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Full Length Research Paper

Evaluating the influence of open cast mining of solid minerals on soil, landuse and livelihood systems in selected areas of Nasarawa State, North-Central Nigeria

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The study was conducted on soils of selected mining areas in Nasarawa State, North Central Nigeria to assess the environmental impact of open cast mining of coal and Baryte minerals. These entailed a survey of twenty four farm households, while soils, minespoils and water were collected and subjected to standard laboratory analyses. The results showed that soils around the mine sites were coarse textured, acidic with pH of 4.8, have high bulk density as evidenced on the hardness of the soil and load content of basic cations. Minespoils were found to be strongly acidic with a pH of 3.5, coarse textured, high organic matter content and low contents of basic cations. The high organic matter content if properly managed will enhance soil aggregation. However, the high contents of iron, copper, cyanide, and sulfate may have caused adverse effect on the soil ecosystem hence unsustainability of plants life. Water resources are polluted with high contents of acidity (pH 4.20), lead (0.23 mg/L), iron (0.6 mg/L), cyanide (0.7 mg/L), and nitrate (32 mg/L). The effluents from the mines caused water hardness (33.67 mg/L). The cumulative effects of the pollution loads on the soil and water resources affected the landuses in the host communities. Consequently, soil reclamation for farming purposes, establishment of water shed protection programme and provision of portable pipe-borne water, among others, were recommended as intervention measures.

Key words: Livelihood systems, landuse, mining, Nigeria.

INTRODUCTION

Mining may be described as an activity and occupation concerned with the extraction of minerals. These minerals include coal, petroleum oil, Baryte-limestone, quartz, lignite etc. Since pre-historic times, mining has been integral and essential to mans' existence (Madigan, 1981), hence the striking of stone flints by early man to make fire. The ever-increasing demand for minerals and energy as well as advancement in extraction techniques has increased the mining of minerals (Whiteman, 1982; Schobert, 1987). In line with this demand, the past four decades has witnessed an unprecedented exploration of solid mineral resources in Nasarawa State of central Nigeria often tagged the "Home of solid Minerals". The major increases in aggregate mineral resource production in this period have been associated with different kinds of minerals such as coal and Baryte. The soils of the communities of Obi LGA have their parent materials as Awgu formation, which is generally fossiferous (Obaje et al., 2005). Furthermore, the communities are characterized to have sedimentary rocks of cretaceous Tertiary ages. The sedimentary rocks in these areas are the host to high rank of coal (seam) and Baryte deposits, which are principally mined at Agwantashi, Jangwa, Shankodi and Agaza communities in Obi Local Government Area (LGA) of Nasarawa State of Nigeria. The quantity of coal and Baryte in these communities makes them attractive to individuals and prospecting companies such as Steel Raw Materials Exploration Agency that mine coal and Baryte minerals under the supervision of Nigerian Mining Corporation. Reserve of good quality coal (of high to medium volatile bitumen) is usually extracted by way of striping away the soil to expose the mineral. This is the activity case of the communities under study.

The solid minerals of coal and Baryte are mined for a variety of reasons. For instance, coal has been assessed to be suitable for coke in steel manufacture because it has high calorific values and heat rising (Obaje et al., 2005). Baryte as the chief constituent of lithopone paint is used extensively as an inert volume and weight filler in drilling mud, glass, paper and in the chemical industry (Whiteman, 1982). The general importance of the mining sub-sector has been documented to include foreign exchange, employment and economic development (Obaje, 1996, 2005; Nwajiuba, 2000). Surface mining of solid mineral resources are necessary in regions where the solid minerals do not lie deep beneath the earth. This has been the practice more particularly when the mineral seems to lie fairly close to the surface and the rock above them may not be solidly consolidated (Schobert, 1987). The usual way is by stripping away the soil to expose the mineral extraction. This is the case of the communities under study. Adverse environmental consequences of surface mining is land degradation arising from vegetation destruction (extensive deforestation), exposure of the soil to run-off and even burden spoils as well as dumps that have been confirmed as having harmful minerals and chemicals that pollute the soil environment (Lawal et al., 1981).

Based on these facts, mining activities in the study areas may, consequently, result in the pollution and destruction of the natural environment. The effects may also have serious consequences for livelihood particularly in agrarian communities such as Obi LGA, whose residents are predominantly arable crop farmers with some livestock mostly cattle, sheep, goat, poultry, etc. The hypothesis for this study, therefore, is that negative externalities of open solid mineral mining impacts on the biophysical and agricultural resources of host communities. Information on soil is highly needed to enhance soil management techniques. More so, to restore our devastated lands for optimal productivity, the precise detection and identification of soil conditions and erosion features constitute core elements for monitoring our environmental ecosystems. This is with a view to conserving and managing the soils so as to produce more food and ensure food security for the populace. The main objective of the study is to assess the negative externalities of coal mining on the biophysical environment and agricultural resources of the communities in Obi LGA, Nasarawa State, Nigeria, where open cast mining predominate. Of interest is also to understand the relationship between the host communities and the mineral prospecting companies.

MATERIALS AND METHODS

Study area

The study was conducted in Agwantashi, Jangwa, Azara and Shankodi communities in Obi Local Government Area (LGA) of Nasarawa State, North Central Nigeria. Nasarawa State is in the southern Guinea savanna agro-ecological zone of Nigeria and characterized by abundant solid mineral reserves of coal, baryte, lead-zinc, lime stone, glass sand, tin, Thorium, Niobum, Monazite, precious metals, Titanium, gemstones, Uranium, manganese, Tungsten, etc, hence tagged the “Home of solid minerals” (Obaje et al., 2005). The predominant landuses is agriculture, mining and tourism. The aggregate spatiality of the mining areas is about 12 ha in an undulating landscape with upland and lowland features. The upland has two special features – stoniness and concretions (mine sites), while lowlands are unmined farming areas.

Sources of data

Biophysical surveys were conducted and involved taking soil samples from the earth surface around the sites and minespoil. Samples of water from adjourning streams into which seepage from the mine effluents flow were collected. Farmers were interviewed to ascertain the level of impacts, on the livelihood and ecosystems, of the mining activities as a major land use in the communities. Primary data was collected during the exploratory survey with the objective of making field observations. During the visit, twenty soil auger samples were randomly collected from mined and unmined sites (total of 40 soil samples) at the depth of 0 to 40 cm, a depth considered to be the agricultural plough layer that contains most essential macro-nutrients for plant growth and the maximum rooting depth for most arable crops (Ezeaku et al., 2002). Also, ten undisturbed core samples (15 cm diameter by 15 to 20 cm length) were randomly collected from each site at the depth of 0 to 15 cm for bulk density and total porosity determinations.

Nine water samples each from mine effluents and polluted stream water were collected (total = 18). The water collection was done up- , mid- and down streams (3 samples each) and thereafter bulked, respectively, to get composite samples.

The soil and water samples were collected in a sterilized polyethylene bags and bottles, respectively, and analyzed for physico-chemical properties in a standard laboratory.

Laboratory determinations

The soils were air-dried, crushed to pass 2 mm screen and analysed for physical properties: particle size distribution according to Gee and Bauder (1986) and bulk density was estimated by core method as described by Blake and Hartge (1986). Total porosity was obtained by Bouma’s (1991) method.

Chemically, soil pH was distilled in both water and 0.1 NaCl solution using soil/liquid ratio of 1:2.5 (McLean, 1982), total N was obtained by micro Khajeldal method of Bremmer and Mulvaney (1982), organic carbon by Nelson and Sommers (1982) method. Organic carbon (OC) was multiplied by a factor of 1.724 to get organic matter. Available phosphorus (P) was determined by the method of Olsen and Sommers (1982). Exchangeable Ca and Mg by complexometric titration method, while K and Na were obtained by flame photometric method. Water samples were analyzed according to the standard procedure of APHA-AWWA-WPCF (1980).

Farmer sampling and data collection technique

Farmers within the spatial boundary of Obi LGA were considered in the study. Sampling was based on purposive non-probability method and only willing famers were interviewed. Twenty four (24) old and experienced farmers (20 males and 4 female headed households) indicated willingness and therefore formed the sample. The farmers were interviewed on the major land uses especially mining activities and how it impacts on their environment (land and water), agriculture and socio-economic life. These farmers had

Table 1. The mean effect of physical properties of soils analysed (n=40).

Nature of soil	Clay (%)	Silt (%)	Cs (%)	Fs (%)	Bd (g/cm^3)	Tp (%)
Unmined	13.75	10.25	22.5	53.50	1.355	33.98
Minespoil	8.75	7.00	28.2	55.75	1.502	32.63
F-LSD (0.05)	1.229	2.387	NS	NS	NS	3.162

% = Percentage; CS = coarse sand; Fs = fine sand; Bd = bulk density in g/cm^3; Tp (%) = percentage total porosity.

been involved in farming activities for over 40 years. Formal and informal in depth interviews were done using a structured questionnaire, and through informal discussions with the experienced farmers. Structured questionnaire containing objective and subjective questions were given to farmers. Data collected were through the farmers' responses as guided by Agricultural extension agent in the locality.

Statistics

The soil physical and chemical property data were analyzed using Genstat Discovery Edition 3 and SPSS 16.0 Version. Data were also analyzed through descriptive statistics and computation was done for percentages.

RESULTS AND DISCUSSION

Reconnaissance visits to the mining communities showed that exploration of solid minerals was by surface exploitation through excavation of the earth over-burden using heavy equipment. This resulted to farm land and forest/vegetation destruction. About 80% of the people indicated that minimal compensation was made for economic trees lost in the process but not for land. Furthermore, households affected were not relocated as prescribed by the Nigerian land use Law of 1978.

Effects of open cast on land, forest, and water resources

Land resources

The inhabitants of Obi LGA communities, where mining activities were done, already perceive mining as taking substantial area of land as indicated by 85% of the respondents. They were also aware that mining could lead to poor soil quality and infertility, and therefore declining crop yield. Reconnaissance observation of the sites showed that plant growth on excavated land was not vigorous in growth. The soils were characterized by scanty vegetation after some years. The poor performance of crops on mined soils may be related to compactness and low nutrient status of the soils. Crops were grown on unmined soils but to which upturned earth materials were washed, especially through water induced erosion were also affected. Growths of plants were observed to be stunted with yellow leaves, suggesting that the soils are poor soil quality. Eroded materials (sediment load) cover farm land with fine sand which does not allow water to percolate into the soil sub-surface. This may also have contributed to the observed poor plant development and growth.

Results of physical analyses of soils (Table 1) show that unmined soils have coarse texture with mean sand, clay and silt percentages (%) of 76, 14 and 10, respectively. Minespoils (Coal remains) was texturally coarse with 9% clay, 7% silt and 82% sand. Though sand particles dominate those of silt and clay in both soils, it is not significant. Silt and clay values were significant ($P\leq 0.05$). Bulk density of mined soil (1.50 Mgm^{-3}) was higher than that of unmined soil (1.36 Mgm^{-3}). The high value observed in mined sites may be due to removal of vegetation arising from mining activities. Similar reports have been made relating high soil bulk density to poor vegetal cover (Ezeaku et al., 2005), soil surface crusting and compaction by raindrop and machine impacts (Neil et al., 1997), and suficial erosion (Lal, 1994). The bulk density of unmined soils may be considered ideal for plant root growth following the threshold classification values of soil bulk density by Arshad et al. (1996) which shows that a value less than 1.40 is ideal for root growth. However, bulk density values of both sites (Table 1) showed non-significance. The values of total porosity in both sites were significant ($P\leq 0.05$) although mined soil had slightly lower value (32.6 %) than that of unmined soils (33.9 %) as can be seen in Table 1.

In terms of chemical characteristics, the mean soil pH (H_2O) values of both soils was generally high; an indication of high acidic load. Even though unmined soil reaction value (4.9) was lower than those of the minespoils (4.1), both values were significant at $P\leq 0.05$ (Table 2). The pH variations of these two soils could be due to natural variation in soils from one location to the other. Soil with a pH value as that of the minespoil has been rated very acidic (Fokken, 1970) and is not likely to favor the entire soil environment including impairment of the functions of microbial organisms. High soil acidity has been shown to hinder the release of available essential plant nutrients and reduce crop yield (Ezeaku et al., 2003). Opara-Nnadi (1988) related yellowish coloration of plant leaves and suppressed vegetative growth, as observed in the mined sites, to high acidity. The results in Table 2 also show that the mean organic matter content (OMC) in the minespoils was higher (13.82 gkg^{-1}) than those of unmined soil (22.93 gkg^{-1}) even though both

Table 2. The mean effect of chemical properties of soils analysed (n=40).

Nature of soil	Soil pH	OM (g/kg)	TN (g/kg)	Ca[1]	Mg[1]	K[1]	Na[1]	CEC[1]	Base sat (g/kg)	Av. P (Mg/kg)
Unmined	4.9	22.93	0.838	1.08	0.500	0.1550	0.135	12.58	11.65	24.68
Minespoil	4.1	13.82	0.287	0.80	0.325	0.1075	0.145	9.27	8.62	20.25
FLSD (0.05)	0.42	2.728	0.2647	NS	NS	0.035	NS	NS	2.052	1.924

OM = Organic matter; TN = total nitrogen; Ca =calcium; Mg = magnesium; K = potassium; Na = sodium; CEC= cation exchange capacity; Av.p = available phosphorus; NS= non significance.

Table 3. Summary of the mean micronutrient values (range and % CV) of the minespoils.

Micronutrients	Range	Min	Max	Mean	SD	CV (%)
Boron	2.5	11.7	14.2	13.008	1.2915	9.93
Iron	0.97	3.22	4.19	3.873	0.4515	11.66
Copper	0.36	3.72	4.08	3.930	0.1588	4.04
Zinc	1.22	3.07	4.29	3.950	0.5878	14.88
Cyanide	0.51	3.79	4.30	4.120	0.2359	5.73
Sulphate	0.35	3.92	4.27	4.083	0.1457	3.57

Min = Minimum; Max = maximum; SD = standard deviation; %CV = percentage coefficient of variation.

values were significant (P≤0.05). Reverse trend was the case for total nitrogen, which also showed significance at the same probability level. The high OM content observed in minespoil may be associated to the vegetation origin of coal seams. The values of exchangeable bases such as calcium (1.08 $Cmolkg^{-1}$) and magnesium (0.500 $Cmolkg^{-1}$) as well as CEC (12.50 $Cmolkg^{-1}$) were higher in unmined soils relative to minespoils. Sodium value (0.145 $Cmolkg^{-1}$) was higher in minespoil (Table 2). All the values were non significant. But the values of potassium (0.1550 $Cmolkg^{-1}$) and base saturation (11.65 $Cmolkg^{-1}$) were significantly (P≤ 0.05) higher in unmined soils than minespoils.

Mean values of available phosphorus (P) concentration in both soils were significant (P≤ 0.05) but higher (24.68 $mgkg^{-1}$) in unmined soils than minespoils with 20.1 $mgkg^{-1}$ as shown in Table 2. The phosphorus values can allow crop growth within the environment without additional P fertilizer application. Vogel (1975) reported similar P value as been sufficient crop plant in mined soils. Data shown in Table 3 indicate the average value ranges and coefficient of variation of micronutrients as observed in minespoils. The value of Boron ranges from 11.7 to 14.4 mg/L with a mean of 13.0 mg/L. This mean value is higher than the rest of other micronutrients. Mean values of iron, copper and zinc were almost similar (mean of 3.9 mg/L). Sulphate (4.08 mg/L) and cyanide (4.12 mg/L) values were almost same (Table 3). In terms of percentage coefficient of variation, zinc varied most (Cv% = 14.88) and sulphate least (Cv% = 3.57) varied. The implication of these variations is that sulphate, copper and cyanide would have more effect on human and livestock than boron, iron and zinc.

Forest resources

Vegetation destruction is a major consequence of surface mining and this applies to the mine sites. Vegetation destruction is due to deforestation activities which usually results from land use pressure. It leads to soil erosion due to run-off, loss of farm lands and plummeting of crop yields as experienced by farmers in the study areas. The mined soils were observed by farmers to be very hard, an evidence of compactness reflecting high bulk density recorded in Table 1. Reduced growth and yields of planted crops by farmers may be related to increased bulk density that inhibits water conduction and availability as well as oxygen availability to root zone. All of these corroborate with earlier observations that compaction, typical of some agricultural systems, decrease aggregate stability (Caron et al., 1992) leading to collapse of soil pores (decreased macro-porosity)(Swartz et al., 2003). These specifically affect the transmission and drainage pores which impair plant performance (Caron et al., 1992). Thus, the net consequences of vegetation destruction are ecological degradation including loss of aquatic life, biodiversity and forest resources (Isirimah, 2004; Ezeaku and Alaci, 2008).

Water resources

During reconnaissance visits, small streams and rivulets, which pass through the mining communities, including neighboring towns were observed. The streams and rivulets were observed to be linked, and both flow into the River Benue (the second largest river after River Niger in

Table 4. Some characteristics of mine effluents and water samples in the study areas.

Property	Mine effluents seeping into streams (a)	Polluted stream water (b)
Colour	Yellow	Yellowish brown
Total dissolved solid	-	50.7 mg/L
pH	2.02	4.20
Conductivity at 28°C	216	285 uskm
Total hardness	43.67	33.60 mg/L
Organic matter	12.91	8.57 mg/L
Iron (Fe)	0.68	0.60 mg/L
Cadmium (Cd)	0.36	0.60 mg/L
Lead (Pb)	0.27	0.23 mg/L
Copper (Cu)	3.8	2.4 mg/L
Zinc (Zn)	9.3	8.0 mg/L
Manganese (Mn)	2.72	2.05 mg/L
Cyanide	0.93	0.72 mg/L
Nitrate (No_3^-)	36.6	31.8 mg/L
Chloride (cl)	312.9	82.7 mg/L
Sulfate (So_4^-)	213.6	103.2 mg/L

Nigeria). The streams are the main source of water supply for households use in the communities. The study however concentrated on the Jangwa and Dep streams because they are the closest to the mine sites and seepage from the mines flow into them. There are indications of pollution of these streams. The indications, as observed by 95% of the respondents, include change in water taste and sometimes odour, water hardness as evidenced by difficulty of soap/detergent to lather or foam when used for washing. Other effects are fish mortality as sometimes farmers observe floating dead fishes on strean surfaces. Itching and whitening cover on the skin were also sometime observed by the farmers when the stream water is used for bathing. Also when the water is used for cooking the local palm oil rarely gives the desired red color. In order to have a safe drink, the communities now largely use alum (calcium carbonate; $CaCO_3$) for treating water from these streams. Isirimah (2004) noted low species diversity and impairment of water recreational use as other effects of stream pollution.

The results in Table 4(a) show an analysis of pollutants and seepage from the mine sites, which flow into the local Jangwa and Dep streams. The effluent had a pH of 2.02, which indicate extreme acidity. Cyanide content at 0.93 mg/L was at high level relative to established standards (Table 5). Chloride at 312.9 mg/L was high and unsafe level. Nitrate ion at 36.6 mg/L was moderately high. Isirimah (2004) earlier reported that any water that has nitrate content in excess of 35mg/L is dangerously unsafe for human health. The sulfate (SO_4^-) value at 213.6 mg/L was very high. It can therefore be inferred that the seepage of this effluent that contain common pollution loads, into the streams is related to the observed characteristics of the water from the streams. The inferences compare well with other studies (Hill, 1979; Paker, 2000). Samples of the mixtures of the mine effluent with local Jangwa and Dep streams, and allowing for a flow of 25 m were analyzed and the results shown in Table 4(b). It however should be expected that the concentration of the effluent in the water downstream, which is available for use by the communities, decreases with distance. Analysis of the water sample shows that the water was still acidic with a pH of 4.20, though this might decrease further downstream.

Drinking water standards as established by the United States Public Health Service (USPHS) and the World Health Organization (Renn, 1970; Isirimah, 2004) is presented in Table 5 and are used to compare with the observed values in Table 4(b). The result show that the stream water was acidic (pH = 4.20), while the values of iron (Fe) (0.60 mg/L), lead (Pb) (0.23 mg/L), copper (Cu) (2.4 mg/L), zinc (Zn)(9.0 mg/L), manganese (Mn) (2.1 mg/L), among others, are unwholesome for human consumption following the USPHS and WHO standards (Table 5). Water pollution is a vital problem and the communities expect improvement in present water supply situation, which is the local streams and which are affected by mining. This is considered as one of the most pressing problem of the host communities.

Agricultural landuses

The traditional land tenure system is through communal access to farmland. This is indicative of low population density and subsistence-oriented agriculture with undeveloped input and product market (Doppler, 1991).

Table 5. Characteristics of drinking water standards (in milligrams per litter-mgL-1 except pH values).

Property	Values
PH	7.0, 9.0
Calcium (Ca)	200.00
Magnesium (Mg)	150.3
Manganese (Mn)	0.05 DL
Iron (Fe)	0.3 DL
Lead (Pb)	0.05 ML
Nitrate (NO_3^-)	35 DL; 40 ML
Chloride (Cl^-)	250.0 DL
Cyanide	0.01 DL; 0.2 ML
Sulfate (SO_4^-)	200.0 DL
Copper (Cu)	1.0DL
Zinc (Zn)	3.0 DL
Total Dissolved Solids	400.0 DL

DL = Desirable limit; ML = maximum limit. Source: Renn (1970) and Isirimah (2004).

Table 6. Characteristics of farmer respondents in the communities (n = 24).

Age	Average	35 years
Labour	Average household size of which	8
	Males	42%
	Females	58%
Occupation	Full time farmers	75%
	Part – time farmers	25%
Land	Average number of plots per household	6
	Average area of land (ha)	2.6
	Average area used (ha)	1.4

Table 6 shows that average age of farmers was 35 years and in an average household of 8. Average number of plots owned per household was 6. Average area owned by each household was 2.6 ha, which means an average plot size of 0.41 ha. However, each household used only 1.4 ha during the study period, suggesting that about 40% of the land holdings were under fallow. Fallow is the main means of soil fertility regeneration. The rotation value for farming systems in the communities studied was 25% (Box 1). This is in tandem with the report by Rutheriberg (1980).

The main form of land utilization was arable cropping of yams, cassava, maize, millet, sorghum, Beniseed (Table 7) under rainfed situation. Mixed cropping was dominant in the area. The major combinations of crops were cassava/maize/yam and cassava/maize. The cropping calender commences in March/April with land clearing and tillage when the rains starts. Usually, planting of yam and maize with vegetables starts from April to June. Cassava planting is virtually done throughout the year except from September to December when the moisture stress is so much that plants wither. In July and August, there is planting of Guinea corn and Pigeon pea. The harvesting of early maize and yam is also in July. Late maize planted between August and September is harvested in November/December.

Community livelihood

Negative environmental externalities of mining may constrain livelihood to host communities by hampering agricultural resource uses. Such possible consequences as soil quality have clear economic importance. The

$$R = \frac{V}{A + B} \times \frac{100}{1}$$

where R = Rotation value;

V = Actually weighted vegetation period (cultivation period);

A = Years of cultivation;

B = years of fallow.

Therefore,

$$R = \frac{1}{3 + 1} \times \frac{100}{1}$$

$$= \frac{1}{4} \times \frac{100}{1} = 25\%$$

Box 1. Rotation value for farming systems in the communities of study.

Table 7. Calendar of cropping system in the communities studied.

Period	Operation
March – April	Land clearing – tillage when rain comes
April – May-June	Planting of yams, maize, cassava
July – August	Planting Guinea corn, Pigeon pea, cassava
July	Harvest of early maize and yam
August – September	Planting of late maize
November –December	Harvest of late maize.

possibility of long-term soil productivity degradation has potential significant implications for economic welfare (Kim et al., 2001). Further, contaminated ground water can have negative impact when consumed or it can contribute to surface water degradation by moving laterally into streams (Parker, 2000; Ezeaku and Anikwe, 2005). The specific positive impact of mining in Obi communities as identified by respondents include employment generation (60% of the population), increased income (80% of the population showed to have earn higher income than realized from farm produce sales), increased economic activities (more petty businesses especially for artisan women) and increased infrastructure (graded roads) and transportation facilities. On the negative side, mining is said to exert pressure on the village livelihood systems through deforestation (vegetation destruction leading to fewer pastures for livestock grazing, low wood harvesting for home use and sale) and declining arable land area. Seepage into the village streams also has adverse effects on the quality of water. Some of the specific negative effects have already been discussed.

Labour and employment

Mining offer direct employment opportunities to some indigenes and the neighbouring inhabitants. Indirectly, some other employment generating activities are stimulated by the mining operations. These include petty trading and transportation, which service the workers at the mines. With respect to labour use for farming, due to the activities of transport an average of 2 km road has been graded by the local government authority. Money realized from taxes/royalties are used for the renovation and rehabilitation exercises.

Income and living standard

Workers were employed at the mines and they reside around the towns surrounding the mine sites and earn their income. This was an important contribution to rural liquidity and therefore living standards. Community Development Association (CDA) obtained money from mineral transport, taxes/royalties. This was used for development activities and was considered by respondents as a positive effect of mining on the areas. The CDA uses the money realised to repair and build schools, cottage hospitals and maintain roads.

Conclusion

The study revealed that the soils have been degraded, while the water resources were polluted through accelerated anthropogenic (human) activities of mining and others. In this case, liming and fertilization of the soils is important for continuous cropping but should be done under good soil conservation practices. Further revelation of the study shows that there is a high level awareness and interest on mining by the communities. They have used the activities of mining to their advantages in terms of income generation to improve their living standard. However, the communities desire development and establishment of related industries such as State Mineral Resource Development Agency, as well as Medium and Small-Scale coal Briquetting Enterprises, so that coal briquettes can be supplied for domestic cooking and to generate more income and gain employment.

Furthermore, the communities expect aid from the government in the following areas: improvement of health centre, educational opportunities, drinking water through establishment of watershed protection programme and extension of electricity supply. All these will reduce poverty level and bring positive social transformation. The communities also expect the government, at local, state and federal levels, to engage in some form of land reclamation, so that they can use the areas already mined for farming and this is the desire of all the respondents (100%). This is not surprising considering that the communities are agrarian with all the inhabitants dependent on the land. Despite the provision of the Federal Government of Nigeria decree (Landuse decree, 1978) on the landuse and reclamation, the decree is silent on these mined soils. Therefore, to restore the land for optimal productivity, mapping and monitoring of the degradation process should be the basic means for the restoration of the degraded areas, while the use of soil amendment is imperative.

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