high percentages come from the gold mining sites at Kateregi and Zazagar. Cases where less than 30% of inhabitants of the communities obtain their sustenance through mining activities make up an overwhelmingly 55%. Fifty seven percent (57%) of all the workers at mining sites studied earn between N500-1000 per day. Those earning more than N1000 make up about 14% while those earning less than N200 constitute about 18%. Sixty two percent (62%) of the workers are of the opinion that what they earn is moderately adequate to sustain their livelihood. Five percent (5%) feel their earnings are very adequate while 12% opined that their incomes are grossly inadequate. It was noted that those who feel that their earnings are grossly inadequate come from those with married marital status while those who feel their incomes are generally adequate are mainly workers with single marital status.

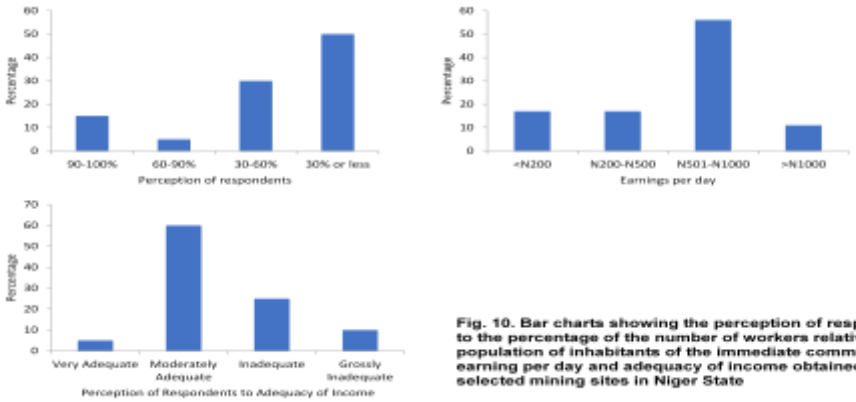

Fig. 10. Bar charts showing the perception of respondents to the percentage of the number of workers relative to the population of inhabitants of the immediate community, earning per day and adequacy of income obtained at selected mining sites in Niger State

4.4 Health and Environmental Impacts

Fifty two percent (52%) of the respondents have the opinion that mining activities have negative impacts on their soil and agricultural practices (Fig. 11). Thirty six percent (36%) are of the opinion that mining activities impact negatively and seriously on their health while 12% feel mining activities constitute the major source of water sources in their communities.

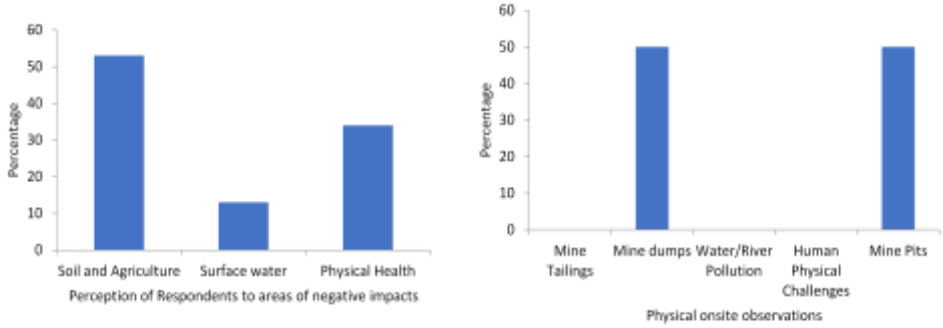

Fig. 11. Bar chart showing the perception of respondents to areas of negative impacts and physical onsite observations by investigators

On-site observations by the researchers show mine dumps and mine pits constitute major environmental hazards and constitute serious impediments to farming and other land uses. The appropriate regulatory agencies should ensure reclamation, proper de-commissioning and enforce adequate health, safety and environmental (HSE) measures at mining sites and in the mining communities.

5. Conclusions

The geology of Niger State is made up of basement complex rocks and sedimentary terrains. Both of these components contain significant deposits of economic minerals typical to their petrogenesis and metallogenies. This study was carried out to document active, rested and abandoned mining sites in Niger State and to identify the impacts of the mining activities (positive and negative) on the environments and the mining communities in Niger State. Physical site mappings and analyses of structured questionnaires were deployed to achieve the objectives. Gold, Manganese, Tantalite, Talc, Marble and Kaolin were the major economic minerals being mined at the selected studied sites. Although men constitute the majority of the mine workers, women and children are also engaged in significant proportions. These have telling effects on the qualification of the miners as the majority have no formal education. The mining activities, however, provide employment to the communities, despite some negative impacts and consequences.

Civilization as we know it today would simply not exist without steel, oil, and hundreds more metals and fuels. Unfortunately, there's a terrible price to be paid for the wrenching of these materials from the ground. Mining produces twice as much hazardous garbage as all other activities combined, and too often it is the environment

that suffers. Many of these old mines are draining lethal concentrations of acid into nearby streams. A few have been cleaned up. It is an expensive and a difficult process. Major and trace elements are abundant in the environment we live. They are present in virtually every area of modern life: construction materials to cosmetics, medicine, processed food, fuel sources to agents of destruction. It is very difficult for anybody to avoid exposure to any of the harmful metals that are so prevalent in our environment. However, man has constantly disturbed and opened up the earth thereby spreading the element throughout the environment. For most elements, humans can only tolerate a range of about +/-a factor of 4 on either side of the mean crustal composition. As the level of these elements rise in air, water, and soil, they also increase within the human bodies as well as plants and animals, thus, contributing to various health disorders, crop damage and ultimate death of some animals and plants. The results in this study attempted to provide an inventory on the mining operations in Niger State which should be placed against derivable funds, royalties and employment generation. The results will also help to design control strategies to achieve a better environmental quality, sustainable livelihood and guaranteed food security. In the time interval, the appropriate regulatory agencies (Federal and Niger State Governments) should ensure controlled land reclamation, proper mine sites de-commissioning and enforce adequate health, safety and environmental (HSE) measures at mining sites and in the mining communities to enable both tiers of governments enjoy economic growth and positive social transformations derivable world-wide from mining of solid minerals.

Acknowledgements

This study was funded by the Tertiary Education Trust Fund (TETFUND)

References

Akande, S.O, Ojo, O.J., Erdtmann, B.D. & Hetenyi, M. (2005). Paleoenvironments, organic petrology and Rock-Eval studies on source rock facies of the Lower Maastrichtian Patti Formation, southern Bida Basin, Nigeria. *Journal of African Earth Sciences* 41, 394-406.

Alabaster, J.S. & Lloyd, R. (1980). *Water Quality Criteria for fish* (2nd ed.), London-Boston, Butterworths, pp.297

Batley, G.E. (1983). *The Current Status of Trace Element Speciation in Natural Waters. In: Trace Element Speciation in Surface Waters*. (Ed.) G.G. Leppard. Plenum Press, New York, pp. 290

Braide, S.P. (1992). Alluvial fan depositional model in the northern Bida Basin. *Journal of Mining and Geology* 28, 65–73.

Dada, S.S. (2006). *Proterozoic Evolution of Nigeria*. In: Oshi, O. (Ed.), *The Basement Complex of Nigeria and its Mineral Resources (A Tribute to Prof. M. A. O. Rahaman)*. Akin Jinad & Co. Ibadan, pp. 29-44.

Don-Pedro, K.N., Oyewo, E.O., & Otitoloju, A.A. (2004). Trend of heavy metal concentration in Lagos Lagoon ecosystem, Nigeria. *West Africa. Journal of Applied Ecology*; 5, 103-114.

Edema, C.U. (1993). Heavy Metals in Shell Fishes of Warri River Catchments Area. Unpublished Ph.D. Thesis, University of Benin, Nigeria.

Egborge, A.B.M. (1991). *Industrialization and Heavy Metal Pollution in Warri River*. 32nd Inaugural Lecture. University of Benin City.

Falconer, J. D. (1911). *The Geology and Geography of Northern Nigeria*. Macmillan, London.

Fischer, A.B. (1987). Mutagenic effects of Cadmium atom and in combination with antimutangenic scienite. Proc. 6th Int. Conf. on Heavy Metals in the Environment. New Orleans, 2.112-114.

Friberg, L., Elinder, C.G., Kjellstroem, T. & Nordberg, G.F. (1986). *Cadmium and Health: A Toxicological and Epidemiological Appraisal: Effects and Response*. CRC Press, Boca Raton, Florida.

Ladipo, K.O., Akande S.O. & Mucke, A. (1994). Genesis of ironstones from the Mid-Niger sedimentary basin: evidence from sedimentological, ore microscopic and geochemical studies. *Journal of Mining and Geology.* 30, 161-168.

Ndiokwere, C.L. (1984). An investigation of heavy metal content of sediment and algae from Nigerian Atlantic coastal waters. *Environmental International*. 16, 1-13.

Obaje, N.G. (2009). Geology and Mineral Resources of Nigeria. Springer Verlag, Heidelberg (Germany), pp. 240

Obaje, N.G., Balogu, D.O., Yakubu, M., Idris-Nda, A., Goro, I.A., Ibrahim, S.I., Musa, K.M., Dantata, H., Yusuf, I., Dadi-Mamud, N.J. & Kolo, I.A. (2013). Stratigraphic exploration of the Bida Basin in North Central Nigeria. *Development Journal of Science and Technology Research*. 2 (1), 1-17.

Rahaman, M.A. (1988). *Recent Advances in the Study of the Basement Complex of Nigeria. In: Geological Survey of Nigeria* (Ed.), Precambrian Geology of Nigeria, p11-43.

Wright, J.B. (1985). *Geology and Mineral Resources of West Africa*. George Allen & Unwin, London, pp. 187