Environmental and Socio-Economic Effects of Mining Activities in Selected Agro-Mining Communities in Nigeria

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Abstract

The environmental and socio-economic effects of mining activities on agricultural practices in selected mining locations in Ondo, Oyo and Plateau States had been carried out. Soil samples from selected agro-mining sites were collected at a distance of 10m apart and an approximate depth of 30cm. $NH_{3,}$ Organic and Moisture Content were analyzed in the laboratory using Kjeldahl, Black Wet Oxidation and Oven Dry methods respectively. pH was analyzed using pH meter. Calcium, Sodium, Magnesium, Zinc, Iron, Lead and Nickel were analyzed in the laboratory using Buck Scientific Model 200 Atomic Absorption Spectrophotometer (AAS) in accordance with American Standard for Testing and Materials (ASTM). Water Samples from ponds and streams within mining sites were taken using sampling bottles at about 30cm depth below the water surface downstream and 2km upstream at 30cm depth below the water surface to act as control. Physical parameters such as pH, Conductivity, Total Suspended Solid, Colour, Turbidity were analyzed and chemical parameters such as, Sulphate, Nitrate, Alkalinity, Chloride, Hardness, Phosphate, and Calcium Samples were also analyzed. The chemical analyses results of soil and water samples showed that some mining locations contained high and low level of heavy metals when compared with Food and Agricultural FAO and World Health Organization WHO standards. The soil samples show high level of depletion of important plant nutrients, such as iron content, Organic content and Soil pH were depleted in the studied locations. Water quality parameter such as Nitrate, pH, Electrical Conductivity, Alkalinity, Chloride, and Phosphate were unconformable with WHO standards. The result of Socio-economic analyzes based on well structured questionnaire issued to the host communities show that consequences of mining activities were not limited to distortion of soil landscape but also include extinction of some animals, poor agricultural productivity, health problems, lack of education, communal conflicts and structural damages.

1 Introduction

Environment can be defined as either the physical and social conditions in which people live, especially as they influence their feelings and development or the natural conditions such as air, water and land in which people, animals and plants live. The alteration of land surface topography as aftermath of land excavation distorts the atmospheric flow, leading to channeling and vertical displacement with immediate effects on cloud, soil moisture and precipitation development (Simmer, 2005). Mining is by its nature, a destructive industry; attention has become focused on ways in which the environmental impact may be reduced (Johnson *et al*, 2004).The determination of the safe distance from an explosive charge requires the knowledge of explosive energy expended in performing useful work of fracturing, fragmentation and rock movement (Opafunso and Onyemaobi, 2005). In the United States, many of these contaminated sites have been classified as Superfund Sites which dictates that some remedial action be taken in the future (Pierzynski, *et al*, 2004). Mine safety is the responsibility of employer, employees and governments at all levels.

The presence of gaseous pollutants in the air and deposition of particulates on to soil can affect plants. The pollutants enter the inner issues through the stomata, where they destroy the chlorophyll and disrupt photosynthesis. Dust deposit on plant leaves when moist become toxic dissolving leaf tissues consequently resulting to less plant growth in form of plants height, numbers of leaves and leaf area (Fabbri, 2002). Most Nigerian's minerals exploitation is carried out by illegal miners with sub-standard methods (Ganiyu, 2007). Mining operations affect physical and chemical soil conditions. An important consequence is soil compaction which, apart from accelerating runoff and erosion may also affect the extent of plants uptake. Ozone layer depletion may also results from mining activities (Opafunso and Daodu, 2005). The poor people of the community are desperate to earn a quick buck, usually take to illegal mining, irretrievably damaging the ecology and environment and putting the lives of hundreds of people in danger, (IANS, 2006). Nigerian's minerals exploitation is mostly carried out by illegal miners with sub-standard methods (Ganiyu, 2007). The demographic shift caused by mining can lead to increase in prices for local goods (Hilton, 2002). Some of the negative environmental impacts of mining activities include; Subsidence; Mine Dust; Health risk; Mine Gas Hazard; Nuisance and Loss of Amenity; Dereliction; Impact on Nutrient Cycling; Biological Impact; Impact on other Water

Users; Direct Hazard to the Safety of Man; Damage to Property, Crops and Livestock; Global Warming; Damages to Top Soil; Ground Vibration; Flyrock and Air Blast. The purpose of blasting in mining operation is typically to fragment and displace material (Daodu, 2009). Incubating embryos are extremely sensitive to mechanical shock, (Quinn, 2005). Exposure to blast vibration can cause egg mortality and premature hatching and recent studies have attempted to examine what those levels are (Faulkner and Welz, 2008).

2 Material and Methods

2.1 The Study Area

The geographical co-ordinates of the selected agro-mining communities in the three states were taken using the Geographical Positioning System (GPS), eTrex Vista Garmin of high resistivity. This map of the selected states in Nigeria is shown in Fig.1. Ondo State is located in the Southwestern part of Nigeria. It lies between longitudes 4.00^0Eand 6.00^0E and latitudes 5.45^0N and 8.15^0N. The map of Nigeria indicating the selected Agro-Mining Communities in Ondo State is shown in Fig.2. The area is more than 377m (An Investment Manual on the Mineral Resources of Ondo State, 2005). Oyo State lies between latitude $7^0$23N and Longitude $3^0$56E. This is as shown in Fig.3. The area is not more than 191m above sea level (Afolayan, 2002). The map of Nigeria indicating the selected Agro-Mining Communities in Oyo State is as shown in Fig.3. Plateau State lies between attitude 9º54N and longitude 8º53E. This is as shown in Fig.4. The area is not more than altitude of about 1,300m above sea level. The town is surrounded generally by hills. The area is generally covered with bushes and scattered trees and tall grass. Recent study revealed that 316km^2 of arable has been devastated by mining activities. Also 316km^2 of arable has been devastated by mining activities, out of which about 13 km^2 has so far been

reclaimed (Mallo, 2007).The map of Nigeria indicating the selected Agro-Mining Communities in Plateau

State is as shown in Fig.4.

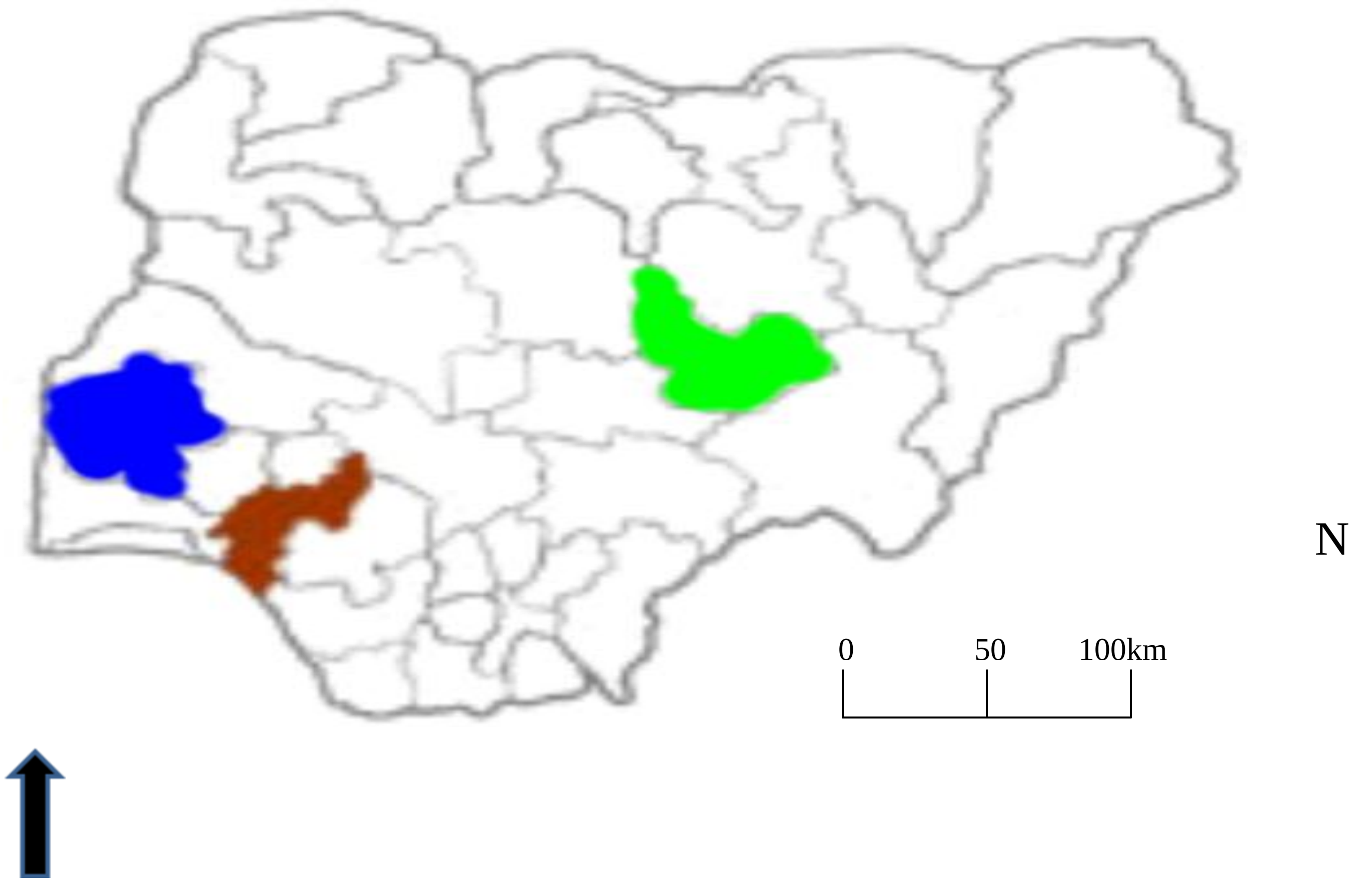


Fig.1: Map of Nigeria showing the Selected Agro-Mining States of Ondo, Oyo and Plateau in colours Red, Blue and Green Respectively.

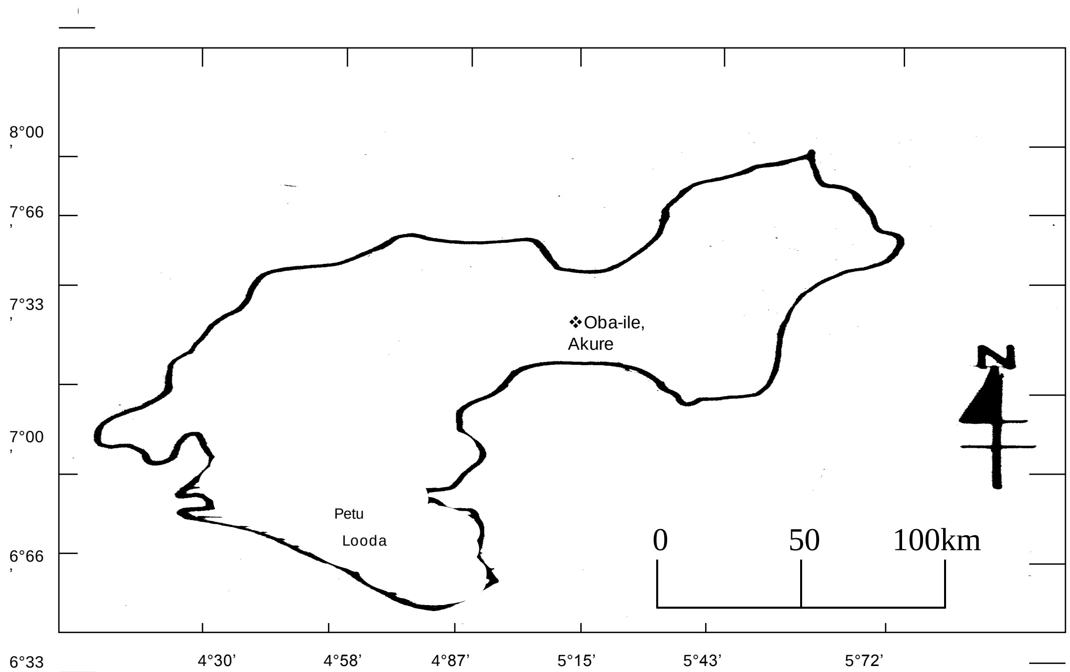


Fig. 2: GPS Map of Ondo State showing the selected Agro Mining Communities

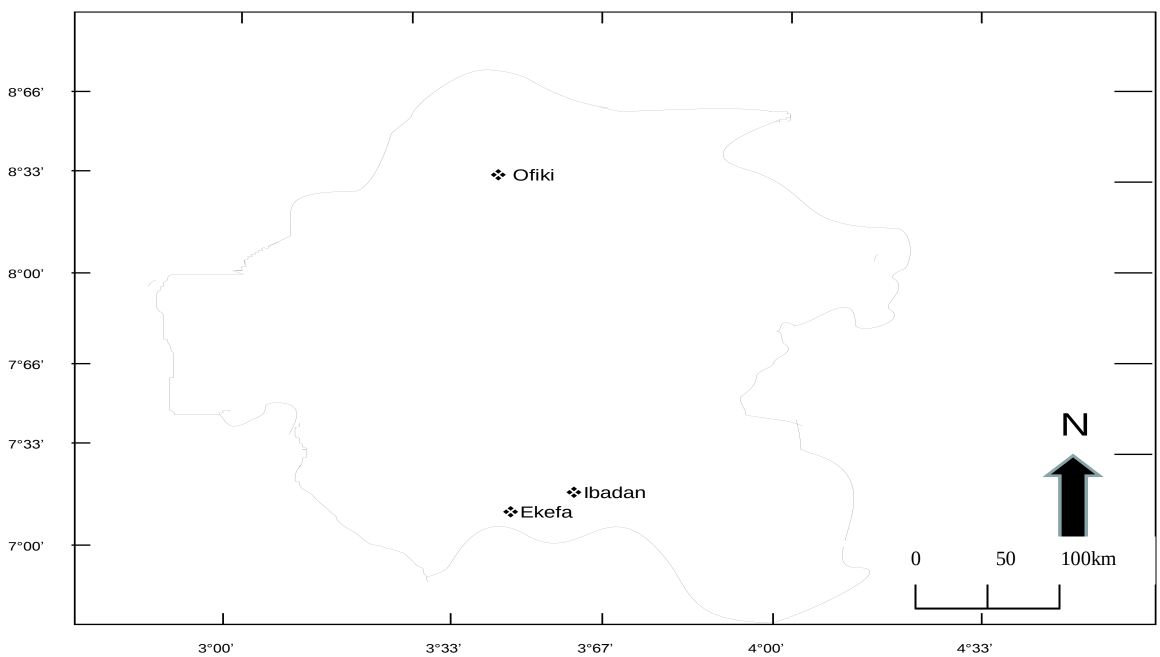


Fig. 3: GPS Map of Oyo State showing the selected Agro Mining

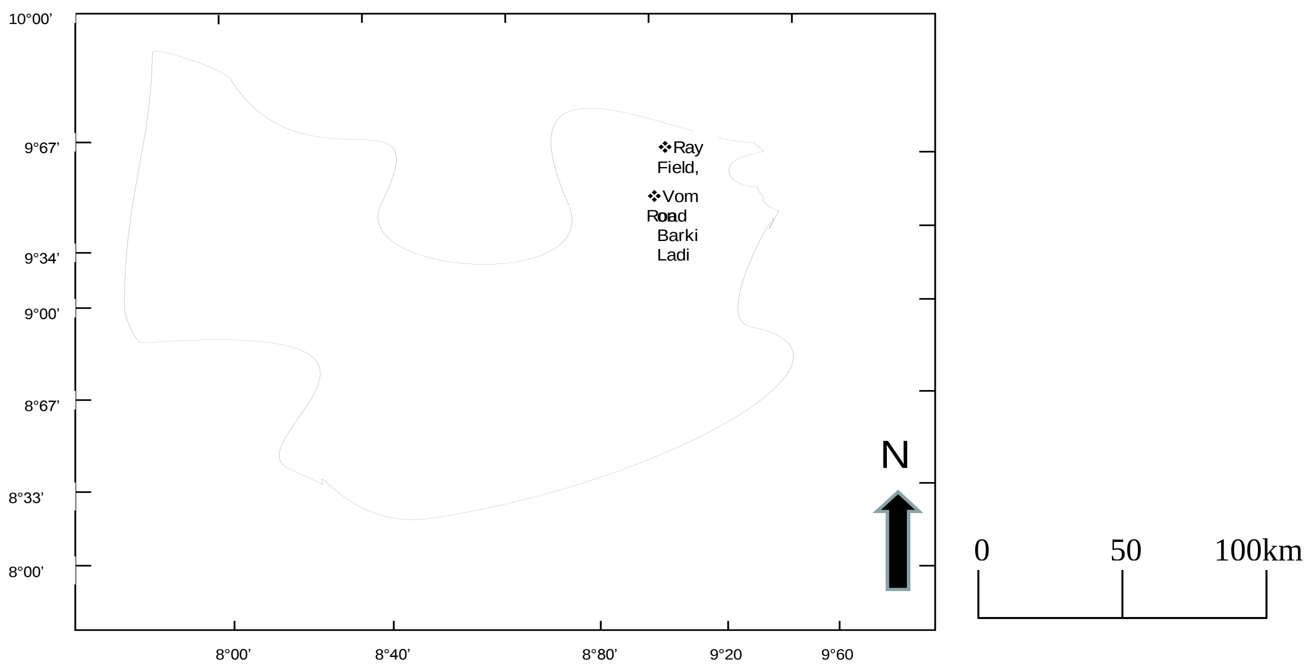


Fig.4: GPS Map of Plateau State showing the selected Agro Mining Communities

The soil samplings were conducted with the assistance of field assistance and Mine Officers in each selected states locations of Ondo, Oyo, Plateau States each. The implements used were cutlass, hand auger, polythene bags, 2 litres water bottles, thread rope, geographical positioning instrument (GPS) and tape rule. The soil samples were collected using the hand auger at 10m distances apart. The soil samples were collected at an approximate depth of 30cm to eliminate the effect of exposure at the surface (Ibitoye 2006). The soil samples were kept in air tight polythene bags and transferred quickly to the laboratory. The soil samples were sun dried, sieved through 2mm sieve and sun dried for another 24 hours. This is in accordance with ASTM D5435 - 03(2008).

Water samples from ponds and streams beside the mining sites and the control site were taken using the bottles dipped below the surface of the water body at about 30cm. The bottles were transported quickly to the laboratory in order to avoid time dependent changes. This is in accordance with ASTM D3856-95(2006). The following other facilities and methods were used for data collection in the course of carrying out the research works. The geographical co-ordinates of the selected Agro-Mining Communities were taken using the Geographical positioning System (GPS) instrument, eTrex Vista Garmin of high resistivity. Photographs of the various mining spots, equipment, damaged structures and tress were taken to complement other data collection methods. Personal observations were conducted at selected Agro Mining sites/communities and photographs were taken using digital camera as shown in Plate 1-3.

Plate 1: Destruction of Landscape and Agricultural Land by Illegal Miners of Tantalite. **Mining Site Location**: N09^{0}46^{I}04.3^{II} E008^{0}51^{I}08.1^{II}, **Village:** Along Vom Road, Behind Funa Guest Inn, along NDA Base. **LGA:** Barkin Ladi. **Elevation:** 1277m, **State**: Plateau

Plate 2: Destruction of Landscape and Agricultural Land by Illegal Miners of Gemstones Mining. Site Location: Illegal Exploitation of Gemstone, **Town**: Ofiki, **LGA:** Atisbo **GPS** Reading N: $8° 30^{1}.05^{11}$ E: $3°25^{1}020^{11}$ **Elevation:** 139m,

State: Oyo

Plate 3: Destruction of Economic Trees in Agro-Mining Communities. This was caused by Flyrock during Drilling and Blasting of Mining Activities. **Village**: Petu camp, **LGA**: Irele. **State**: Ondo. **GPS Reading**: N: 06°39^{1} 584^{11}, E: 004° 54^{1} 654^{11}

3 Results and Discussion

3.1 Soil Analysis

The following soil quality were determined: pH, electrical conductivity, total organic carbon and total organic matter, total nitrogen and phosphorous, exchangeable bases such as calcium, magnesium, potassium and extractable micronutrients such as iron, copper, manganese, lead and zinc. The results were compared with FAO (2005) standard.

3.2 Physico-Chemical Analysis of the Soil in the Study Area

Deficiencies of micronutrient element are commonly related to low contents of the elements in the parent rocks and similarly, toxic quantities are commonly related to abnormally large amount in the soil forming rocks and minerals. Calcium, Sodium, Magnesium, Zinc, Iron, Lead, NH_3 Nickel, Organic Matter, and pH were analyzed in all the selected nine mining locations of the three States of Ondo Oyo and Plateau States. Some of the critical results of the soil test are enumerated.

3.3 Calcium in Soil

Calcium is dissolved from practically all rocks and is found in greater quantity in leaching deposits of

limestone, dolomite, gypsum or gysiferrous shale these minerals were not found in the mines visited. It impacts the property of hardness to soil and water. It is very essential to the body for body metabolism for structure (bone) formation. However, the presence of calcium (and magnesium) in excess has been blamed for the occurrence of gout, rheumatism and urinary calculi. According to Food and Agricultural Organization, FAO (2005) the acceptable calcium level in soil should not be greater than 2.8 – 8.8 Cmol/kg, (FAO, 2005). Thus, all the mining locations were above this standard in Table 1.

Table 1: Calcium (ppm) Content in the Soil of the Mining Locations.

Location	1st Value	2nd Value	3rd Value	4th Value (Control)	Mean	Maximum Value	Minimum. Value	S.D
$OD_{A(s)}$	33.33	33.32	33.30	33.30	33.31	33.33	33.30	0.015
$OD_{B(S)}$	2.50	2.30	2.10	2.10	2.25	2.50	2.10	0.191
ODc(s)	62.50	62.40	62.60	62.40	99.64	62.60	62.40	0.150
$OY_{D(S)}$	167.00	166.00	164.00	164.00	165.25	167.00	164.00	1.500
$OY_{E(S)}$	488.33	488.30	488.29	488.29	488.30	488.33	488.29	0.019
$OY_{F(S)}$	174.29	174.27	174.20	174.20	93.00	174.29	174.20	11.804
$PL_{G(s)}$	46.67	46.64	46.64	46.64	46.65	46.67	46.64	0.0150
$PL_{H(S)}$	49.47	49.44	49.40	49.40	49.43	49.47	49.40	0.034
$PL_{I(S)}$	50.33	50.34	50.31	50.31	50.32	50.34	50.31	0.015

Location	1st Value	2nd Value	3rd Value	4th Value (Control)	Mean	Maximum Value	Minimum. Value	S.D
$OD_{A(s)}$	29.17	29.15	29.12	29.12	29.14	29.17	29.12	0.024
$OD_{B(S)}$	3.75	3.73	3.71	3.73	3.73	3.75	3.73	0.016
ODc(s)	4.75	4.73	4.71	4.71	4.72	4.75	4.71	0.019
$OY_{D(S)}$	55.58	55.57	55.56	55.56	55.57	55.58	55.56	0.010
$OY_{E(S)}$	65.18	65.17	65.15	65.15	65.16	65.18	65.15	0.015
$OY_{F(S)}$	28.19	28.17	28.16	28.16	28.17	28.19	28.16	0.014
$PL_{G(s)}$	3.75	3.73	3.72	3.72	3.73	3.75	3.72	0.014
$PL_{H(S)}$	12.18	12.17	12.15	12.15	12.16	12.18	12.15	0.015
$PL_{I\ (S)}$	4.77	4.75	4.69	4.69	4.73	4.77	4.69	0.041

SD = Standard Deviation

Iron in Soil

Iron is most important in chlorophyll formation, active inoxidation reduction reactions and plays a vital role in the activity of enzyme systems. The composition for iron in the soil in the study area range 50–250 mg/kg while from that of Food and Agriculture FAO (2005)

Organization ranges from 90-250mg/kg. All the soils in the agro-mining communities have low quantities of iron except Ekefa and Ibadan in Table 2.

Table 2: Iron (ppm) Content in the Soil of the Mining Locations.

S.D = Standard Deviation

Zinc in Soil

Zinc is essential to the formation of chlorophyll. It influences seed production and grain yield. Deficiency of zinc leads to mottled leaf of citrus plants. The normal level of zinc is 4 - 8mg/kg, according to FAO (2005). Toxic level is 1500mg/kg and any soil with the quantity below 4mg/kg is deficient (FAO, 2005). Therefore, in line with FAO (2005), all the communities in the mining sites are above this value except Oba Ile and Looda that are deficient as shown in Table 3.

Table 3: Zinc (ppm) Content in the Soil of the Mining Locations.

Location	1st Value	2nd Value	3rd Value	4th Value (Control)	Mean	Maximum Value	Minimum. Value	S.D
$OD_{A(s)}$	6.67	6.65	6.62	6.62	6.64	6.67	6.62	0.024
$OD_{B(S)}$	2.75	2.76	2.72	2.72	2.74	2.76	2.72	0.021
ODc(s)	3.67	3.65	3.61	3.61	3.64	3.67	3.61	0.030
$OY_{D(S)}$	10.30	10.32	10.30	10.30	10.31	10.32	10.30	0.010
$OY_{E(S)}$	6.67	6.65	6.63	6.63	6.65	6.67	6.63	0.019
$OY_{F(S)}$	7.86	7.83	7.82	7.83	7.84	7.86	7.83	0.017
$PL_{G(s)}$	5.83	5.82	5.81	5.81	5.82	5.83	5.81	0.010
$PL_{H(S)}$	5.79	5.75	5.72	5.72	5.73	5.79	5.72	0.033
$PL_{I (S)}$	6.19	6.18	6.16	6.16	6.17	6.19	6.16	0.015

S.D = Standard Deviation

Lead, NH_3 and Nickel in Soil

Lead occurrence is only a minor element in most natural water. Major sources of lead are industrial waste, engraving industries, smelter, effluents, photography, mine, dyeing and lead from traffic fumes and drinking water carried by lead pipes. Lead is foreign to the body and its toxicology is well known. Likewise, abattoir ground water should not be sited near to industrial waste so as to reduce the quantities or level of lead. It is a cumulative poison. In comparison with the FAO (2005) standard which is within 2-4 mg/kg. No traces of lead in all the mining sites in the three States except community around RATCON Construction Company, Ibadan, Oyo State which was insignificant. NH_3 was not detected in the studied areas of Plateau, Oyo and Ondo States. Nickels detected were of insignificant quantities in the studied areas. Most of the agro-mining communities had no traces of nickel.

Organic Matter in Soil.

Organic matter in soil serves several functions. From a practical agricultural standpoint, it is important for two main reasons. At any given time, it consists of a range of materials from the intact original tissues of plants and animals to the substantially decomposed mixtures of loamy (FAO, 2005). The mean value of the organic contents which ranges between 2.15% and 3.02% are lower than the control value in each of the sites, as such, the entire agro-mining site experienced depreciation of organic contents as a result of mining activities as shown in Table 4.

Table 4: Organic Matter (%) in the Soil of the Mining Locations.

Location	1^{st} Value %	2^{nd} Value %	3^{rd} Value %	4^{th} Value (Control) %	Mean %	Maximum Value %	Minimum. Value %	S.D %
$OD_{A(s)}$	2.10	2.12	2.14	2.50	2.22	2.50	2.1	0.191
$OD_{B(S)}$	2.08	2.1	2.12	2.60	2.23	2.60	2.08	0.251
ODc(s)	2.83	2.81	2.80	2.80	2.81	2.80	2.80	0.014
$OY_{D(S)}$	3.03	3.01	3.00	3.05	3.02	3.05	3.00	0.022
$OY_{E(S)}$	2.78	2.80	2.82	3.00	2.85	2.82	2.78	0.101
$OY_{F(S)}$	2.32	2.30	2.28	3.00	2.48	3.00	2.28	0.350
$PL_{G(s)}$	2.02	2.00	1.98	2.60	2.15	2.60	1.98	0.300
$PL_{H(S)}$	2.00	1.99	1.97	2.70	2.17	2.70	1.97	0.357
$PL_{I\ (S)}$	2.01	2.03	2.05	2.80	2.22	2.80	2.01	0.385

S.D = Standard Deviation

pH in Soil

The suitable pH value for plant growth according Food and Agricultural Organization is medium which ranges between 6 and 7 (FAO, 2005). Only communities around Ekefa and Ibadan with pH mean values 7.01 and 6.40 have suitable soils for plant growth as shown in Table 5. Others have pH which is less or greater than 7, thus making it difficult for plant to grow well in these areas.

Table 5: pH Values in the Soil of the Mining Locations.

Location	1st Value	2nd Value	3rd Value	4th Value (Control)	Mean	Maximum Value	Minimum. Value	S.D
$OD_{A(s)}$	3.70	3.71	3.70	3.70	3.70	3.71	3.7	0.005
$OD_{B(S)}$	4.80	4.81	4.81	4.80	4.81	4.81	4.8	0.006
ODc(s)	3.81	3.82	3.81	3.81	3.81	3.82	3.81	0.005
$OY_{D(S)}$	7.70	6.78	6.79	6.78	7.01	7.7	6.78	0.458
$OY_{E(S)}$	6.40	6.41	6.40	6.40	6.40	6.41	6.4	0.005
$OY_{F(S)}$	3.10	3.60	4.90	3.10	3.68	4.9	3.1	0.85
$PL_{G(s)}$	5.91	5.90	5.91	5.90	5.91	5.91	5.9	0.006
$PL_{H(S)}$	5.82	5.81	5.80	5.80	5.81	5.82	5.8	0.010
$PL_{I\ (S)}$	5.93	5.95	5.94	5.93	5.94	5.95	5.93	0.010

S.D = Standard Deviation

Physico-Chemical Properties of Surface Water at Selected Agro-Mining Communities

Nitrate, Colour and Turbidity, pH, Sulphate, Conductivity, Alkalinity, Chloride, Hardness, Total Suspended Solid and Total Solid, Phosphate, Calcium Samples were also analyzed in all the nine mining locations of the three States of Ondo, Oyo and Plateau States. Some of the critical results of the water test were evaluated as follows.

Nitrate in Water

Water containing high nitrate concentration is potentially harmful to infants and young children. All the samples tested were above the standard of ≤10 (mg/I) recommended by World Health Organization WHO (2004) and Federal Environmental Protection Agency, (FEPA, 1991) for nitrate in drinking water except Rayfield and Barki Ladi with mean values 8.41(mg/I) and 9.41(mg/I) respectively. Therefore, the water in other locations are not safe for consumption except when treated and this may be as a result of the deposition of the explosives compounds after blasting operations. Table 6 shows Nitrate Content in the study area.

Table 6: Nitrate (mg/I) Content In Streams Around the Mines/Quarries within the Locations:

Location	1st Value	2nd Value	3rd Value	Mean (mg/l)	Maximum Value	Minimum Value	S.D (mg/l)
$OD_{A(w)}$	16.8	16.80	16.70	16.77	16.80	16.70	0.058
$OD_{B(w)}$	38.1	38.15	38.11	38.12	38.15	38.10	0.026
ODc(w)	12.18	12.17	12.19	12.18	12.19	12.17	0.01
$OY_{D(w)}$	24.6	24.55	24.59	24.58	24.6	24.5	0.026
$OY_{E(w)}$	25.6	26.610	25.59	25.6	25.61	25.59	0.586
$OY_{F(w)}$	21.12	21.40	20.60	21.04	20.60	21.12	0.406
$PL_{G(w)}$	8.40	8.42	8.40	8.41	8.42	8.40	0.012
$PL_{H(w)}$	15.40	15.410	15.43	15.41	15.43	15.40	0.015
$PL_{I (w)}$	9.42	9.4	9.41	9.41	9.42	9.40	0.01

S.D = Standard Deviation

Colour and Turbidity in the Selected Agro-Mining locations of Ondo, Oyo and Plateau States.

Table 7 shows that the colour of water in the mining locations, Petu is 14.25 (tcu), Oba Ile is14.00 (tcu) and Looda are 10.15 (tcu). These are lower than WHO (2004) limit of 15.00 (tcu). The colour of water are also higher than the WHO (2004) limit of 15.00 (tcu); Ekefa is 16.00 (tcu), Ibadan is15.03 (tcu), except Ofiki of the value 14.00 (tcu) which is lower than the WHO (2004) limit of 15(tcu). The colour of the selected mining locations in Rayfield is 16.10 (tcu), Sabon Barki is 17.20 (tcu) and Barkin Ladi is 15.50 (tcu), these are higher than the WHO (2004) limit of 15(tcu). Also the turbidity of all the selected sites is higher than the WHO (2004) limit of 5.00 Normal Turbidity Unit (NTU).

Table 7: Colour and Turbidity in the Selected Agro-Mining locations

SITES	COLOUR (TCU)	TUBIDITY (NTU)
$OD_{A(w)}$	14.25	8.21
$OD_{B(w)}$	14.00	7.51
ODc(w)	10.15	7.11
$OY_{D(w)}$	16.00	8.20
$OY_{E(w)}$	15.03	8.30
$OY_{F(w)}$	14.00	6.30
$PL_{G(w)}$	16.10	7.12
$PL_{H(w)}$	17.20	8.22
$PL_{I\ (w)}$	15.50	8.55
WHO Limit	15 TCU	5.0 NTU

Sulphate in Water.

Sulphate comes from several sources such as the dissolution of gypsum and other mineral deposits containing sulphate, or mostly from oxidation of metallic suphides. Sulphate should not exceed 200mg/I (WHO, 2004). Samples taken from Johnson International Construction, Ltd., Oba Ile, Akure; Bitumen Deposit, Looda, Irele, Ondo State and Illegal Exploitation of Gemstone, Ofiki Atisbo, Oyo State are within the permissible limit of WHO (2004) while samples from Piccolo Brunelli Enginering Ltd., Petu, Irele, Ondo State with mean value of 244.22 (mg/I), Reynolds Construction Company Nig. Ltd., Ekefa, Ibadan, Oyo State with mean value of 240.09 (mg/I) and RATCON Construction Company Nig. Ltd., Ibadan, Oyo State with mean value of 448.05 (mg/I) exceeded the minimum standard thereby containing excess sulphate which are not safe for consumption. The concentrations of sulphate in all the water samples are not within the permissible limit and may not support agricultural practice effectively. The result is as shown in Table 8.

Table 8: Sulphate (mg/I) Content in Streams around the Mines/Quarries within the Study Area:

Location	1st Value	2nd Value	3rd Value	Mean (mg/l)	Maximum Value	Minimum Value	S.D (mg/l)
$OD_{A(w)}$	244.21	244.25	244.2	244.22	244.25	244.20	0.026
$OD_{B(w)}$	18.20	18.10	18.09	18.13	18.2	18.09	0.061
ODc(w)	20.50	19.50	18.50	19.50	20.5	18.50	1.000
$OY_{D(w)}$	240.16	240	240.11	240.09	240.16	240	0.082
$OY_{E(w)}$	448.09	448.05	148.02	448.05	448.09	448.02	173.234
$OY_{F(w)}$	88.30	88.00	87.60	87.97	87.60	88.00	0.351
$PL_{G(w)}$	8.00	15.00	20	14.33	20.00	8.00	6.028
$PL_{H(w)}$	40.05	42.01	40.01	40.69	42.01	40.01	1.143
$PL_{I (w)}$	21.05	21.04	21.02	21.04	21.05	21.02	0.015

S.D = Standard Deviation

Phosphate in Water.

The concentration of phosphate is low in all the samples except for Reynolds Construction Company Nig. Ltd., Ekefa and RATCON Construction Company Nig. Ltd., Ibadan with mean values 67.07 (mg/I) and 68.80 (mg/I) that were relatively high; however, the standard requirement for phosphate

in drinking water, is 75mg/I, and is not exceeded. The high concentration of phosphate in Ekefa and Ibadan may the due to accumulation of phosphorus ore through subsurface absorption system to the water Table 9 Shows Phosphate content in stream in the study area.

Table 9: Phosphate content (mg/I) in Streams around the Mines/Quarries within the Study Area of Ondo, Oyo and Plateau States:

Location	**1st Value**	**2nd Value**	**3rd Value**	**Mean** (mg/l)	**Maximum. Value**	**Minimum Value**	**S.D** (mg/l)
$OD_{A(w)}$	8.16	8.15	8.12	8.14	8.16	8.12	0.021
$OD_{B(w)}$	0.03	0.04	0.05	0.04	0.05	0.03	0.010
ODc(w)	7.20	6.10	6.90	6.73	7.20	6.10	0.569
$OY_{D(w)}$	67.10	67.11	670	67.07	67.11	670	0.061
$OY_{E(w)}$	68.80	68.81	68.8	68.80	68.81	68.80	0.006
$OY_{F(w)}$	20.02	17.01	16.05	17.69	20.02	16.05	2.071
$PL_{G(w)}$	0.02	0.03	0.01	0.02	0.03	0.01	0.010
$PL_{H(w)}$	6.01	6.06	6.00	6.02	6.06	6.00	0.032
$PL_{I\ (w)}$	7.01	6.01	7.00	6.67	7.01	6.01	0.574

S.D = Standard Deviation

Chloride in Water

Chloride basically is not a natural constituent of water. The explosives used in the quarries are basically a mixture of salts. It decomposed to give heat, oxygen and chlorine gas. The limitation value of chloride in drinkable water for public consumption is 200(mg/I) (WHO, 2004). It was generally observed from sample analysis that the chlorides values obtained were all below the recommended unit of 200 (mg/I) which showed that there were low decomposition of explosive content around the mining locations as shown in Table 10.

Table 9: Chloride (mg/I) content in Streams around the Mines/Quarries within the Study area:

Location	1st Value	2nd Value	3rd Value	Mean (mg/l)	Maximum Value	Minimum Value	S.D (mg/l)
$OD_{A(w)}$	70.91	70.91	70.90	70.91	70.91	70..90	0.006
$OD_{B(w)}$	85.08	85.05	85.03	85.05	85.08	85.03	0.025
ODc(w)	60.05	60.03	60.01	60.03	60.05	60.01	0.02
$OY_{D(w)}$	41.24	41.23	41.22	41.23	41.24	41.22	0.01
$OY_{E(w)}$	42.54	42.52	42.53	42.53	42.54	42.52	0.01
$OY_{F(w)}$	40.26	40.28	40.00	40.18	40.28	40.00	0.156
$PL_{G(w)}$	49.67	49.68	49.66	49.67	49.68	49.66	0.01
$PL_{H(w)}$	40.17	40.18	40.2	40.18	40.20	40.17	0.015
$PL_{I\ (w)}$	60.02	60.00	60.10	60.04	60.10	60.00	0.053

S.D = Standard Deviation

Socio-Economic Analyses

Questionnaires Responses

Residents of host communities of Agro-Mining were interviewed orally by the researcher. Well structured questionnaire were also distributed to respondents in host communities as in Figure 1-4. Responses were impressive and descriptive statistical analysis was used. The percentages of environmental problems confronting the Agro-Mining locations in Petu, Oba Ile and Looda communities are represented with codes (OD1), (OD2) and (OD3) respectively as shown in Fig.1. Similar graph was applicable in Oyo and Plateau State. For example, 60% of the respondents complained of water pollution around Petu. Also, 60% of the respondents complained about the destruction of soil fertility around Oba Ile. It was concluded from Fig.1 that mining activities have significant negative effects on the source of drinking water through surface water pollution, destruction of soil fertility and others environmental problems. All the Agro-Mining locations in the three States were affected except Looda where the effect was not pronounced. This is because mining activities are not regularly carried out yet in that location.

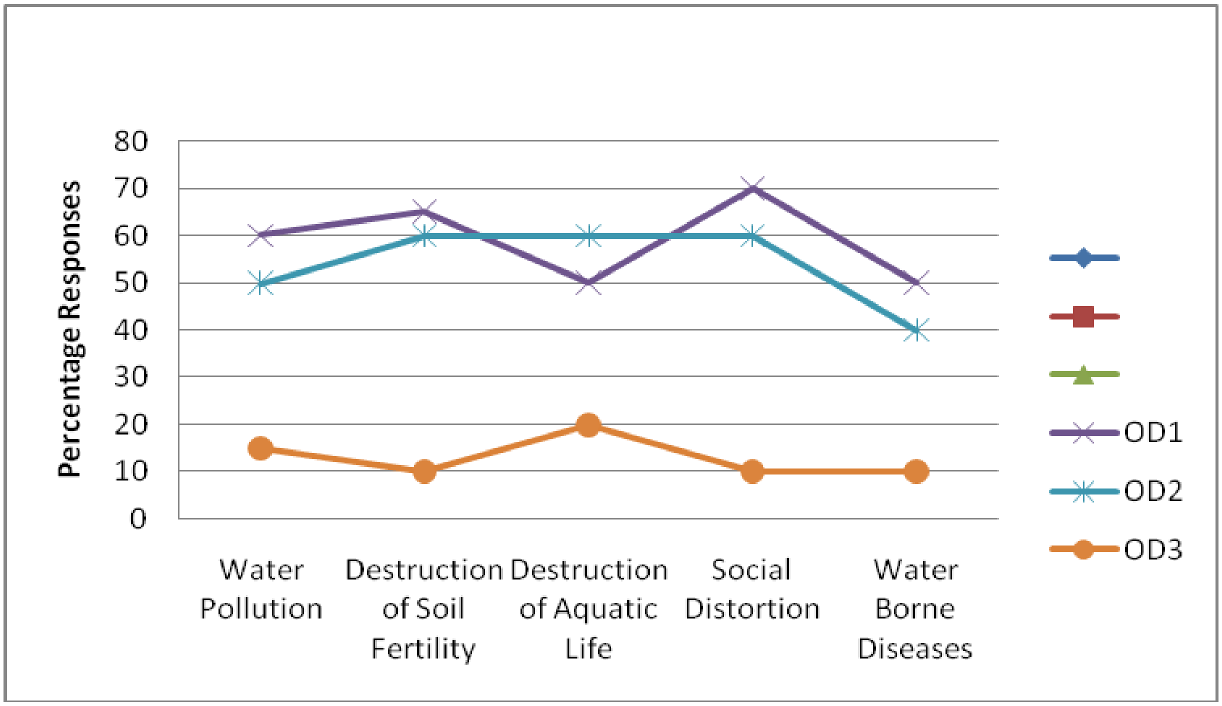


Fig. 1: Percentages Responses in each location of Ondo State to Environmental Problems

<u>Social Issues as a Result of Mining Activities</u>

The percentages of social issues confronting the Agro-Mining locations in Petu, Oba Ile and Looda communities are represented with codes (OD1), (OD2) and (OD3) respectively as shown in Fig.2. For example, 20% of the respondents complained of no regular meeting between the community and the mining company in Oba Ile. Also, 65% of the respondents complained of conflicts between mining company and the Agro-Mining community in Petu. All the Agro-Mining Communities in the selected locations of Ondo, Oyo and Plateau States experienced similar consequences of mining activities. The social problems usually result to conflicts and sometimes violence between the host Agro-Mining Communities and the Mining Operators. Over 60% in all the locations in those figures reported lack of compensation in form of scholarship neither was any workshop organized to the host agro-mining communities by the Mining Operator nor Government.

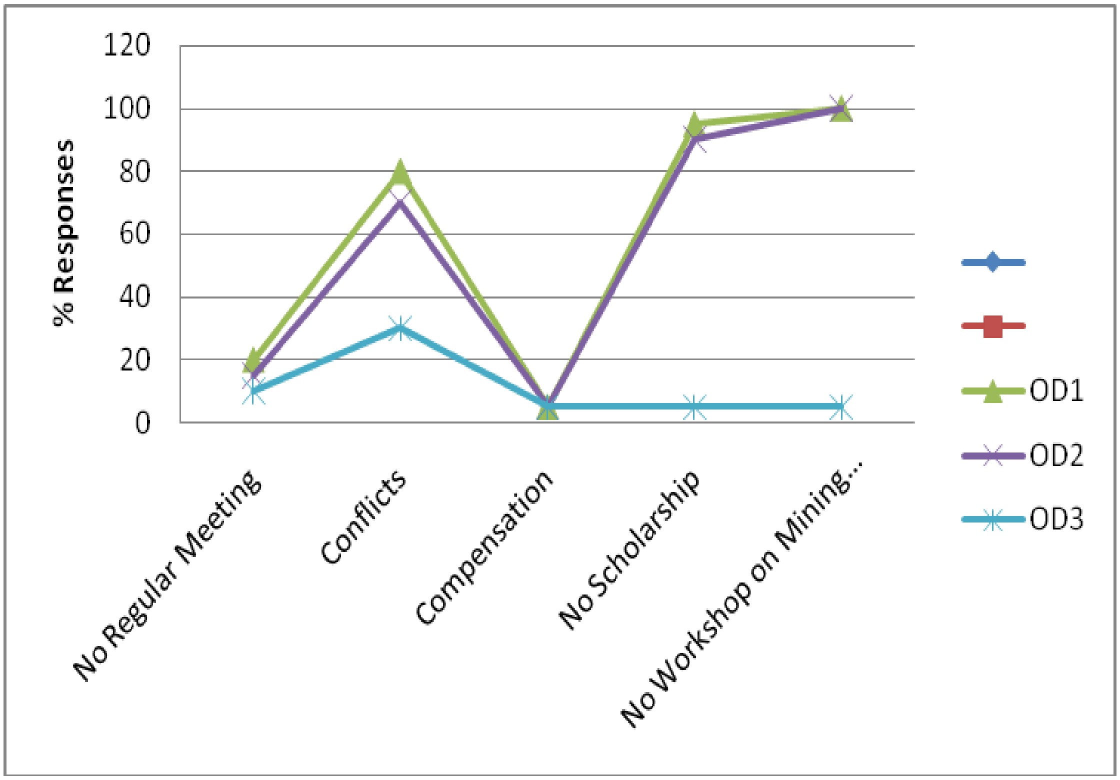


Fig. 2: Percentages Responses to Social Issues as a result of Mining Activities.

<u>Health Related Issues & Agro-Mining Communities</u>

The percentages of health problems confronting the Agro-Mining locations in Petu, Oba Ile and Looda communities are represented with codes (OD1), (OD2) and (OD3) respectively as shown in Fig. 3. For example, 95% of the respondents complained of malaria fever/occasionally which may be due to holes drilled by mining company which later turns to stagnant water around Petu. Also, 60% of the respondents complained of typhoid fever/occasionally which may be a result of untreated rivers/ponds around the same location. Health problems are common to all the selected Agro-Mining locations in Ondo, Oyo and Plateau States, though mostly occasional. This can also be linked to pits that are excavated or dug during mining activities which are usually filled with polluted water after the mining and sometimes used for sexual related crimes.

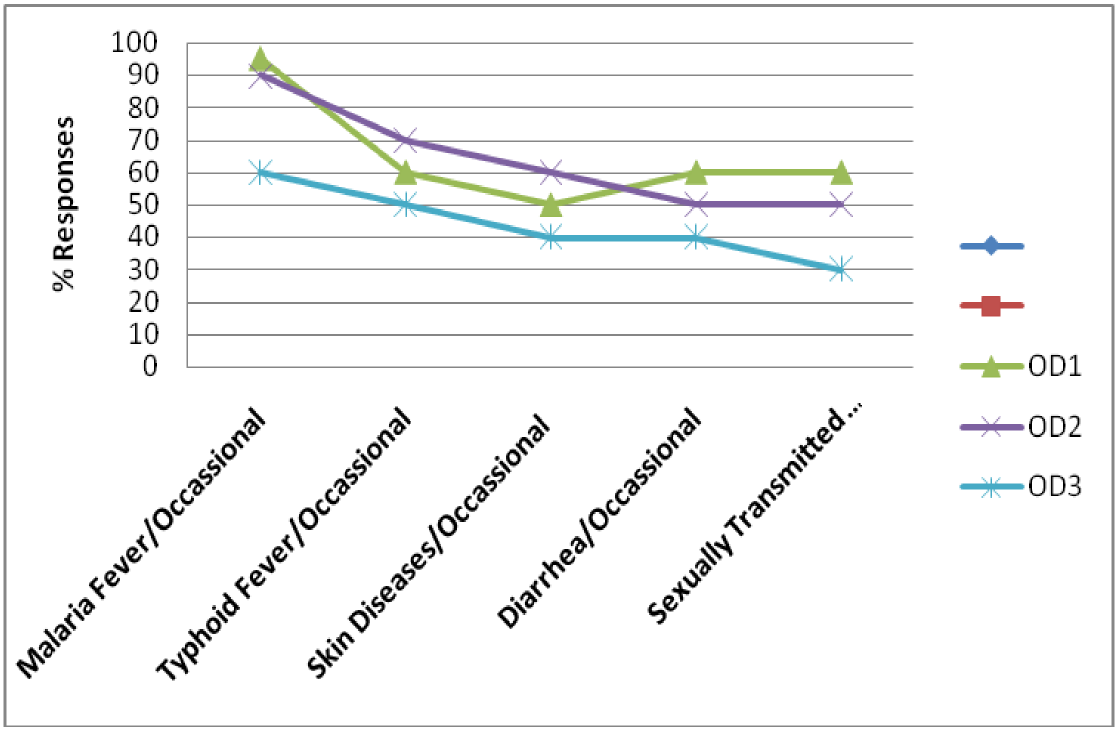
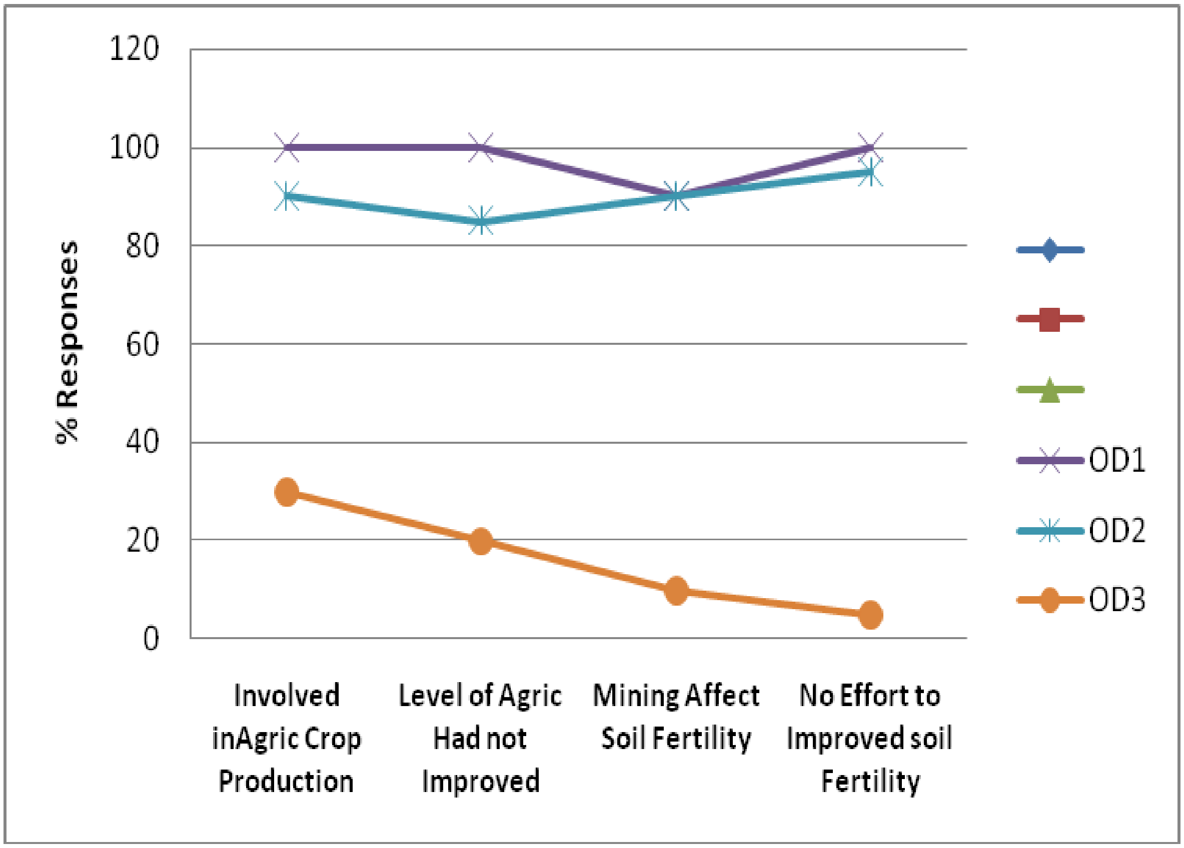


Fig. 3: Percentages Ranking of Health Issues around Agro-Mining Locations

Agricultural Problems & Agro-Mining Communities

The percentages of agricultural problems confronting the Agro-Mining locations in Petu, Oba Ile and Looda communities are represented with codes (OD1), (OD2) and (OD3) respectively as shown in Fig. 4. For example, 100% of the inhabitants were involved in agric crop production which had not improved since the incident of mining around the Agro-Mining Community in Petu. Also, 85% of the respondents complained that mining affects their soil fertility around the Agro-Mining Community in Petu and Oba Ile. Reports show that agricultural activities had not improved in the selected locations of Ondo, Oyo and Plateau States since incident of mining began and that mining reduced the size of the cultivable land.



: **Fig. 4: Percentages Ranking of Agricultural Issues around the Agro-Mining Locations**

Conclusion

On the basis of result obtained from the analyzes in the course of this study, the soil analyses show that the soils in and around selected agro mining sites have been degraded chemically, the degree of pollution decreases with distance away from mining sites in most of the site as seen in the this study. The chemical constituents of soils in the agro-mining locations in the study areas were above FAO (2005) standard. The study also reveals that Oba Ile, Irele and Ekefa may suffer chlorophyll deformation in plants due to insufficient zinc contents. Petu, Looda, Ofiki, Rayfield and Barkin Ladi may suffer the same effect as a result of low iron contents in their soil. These effects may invariably lead to low production of agricultural produce in those agro-mining locations. All the agro-mining communities lacked the normal quantity of loamy soil required for plant growth as a result of low organic contents which is a direct result of mining activities in those locations. pH of soil were also affected negatively, though, from the soil results, Ekefa and Ibadan with pH values of 7.01 and 6.40 respectively may not be too low since FAO (2005) recommends 6 and 7 pH values for suitable soil for plant growth. However, other locations may be too acidic to support plant growth as a result of low pH contents. All the agro-mining locations also experienced loss of moisture content which may be as a result of the effects of the use of heavy duty equipment for mining activities.

The results of social-economic analyzes of mining activities in the selected locations reduced the size of cultivated land and do affect agricultural practices negatively. There is deforestation, social conflicts, environmental problems, structural foundational problems, cracks and collapse of building structures, damages to plants and animals as a result of mining activities in the studied locations. Ailments such as malaria fever resulting from stagnant water in abandoned holes which produces breathing opportunities for mosquitoes, typhoid and sexually transmitted diseases also existed in the selected agro-mining locations. Abandon mines were used as hideout for perpetration of robbery offences and assaults since its not properly monitored and converted to other useful purposes. The attitudes of the mining operators to cleaning up mining wastes were poor. Also, no scholarship or any forms of compensations were made by neither mining operators nor the government. Mining operators rarely held meetings with host agro-mining communities in the selected locations and there had been conflicts which have been resolved severally by traditional rulers in those locations. Sometimes, some of the conflicts between the host agro-mining communities and the mining operators often resulted to violence. The mining operators do not organize training/workshop for people on how to abate pollution from mining activities.

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