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Land degradation in gold mining communities of Ijesaland, Osun state, Nigeria

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Abstract This paper identified 37 mining sites in ten gold mining communities of Ijesaland, Nigeria; examined the forms, levels and extent of land degradation resulted from mining activities; analyzed spatial pattern of land use and finally assessed the effects of mining on livelihood of the people. The study utilized global positioning system receiver to obtain geographic coordinates of mining sites. The forms of land degradation were captured through field observations and photographs while the levels and extent of the degraded lands were measured with measuring tape and the values were determined using mathematical formula for calculating area of a circle. Landsat datasets were used to analyze spatial pattern of land use and the effects of mining activities were examined through questionnaire administration on two hundred heads of household who were randomly selected. Focus group discussions (FGD) were organized among adult men and women to complement information obtained from questionnaire survey. The study discovered 354 mining pits as major form of land degradation, which ranges in sizes and depths. The average depth of mining pits was 3.4 m while an estimate of 25.8 ha. of land was degraded in the entire mining sites. There was a consensus among FGD participants and respondents of questionnaire survey that mining activities introduced adverse effects into their communities and attracted socio-economic benefits at the same time. The results of this study underscore the need for close monitoring of mining operations to reduce the negative impact of mining activities on the environment.

Keywords Mining · land degradation · Socio-economic benefits · Ijesaland · Nigeria

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Introduction

Mining as part of human activities on land is an expanding industry that can provide sustainable economic, environmental and social benefits to communities and regions where it is taking place. The general importance of mining sector has been documented to include foreign exchange earning, employment generation, physical and economic development (Obaje and Abba 1996, 2005; Nwajiuba 2000). Increasing realization of the potentials of the solid minerals mining sector in recent times has made the Federal Government of Nigeria to undertake a number of reforms in the sector in order to make it earn more non-oil foreign revenue for the country (Essaghah et al. 2013).

In spite of the benefits associated with mining activities; exploration, mining, processing, inappropriate and wasteful working practices and rehabilitation measures have always been responsible for different

types of adverse effects on the physical environment, which include ecological disturbance, biodiversity loss, pollution of air, land and water, instability of soil and rock masses, landscape degradation and radiation hazards (Abegunde et al. 2007; Aigbedion and Iyayi 2007; Olanipekun 2002; Kitula 2006). The potential adverse impacts of mining have also been asserted to include displacement of local people from ancestral lands, marginalization, and oppression of people belonging to lower economic classes (Tauli-Corpuz 1997; Filer 1998; Makinde et al. 2014).

The adverse effects of mining on the physical environment have therefore; become an issue of concern, which became popular during the 1960s. The waves of concern have translated into a number of researches that are solution based. Among the academics, scholarly writings have tried to explain the dimension and severity of mining activities on the environment. For instance, Gyang et al. (2010) enumerated the problems associated with mineral development in Nigeria. In Zamfara State for instance, where active mining of gold, lead and other minerals was active, the indiscriminate manner in which the activity was carried out led to the death of about 300 people as a result of lead poisoning of shallow water sources and soils. Similarly, in Jos Plateau, North Central Nigeria where mining of cassiterite and columbite had taken place for more than half a century, a total of 2015 disturbances were recorded in the form of abandoned mine ponds and mine dumps.

Essaghah et al. (2013) investigated environmental and socio-economic effects of Lead and Zinc Ores mining in Ishaiagu Community in Ivo Local Government Area of Ebonyi State, South Eastern Nigeria. The results obtained from physico-chemical analysis of collected soil and water samples, as well as, related in situ air parameter measurements revealed serious environmental pollution and degradation, threatening farming activities in the area. Adeyinka et al. (2011) also examined residents' perception of the effects of mining activities on their environment in Ijero Local Government Area of Ekiti State, South Western Nigeria. The study revealed that the resident tolerance index (RTI) was found to be between "*not tolerable and not at all tolerable*". The study further showed that only three variables, which include high influx of people, increase in sales and services, and improved economic condition with RTI values above 3.0 (just tolerable) were the accrued benefits to the residents while the remaining 17 variables with RTI values of less than 3.0 were considered to have adverse effects on the environment.

Ako et al. (2014) in a recent study evaluated environmental hazards associated with artisanal gold mining in Luku, Minna, North Central Nigeria. It was revealed that mining activity resulted in a lot of physical environmental impacts such as land degradation, destruction of vegetation, erosion of soils and degrading water quality. The laboratory analyses of the hazards showed that soils were contaminated with elements such as, Pb (85.73 ppm), As (9.27 ppm), Cu (56.46 ppm), Zn (31 ppm), Ni (85.55 ppm), Mn (283.73 ppm), Cd (1.68 ppm), Co (10.91 ppm), Mo (0.91 ppm), Hg (0.27 ppm), Ag (0.73 ppm), and Zr (143.27 ppm). It was further discovered that these elements in the soil get accumulated in plants and animals, and are passed on to human through the food chain, which consequently can induce slow growth rate in plants and respiratory problem, liver and kidney damage in man.

From the foregoing, it is obvious that most researches on mining activities focused on the benefits and the effects of mining on the physical environment such as, water resources, vegetal cover and biodiversity as well as agricultural activities. However, research is still sparse on the spatial pattern of land use in mining community, which informs the gap in our knowledge. Gold mining in Osun State has been well studied but little or none of these studies have selected many of the main settlements where mining has been taken place as the study area. The dimension of the land degradation in terms of the depths and areal extent are still poorly documented or undocumented. Again, the debate on the effects of mining on the local livelihood of people is inconclusive, which still needed to be explored.

Based on these scenarios, the study therefore, identified mining sites in ten mining communities of Ijesaland; examined the forms, levels and extent of land degradation; analyzed spatial pattern of land use; and finally assessed the effects of mining on the local livelihood of the people. Mining in the study area has been done by illegal, inexperienced, money conscious and unconcerned miners. While environments are being polluted, the illegal miners smile to the bank. The activities of the miners constituted environmental degradation to the local environment even though government at various times has tried to control their

activities without any positive impact, which was the reason for the selection of the study area.

The study area

The study area consists of ten mining communities in Ijesaland, Nigeria. They are sitting on vast fields of raw gold and other minerals in considerable proportion. These are Atorin, Epe, Faforiji, Ibodi, Ifewara, Igun, Ijemogun, Itagunmodi, Iwara-Odo and Iperindo. They lie between latitudes 7° 20′N and 7° 60′N and longitudes 4° 60′E and 4° 85′E in Ilesa west, Atakunmosa west and Atakunmosa east Local Government Areas of Osun State, Nigeria (Fig. 1). As revealed by Makinde et al. (2014), gold mining operations started in Ilesa-west Local Government Area of Osun state, Nigeria in early 1950s. Though official mining operation stopped in mid 1990s, illegal mining is still active in the area till date.

The climate of the area is tropical with distinct wet and dry season (Adesina 1997). It has annual rainfall of 1200–1500 mm, which promotes dense vegetation. The wet season spans the period of 8 months that is, between March and October while the dry season lasts for 4 months from November till February. During the dry season the North East (NE) trade wind prevails whereas, the southwesterly wind dominates during the wet season. Temperature is high throughout the year ranges from 27 to 32 °C with the maximum temperature around April. The relative humidity ranges from 50 to 80 % (Adejuwon 1979). The original vegetation of the study area is tropical rainforest characterized by big and robust trees such as Iroko (*Milicia excels*), Mahogany (*Khaya grandifoliola C. DC.*), Sapele (*Entandrophragma cylindricum*) and tall grasses (Montimore 1975).

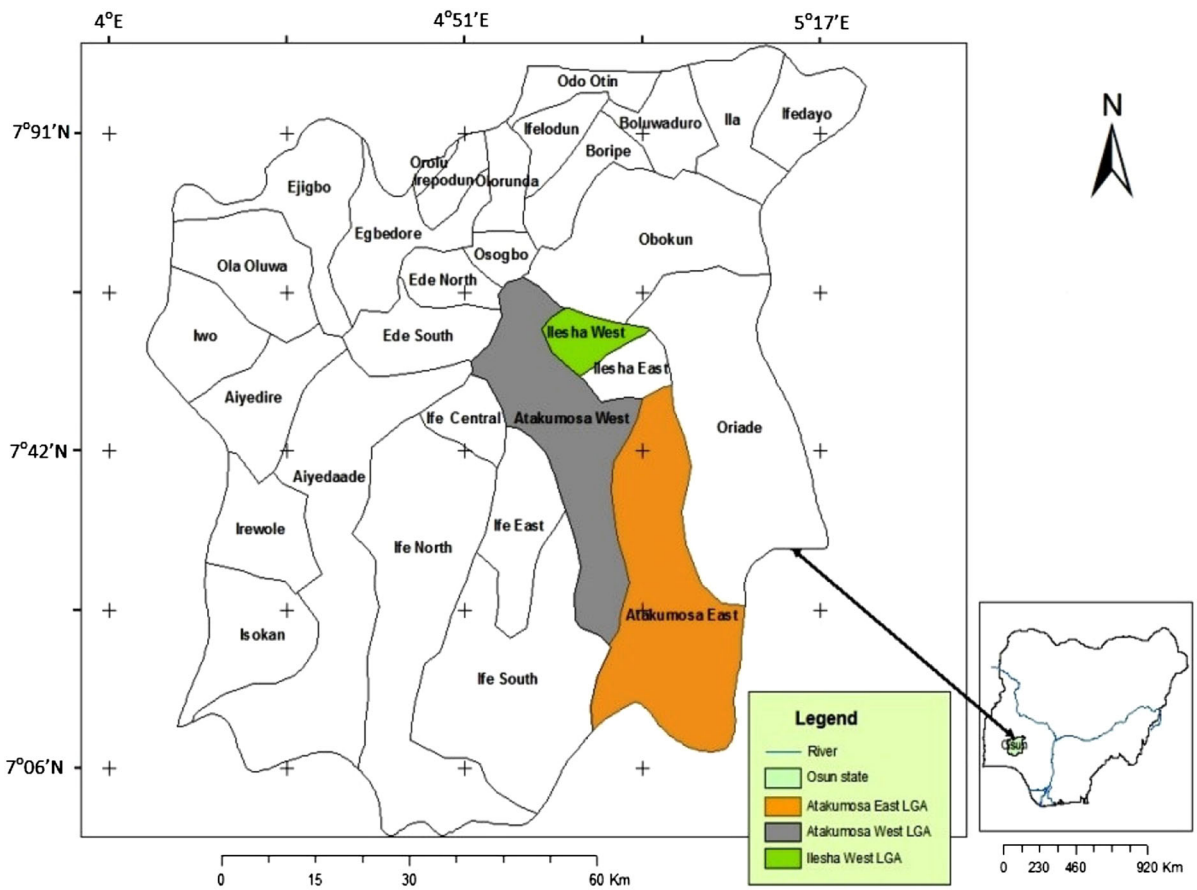

Fig. 1 Local Government Areas of the study area

However, tall grasses are results of the degradation; they are not part of the original tropical rainforest found in the area. Nowadays, the natural vegetation is hardly present because of mining and agricultural activities.

The landscape of the study area is punctuated with projecting hills, which range from 366 to 394 m above the sea level. The area is located within the schist belt of southwestern Nigeria, which embraces undifferentiated schist, gneisses, and migmatites with pegmatites, schist and epidorite complex, quartzite and quartz schist, granite gneiss, amphibolite, pegmatised schist, granulite, and gneiss (Fadare 2000). The soils of the study area are tropical ferruginous red soils from the material of basement complex of western highland. The soils are generally deep and of two types; namely, deep clayed soil formed on low smooth hill crest and upper slopes and the sandier hill wash soils on the lower slopes. The well drained clayed soils of the hill crest and slopes are very important because they provide the best soils for Cocoa (*Theobroma cacao*), Oil palm (*Elaeis guineensis*), Citrus (*Gambeya Africana*) and Coffee (*Coffea brevipes*), which are the major cash crops in the area. However, mining activities had affected agricultural practices in most communities of the study area. For instance, much of the gold is found on soils of Itagunmodi series, which are some of the best soils for cocoa plantations. Thus, the first causalities of the onslaught of gold mining are the loss of rich cocoa plantations which, communities have benefited from for many decades.

The study area is dominated by Yoruba ethnic group and mainly speaks Ijesa dialect. The homogenous nature of the people makes them unique among the Yorubas. The settlements of the study area are rural in nature while the patterns are both linear and nucleated especially in few locations. The total population of Ijesaland according to the 2006 Population census was put at 620,109. The major occupation of people in the study area is basically farming and hunting. Many parts of the study area are not motorable especially during the rainy season and basic social amenities are almost non-existent in several settlements. At Igun, for example, where a thriving gold mining industry once existed, the environment is devoid of development in almost all ramifications. In recent times, the State Government provided some social amenities to many gold mine communities; among them are water bore holes, dispensaries, primary and secondary schools. However, the major source of drinking water still remains streams, rivers and rain water in some communities of the study area.

Materials and methods

The study utilized global positioning system (GPS) receiver to obtain geographic coordinates of mining sites and pits. This was superimposed on Landsat ETM+ 2013 for the analysis of spatial pattern of mining sites. The forms of land degradation were captured through field observations and photographs while the levels and extent of the degraded lands were measured with measuring tape and the values were determined using mathematical formula for calculating surface area of a circular shape. The reason for this is that the spatial resolution of the satellite data used was too low to detect the area extent of the degraded areas. To measure the depth of abandoned mining pits and ponds, stone was tied on a rope and let down into the deep and the measuring tape was used to estimate the values in metres.

The pattern of land use was analyzed using two sets of satellite data. These include Landsat TM acquired on December 17, 1986 and Landsat ETM+ acquired on January 3, 2002 located on path 190 row 055 with 30 m spatial resolution respectively. The data were extracted as a sub-scene from the original dataset. For the purpose of temporal land use/cover change detection, a common window covering the same geographical coordinates of the study area was extracted from the scene of the images obtained. The sub-map operation of ILWIS 3.2 Academic allows the user to specify a rectangular part of a raster map to be used. To extract the study area from the whole scene of the images obtained, the numbers of rows and columns of the area were specified. All the images were georeferenced to Universal Transverse Mercator projection of WGS84 coordinate system, zone 31 N with Clarke 1880 Spheroid. Nearest-neighbor re-sampling method was used to correct the data geometrically. A correlation threshold was used to accept or discard points. The correlation range was within limits i.e. 1 pixel size. The x and y corrections were below 0.5 pixel. In this study, the satellite data were classified using supervised classification method into six different land uses. These are forest/secondary re-growth, agro-forestry/shrub/fallow/, bare

rocks, bare soils, water body and settlements/built-up areas.

Structured questionnaire was designed and administered on people in ten selected mining communities to obtain information on the effects of mining activities on local livelihood of the people. Simple random sampling technique was adopted in the administration of the questionnaire. Two hundred heads of households were targeted for the study. This is because most of the settlements of the study area were rural in nature, small in sizes and population. However, only 195 returned forms of questionnaire were used for the study. Most of the respondents who thought could fill the questionnaire by themselves returned an incomplete form, which could not be used for the study. Variables such as, socio-economic characteristics of respondents, length of stay in the community, perception on the effects of mining activities on the local livelihood, among others, were major questions raised in the questionnaire (see appendix 1). The selected mining communities include Atorin, Epe, Faforiji, Ibodi, Ifewara, Igun, Ijemogun, Itagunmodi, Iwara-Odo and Iperindo (Fig. 2). These communities were selected because of the abundance of gold in the area and the devastating effects of gold mine, which became issues of concern in recent times Figs. 3 and 4.

Two focus group discussions (FGDs) sessions were organized among adult males and females in each of the ten selected mining communities, making twenty sessions altogether (Table 6). This was done to complement the information obtained from questionnaire survey. The FGD participants were those who have lived in the communities for more than three decades and who could relate the past. The male participants were between four and six in number in the locations where it was conducted while the female counterparts ranges from two to four except in Faforiji community where an in-depth interview was organized for an old woman because of the uncooperative attitudes of most women in the community (Table 6). All the participants were randomly selected. The FGD sessions held in the evenings for maximum participation of the audience because the villagers do not joke with their day. The market squares and the king's palace were used as venue of discussion for males while the female counterparts were organized together in front of the house of one of the participants. The reason for this is that most of the women did not want to grant their audience because of fear and suspicion. In few communities such as, Ifewara, Epe, Igun, Itagunmodi and Iperindo, the king's delegates were assigned to conduct the researcher to mining sites especially the pits left in the communities to corroborate their claims. The FGD participants were given a packet of matches as a token of appreciation. All the participants were allowed to contribute to the questions raised by the researcher who moderated all the sessions. Some of the questions raised include length of stay in the community, source of livelihood, inception of mining activities in their communities, years of mining operations, effects of mining activities on the source of livelihood of residents, etc. (see appendix 2). The discussions were recorded, transcribed, analyzed and presented in ZY index tables. Table 6 reveals the communities where the FGDs were conducted and the composition of the participants.

Results and discussion

Mining sites

The study area is sitting on vast fields of raw gold; one of the world's most sought after jewels. The communities selected for this study were not the only settlements where gold are found but the devastating effects of gold mine, which culminated to the hostile behaviours of some members of the communities informed the reason for their selection. Thirty-seven mining sites were identified and captured, with the highest numbers found in Ibodi and Faforiji, which was 13.5 % of the entire mining sites in the study area (Table 1). At Itagunmodi, Igun, Ifewara, and Iperindo, only four mining sites, which constituted 10.8 %, were identified. Epe, Iwara-Odo, and Atorin, recorded only three sites, which amounted to 8.1 % while Iyemogun settlement had two mining locations (5.4 %) (Table 1). Observation made during the field work shows that mining activities were mainly found on farmlands, forested area and sometimes around the settlement, which consequently led to the destruction of farmlands, vegetal cover, pollution of drinking water and land degradation. This discovery substantiates the claim of Ako et al. (2014), who reported that mining activity resulted into land degradation,

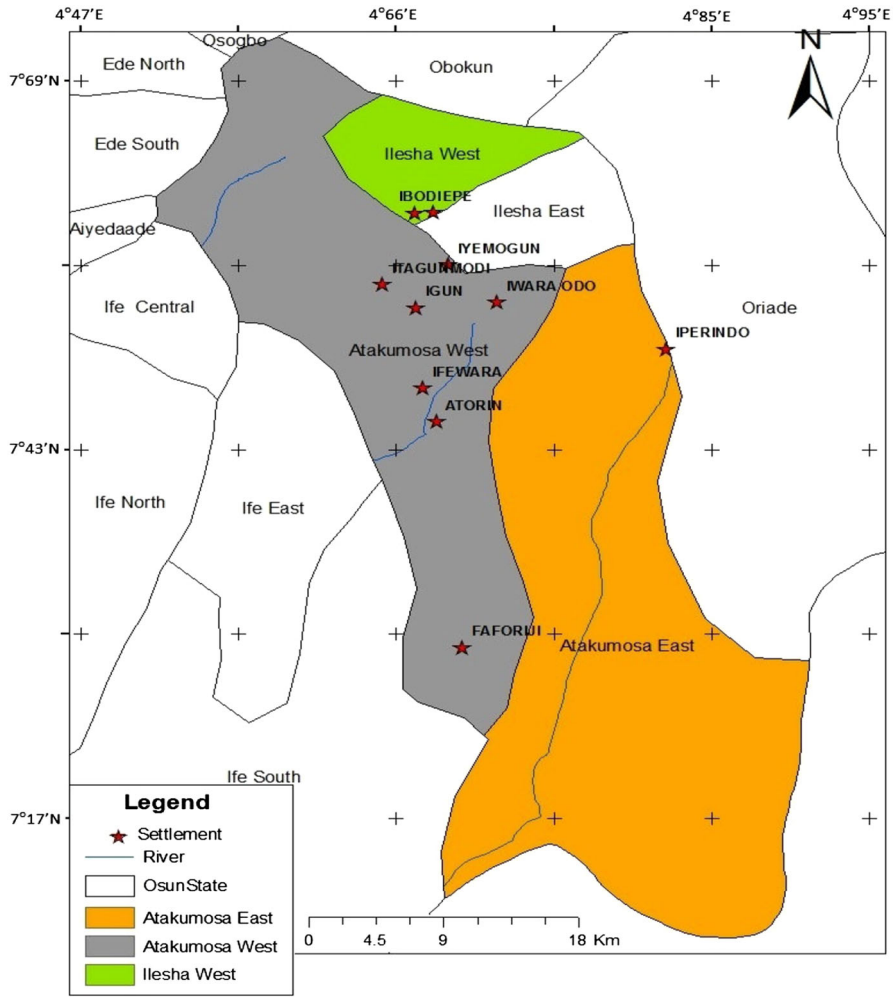

Fig. 2 Location of mining communities

destruction of vegetation, erosion of soils and pollution of water quality.

Forms, levels and extent of land degradation

The major form of degradation discovered in the study is mining pits, which were found both on farmlands and forested areas (Figs. 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14). In all the 37 mining sites, a total number of 354 mining pits were discovered and they varied in sizes and depth. As observed during the field work, the illegal miners cleared, scooped and digged through the ground of the farmlands on which gold is discovered by the instrument called testing bar. After gold is mined, the illegal miners relocate to another site where gold is discovered with due consultation with the owner of the sites or farmlands. This could explain the reason for large number of pits discovered in the study.

As shown in Table 2, Iperindo and Faforiji recorded the highest number of mining pits, which constituted 12.7 % while Ibodi, though with five mining locations, recorded the least number of mining pits (6.7 %). The reason might not be unconnected with the proximity of the settlement to Ilesa, the headquarters of two Local Governments, which is also the seat of environmental protection agency that is meant to monitor and supervise the activities of the industrialists and miners. It can therefore, be inferred that proximity of the agency to the settlement put a check to the activities of the miners. A close examination of Table 2 and Fig. 2 revealed that settlements that are farther away from Ilesa township were more devastated in terms of

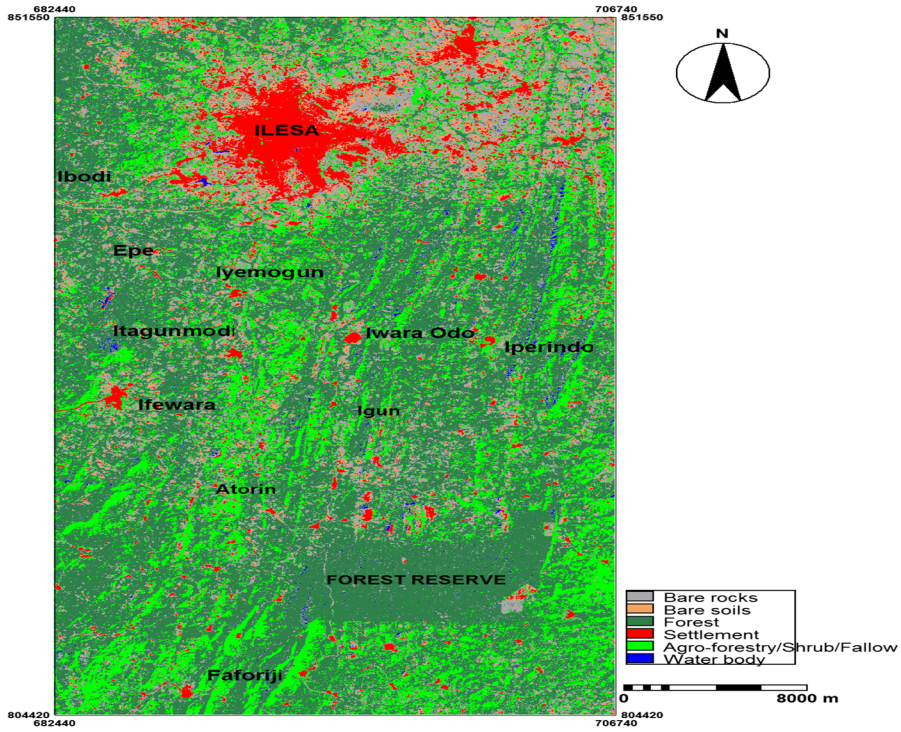

Fig. 3 Land use pattern in 1986

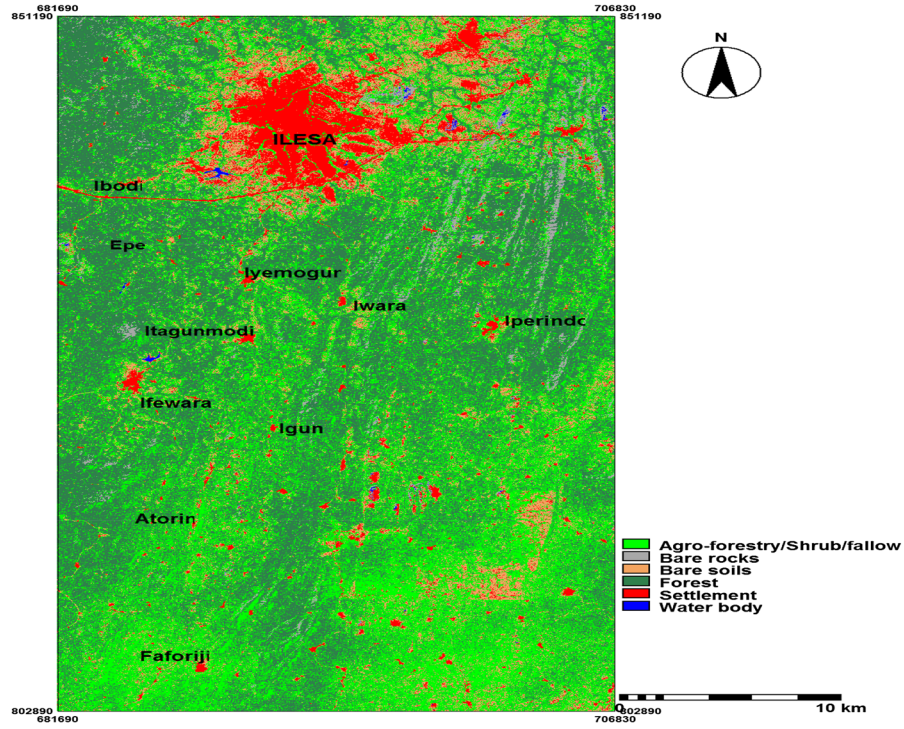

Fig. 4 Land use pattern in 2002

Table 1 Number and the coordinates of Mining Sites

Mining communities	No. of mining sites	%	X	Y	Z (elevation in meters)
Ibodi	1	13.5	684750	839837	363
	2		684742	839986	350
	3		684876	839944	354
	4		684893	839768	351
	5		684608	839750	360
Itagunmodi	1	10.8	682591	834263	366
	2		682429	834209	356
	3		682528	834111	344
	4		682831	834188	356
Igun	1	10.8	684871	832470	309
	2		684962	832444	303
	3		684943	832321	307
	4		684677	832436	305
Epe	1	8.1	685131	839759	375
	2		685274	839782	380
	3		685216	839643	397
Iyemogun	1	5.4	686961	835816	386
	2		686321	836332	390
Iwara Odo	1	8.1	690236	832908	375
	2		689524	832207	356
	3		691118	832213	345
Faforiji	1	13.5	688031	806011	246
	2		687746	805988	250
	3		688201	805801	234
	4		688024	805689	278
	5		687846	805744	250
Ifewara	1	10.8	685359	826185	347
	2		684700	825813	340
	3		685360	825230	329
	4		686012	826844	350
Iperindo	1	10.8	701393	829287	308
	2		701582	828445	306
	3		700558	828441	308
	4		700043	829245	305
Atorin	1	8.1	686228	823594	361
	2		685903	822667	370
	3		686852	823184	370
Total	37	99.9			

mining pits recorded. The size and depth of each mining pits were measured in the study. Measuring tape was used to measure the length and breadth of each mining pit and the values were determined using mathematical formula for calculating area of a circle, which was later converted to hectares. As observed during the field work, most mining pits were irregular polygons, though varied in sizes. The size of the largest pits, sum together, was found in Iperindo, which amounted to 3 ha. This was followed by the

Fig. 5 Mining pit covered with water in Iperindo and constituting environmental pollution

Fig. 6 Mining pit in a farmland in Ifewara

Fig. 7 Mining pit in a farmland in Faforiji with research assistant

Fig. 8 Mining pit in a farmland in Atorin

Fig. 9 Mining pits in Iwara-Odo with research assistant

Fig. 10 Mining pit in Iyemogun constituting environmental pollution

pits found in Ifewara (2.8 ha.), while the pits with the least size were found in Ibodi, the estimate of which was 0.5 ha. (Table 2).

There is no sampled mining pit that is not deep but the deepest mining pits was found in Igun, which was 3.4 m deep (Table 2). The pit, (Fig. 12), which has become pond, situates few metres away from the village. As expressed by the villagers, "*the pit is a nuisance and a dead trap*". It has become a breeding space for mosquito and other dangerous aquatic

Fig. 11 Mining pit constituting health hazards in Epe

Fig. 12 Mining pit that claimed life in Igun

Fig. 13 Mining pit becoming pond in Itagunmodi

animals. It was revealed that there is no single fish in the pond because of the reaction of the element of gold with water, which is poisonous to aquatic life.

Fig. 14 Farmland destroyed by illegal

Spatial pattern of land use/cover

The study observed six major land uses/covers in the study area. These include forest/secondary re-growth/agro-forestry, shrub/fallow, bare rocks, bare soils, water body and settlements. As shown in Table 3, the area covered by forest decreased from 58,955 to 30,689 ha, which was a decrease of 24 % over the period of 16 years. This period was the period of large scale mining of gold by Nigerian Incorporated Mining Company in some settlements in the study area, especially in Igun community. As revealed by Makinde et al. (2014), gold mining operations started in Ilesa-west Local Government Area of Osun state, Nigeria in early 1950s. Though official mining operation stopped in mid 1990s, illegal mining is still active in the area till date. Figure 15 shows illegal gold miner in one location in Ilesa. As shown in the plate, vegetation was first removed before mining operation began, which supports the claim of Makinde et al. (2014) that mining activities was one of the factors responsible for deforestation and consequently, biodiversity loss in the area.

All the communities of the study except Ilesa, were rural in nature and there was no major development that warranted expansion thus, they only recorded the growth of 0.13 %. The farmlands that were abandoned to fallow and the uncultivated lands increased with time. From Table 3, the area occupied by shrub/fallow increased from 26,733 to 45,462 ha, which constituted16 % increase of the entire land uses. This substantiates the findings of Adeoye et al. (2012) who reported an increase in the areal extent of shrub/fallow in a study. Also, Aweto

Table 2 Size and depth of mining pits across mining communities

Mining communities	No. of mining sites	No. of mining pits	%	Area of mining pit (ha)	Depth of a sampled mining pit (m)
Iperindo	4	45	12.7	3.0[a]	1.5
Ifewara	4	36	10.2	2.8[a]	2.4
Faforiji	5	45	12.7	2.7[a]	2.7
Atorin	3	33	9.3	2.5[a]	2.1
Iwara-Odo	3	30	8.5	2.3[a]	2.5
Iyemogun	2	36	10.2	1.8[a]	2.3
Epe	3	36	10.2	1.6[a]	2.9
Igun	4	30	8.5	1.3[a]	3.4
Itagunmodi	4	39	11.0	0.9[a]	3.2
Ibodi	5	24	6.7	0.5[a]	3.0
Total	37	354	100	19.4	26

[a] Formula used in calculating the surface area of a circular pit is 22/7 r^2

Table 3 Pattern of land use between 1986 and 2002

Land use Type	Land use in 1986		Land use in 2002		% change
	Area (ha.)	%	Area (ha.)	%	
Bare rocks	21,517	17.91	20,012	16.66	−1.25
Bare soils	4671	3.89	14,850	12.36	8.47
Forest	58,955	49.07	30,689	25.55	−23.52
Settlement	7736	6.44	7896	6.57	0.13
Shrub/Fallow	26,733	22.25	45,462	37.84	15.59
Water body	526	0.44	1189	0.99	0.55
Total	120,138	100	120,138	100	

Fig. 15 Illegal gold miner in a community, in Ilesa. Source: The Sun Newspaper Magazine, September 22, 2012 (www.sunnewsonline.com)

(1990) posited that in Nigeria, the areas previously characterized by continuous forest cover were often been converted into secondary re-growth vegetation, mainly as a result of shifting cultivation and lumbering. The study also, discovered that the areal extent of water body increased by 0.55 % between 1986 and 2002, probably because of climate change, which made places that were originally dry to become wet (Table 3). Again, the area of bare rocks in the study area decreased with time. This might be connected to the quarry activities in Ilesa and its environs. Across the study area and Ilesa, the locations of bare soils increased over time as the area increased by 9 % within the period of 16 years.

The general pattern observed in Figs. 3 and 4 show that the selected mining communities were scattered abroad, which suggest to mind that gold is available all over the soil of Ijesaland. Besides, all the mining communities were accessible by roads, though the condition of these roads varied from one community to another. As observed during the field work, the roads of the settlements that were closer to Ilesa or to local government headquarters, as the case of Ibodi, Epe, Iyemogun, Itagunmodi, Ifewara and Faforiji were tarred though with some potholes, while those farther away from the local government headquarters (such as, Igun, Atorin) were not tarred and the conditions of the roads were in deplorable situation. A close examination of Figs. 3 and 4 revealed that in 1986, all the selected mining communities were surrounded by forest but by 2002 the forest had completely disappeared, which confirms the claim of Ako et al. (2014) who reported loss of vegetal cover, erosion of soils, loss of water quality and land degradation from gold mining in Luku, Minna, North Central Nigeria.

Effects of mining activities on livelihood of people

Negative effects of mining

As indicated by Noronha (2001), the social and environmental impacts are more pervasive in regions where mining operations are newly established or are closing down. This gives the picture of the communities where this study was conducted. The respondents of questionnaire survey, which were 67 % males and 33 % females and had lived in the community for more five decades, declared that mining activities introduced a lot of negative effects into their land. For instance, 31 % indicated that many farmlands were lost to mining activities (Table 4). This affirms the claim of Olanipekun (2002) that mining pits were found in many farmlands in Igun, Epe and Ijana communities, which destroyed the farmlands. Ilori (2006) also discovered that economic trees such as, Cocoa (*Theobroma cacao*), and Kola nuts (*Cola nitida*) were destroyed by miners of gold in Igun community. The respondents, which constituted 25 %, agreed that mining activities in their communities led to the destruction of forest estate. This corroborates the assertion of Hodges (1995); Olanipekun (2002); Bridge (2004); Crowson (2011) that mining of gold entails high degree of forest removal before the gem is extracted. Moreover, 23 % of the respondents were of the opinion that mining activities destroyed the value of their water bodies, which were being used for drinking and other domestic purposes. This is in agreement with the report of Olanipekun (2002), who narrated that Eti-Okika stream, that used to be for drinking and other domestic purposes by the residents of Igu community forfeited its value the moment it was dammed in 1986 with the aim of providing water for the miners and the community people. The trees that decayed inside the dam and the washing of the gem inside the stream made it to become contaminated and unfit for drinking few years after it was dammed. Some of the respondents (21 %) attributed various health challenges of the people in their communities to mining activities. They identified ailments such as, malaria, typhoid, cholera, and skin leach, among others as common diseases in their mining communities (Table 4). Olanipekun (2002) in his report identified diseases such as, typhoid, cholera, malaria, guinea worm, cough and swollen stomach, skin leach etc. as diseases common to the mining communities.

Positive effects of mining

In spite of the negative effects identified by the respondents of questionnaire survey, some positive effects of mining activities were recognized. 26 % of the respondents acknowledged that during the period of active mining in their communities (especially, in Igun where large scale mining took place by Nigerian Incorporated Mining Company), business activities flourished. It was added that some members of the community took to trading to provide food stuff,

Table 4 Negative effects of mining

Negative Effects of Mining	Frequency	Percentage
Loss of farmlands	60	31
Loss of forest and vegetal cover	50	25
Pollution of water body	45	23
Health related problem (malaria, cholera, typhoid, skin leach etc.)	40	21
Total	195	100

Table 5 Positive effects of mining

Positive Effects of Mining	Frequency	Percentage
Boost business activities	50	26
Generate employment opportunity	35	18
Development of social amenities	–	–
Increase popularity/exposure of their communities	110	56
Total	195	100

provisions, wears, electrical and electronics appliances, among others to the influx of people and miners who came for job and mining operations. This consequently boosted the economy of their local communities and the living standard of people. Moreover, 18 % indicated that mining activities provided employment opportunity to the people of their communities (Table 5). As gathered during field survey, only few members of the community were offered employment, which was below their expectations. It is instructive to note at this juncture that mining requires skillful labour and some levels of technical know-how, which may be lacking in the local communities where mining took place. This could explain the low percentage of worker absorbed from those communities. The study however, supports the claim of Emielu (1996) that mining is significant in the provision of employment of the masses.

It was a surprise to note that none of the respondents indicated that mining induced any social amenities into their communities neither did they attribute the provision of roads, dispensary hospitals, electricity, schools, bore holes, hotel accommodation available in their communities to the miners. It was gathered that the affluence members of the communities and government provided the infrastructure, though some of them were in deplorable situation. As reported by Olanipekun (2002), the gold mining communities of Igun, Epe and Ijana, in Ijesa region were not accessible during raining season while the available facilities such as, dispensaries, electricity and school were not properly maintained.

The respondents, who amounted to 56 %, indicated that mining activities made their communities to become popular (Table 5). This upholds the claim of Ilori (2006), who reported that mining communities of Ijesa, Western Nigeria were known, all over the world due to vast deposit of gold and haphazard mining activities. This present study discovered that many tourists and researchers have been attracted to these mining communities, which has brought them into limelight.

FGD excerpt on negative effects of mining

The general opinions of FGD participants expressed during the discussion in ten communities where the FGD was conducted are discussed in this section. The participants, whose age ranges between 25 and 90 years and majorly the indigenes (Table 6), disclosed that gold was discovered in their communities as far back as 1930s. As revealed in Ibodi, the attention of the residents was drawn to the presence of gold in their land when the colonial masters brought Hausa labourers (the Northerners) to their community for mining operation in 1935 and since then gold mining has become the business of the illegal miners till date. Similar information was disclosed in other communities but the period of operation differs from place to place. In Igun, gold mine dated back 1938 but large scale gold mine in the study dated back 1950s. As revealed by Makinde et al. (2014), gold mining operations started in Ilesa west Local Government Area (part of the study area, see Table 6) of Osun state, Nigeria in early 1950s.

The discussants revealed that many companies, including foreign company had operated on their gold fields since 1970s and stopped operation in the mid 1990s. Among them are Nigerian Incorporated Mining Company Limited (NIMCL) and the Livingspring Mineral Promotion Company Limited. They disclosed that others small-scale, illegal miners have done so and still active in the area till date without the permission of the law. As expressed, "this category of miners do not carry all the big machinery to dig as deep as NIMCL has done in Igun, they were well equipped to carry out their own mission". They were all illegal gold miners young men of different ages and sizes who have come from distant places to scoop and dig through the vast fields of the community's largely untapped gold deposits.

There was a general consensus among FGD participants in all the selected communities that mining activity led to loss of their farmlands (Table 7). They lamented that many of their economic trees such as, Cocoa (*Theobroma cacao*), Kola nut (*Cola nitida*), Citrus (*Gambeya Africana*),

Table 6 Composition at focus group discussion locations

Name of mining communities	L.G.A	Gender	Number	Age range (years)	Total	Ethnic group
Ibodi	Ilesa West	Male	6	40–70	9	Yoruba
		Female	3			
Itagunmodi	Atakumosa West	Male	6	50–75	8	Yoruba
		Female	2			
Igun	Atakumosa West	Male 6	6	30–75	9	Yoruba
		Female	3			
Epe	Ilesa West	Male	5	45–60	9	Yoruba
		Female	4			
Iyemogun	Atakumosa West	Male	4	60–90	7	Yoruba
		Female	3			
Iwara– Odo	Atakumosa West	Male	5	30–50	8	Yoruba
		Female	3			
Faforiji	Atakumosa West	Male	6	40–70	7	Yoruba
		Female	1			
Ifewara	Atakumosa West	Male	6	50–68	8	Yoruba
		Female	2			
Atorin	Atakumosa West	Male	5	50–71	8	Yoruba
		Female	3			
Iperindo	Atakumosa East	Male	5	25–60	9	Yoruba
		Female	4			

Plantain (*Musa sapientum var paradisiaca*), among others were removed by both licensed and the illegal miners without full compensation. In their expression they said *"han gboko loo ria, han si mu nko kan koa"*. This literally means 'farmlands were taken from them with little or no compensation'. The discussants expressed concern about the amount paid for compensation by Government to the affected farmers for economic tree destroyed. The ridiculous amount of one Naira and fifty Kobo (₦1:50 k) per economic tree, equivalent of $0.01 (when $1 was equivalent of ₦1.50) was unacceptable when compared to the yield the farmers could have realized from the produce. They added however, that small-scale illegal miners made financial arrangement with the owners of the farm on which the deposit of gold is found. This private financial arrangement has made it difficult to estimate the amount loss to illegal gold miners in the study area. But as reported by the Sun Newspaper Magazine, (2012), the annual loss in gold stolen and illegally mined from Ilesa and other parts of the country was put at $20 billion, based on Federal Government record.

The discussants expressed concern on the devastating position of their farmlands. They revealed that most of the farmlands where mining had taken place had become dead traps as many mining pits were created by the illegal miners. It was added that some of the mining pits have become breeding space for mosquitoes and other dangerous aquatic life as those contaminated ponds were not viable for breeding of fishes and crabs, which are sources of protein to human body. As expressed, "e s*eja ninu iyan omi ni",* meaning, there were no fish in those contaminated ponds. They reiterated that fish used to be caught in their streams and rivers in time past but now fish had become a thing of the past.

There was a unanimous assertion that mining activities led to the removal of forest resources, rendering lumbermen and hunters jobless (Table 7). They were of the opinion that mining also promoted biodiversity loss and extinction of medicinal plants. In their expression, *"han ti wo gbogbo igi lila lila egan ria danu, ati erako igbe ni han ti le salo"*. This means that mining has caused destruction of forest and biodiversity loss in their environment.

Table 7 Response of FGD participants on negative effects of mining

Communities	Gender	Number	Age group composition	Ethnic group	Loss of farmland	Loss of forest	Land degradation	Out-migration of able body	Pollution of water body	Health related problems (malaria, cholera, typhoid etc.)
Ibodi	Male	6	40–70	Yoruba	+	+	+	−	+	+
	Female	3			+	+	+	−	+	+
Itagunmodi	Male	6	50–75	Yoruba	+	+	+	−	+	−
	Female	2			+	+	+	−	+	+
Igun	Male	6	30–35	Yoruba	+	+	+	+	+	+
	Female	3			+	+	+	+	+	+
Epe	Male	5	45–60	Yoruba	+	+	+	−	+	−
	Female	4			+	+	+	−	+	+
Iyemogun	Male	4	60–90	Yoruba	+	+	+	−	+	+
	Female	3			+	+	+	+	+	−
Iwara-Odo	Male	5	20–50	Yoruba	+	+	+	−	+	+
	Female	3			+	+	+	−	+	+
Faforiji	Male	6	40–70	Yoruba	+	+	+	−	+	−
	Female	1			+	+	+	+	+	+
Ifewara	Male	6	50–68	Yoruba	+	+	+	−	+	−
	Female	2			+	+	+	−	+	+
Atorin	Male	5	50–71	Yoruba	+	+	+	+	+	−
	Female	3			+	+	+	−	+	+
Iperindo	Male	5	25–60	Yoruba	+	+	+	+	+	+
	Female	4			+	+	+	+	+	+

+ Where discussants agreed with opinion

− Where discussants disagreed with opinion

Moreover, the opinion of the discussants was the same across FGD centres as regards the pollution of drinking water by mining. They explained that their streams and rivers were safe for drinking before the inception of mining in their land. But this was not so any longer as those streams and rivers were all contaminated and unfit for drinking due to washing and processing of gold inside the rivers, especially the ones that were dammed and those located around the mining sites. In their dialect, they said "*gbogbo omi ria ni han ti baje*", meaning, all their drinkable water sources were contaminated. The discussants lamented that their women and young children trekked long distances to get drinkable water in the bush. It is instructive to note that there were some well waters dug by private individuals especially, in the big towns like Ifewara, Ibodi, Faforiji, Itagunmodi, among others, but majority of the mining communities still relied on streams for drinking.

There was a mix reaction among FGD discussants that mining poses danger to the health of the inhabitants (Table 7). While some argued that mining activities can introduce disease carrier micro organisms to the environment, some held the opinion that disease can emanate from different sources, which was not limited to mining. The first group maintained that water borne diseases such as, typhoid, cholera, malaria, guinea worm, coughs and skin leach, etcetera, were among the top listed prevalent health related diseases they experienced, which were attributed to mining activities. The second group held the view that sicknesses can be traceable to the eating habit and lifestyle of an individuals and not mining activities.

The opinion of the discussants also differs as regards the impact of mining on out-migration of the able-bodied individuals from rural mining communities to the city (Table 7). One group, who were

largely men, argued that people migrate to urban centres because of better employment opportunities, which were absent in rural communities. They added that some members of their communities were forced to relocate to new land when they could not secure enough land for farming because of mining activities on their farmlands. The other group, who argued in support, revealed that during the period of active mining in their communities, some members of the communities were employed while business activities flourished, which consequently attracted migrants to their lands for business activities.

FGD excerpt on positive effects of mining

The contribution of mining to the economic activities of people posed a lot of controversies during FGD sessions. While some held the view that business activities blossomed during the active mining in their communities, which directly and/or indirectly improved their source of income and other members of the community; some others maintained that only the owners of the land where gold were mined benefited (Table 8). The discussants who claimed they benefited, revealed that many people went into sales of food items, provisions, men's and women's wears, which consequently boosted the economy and the living standard of people. At the time this study was conducted, large scale mining had stopped, but the presence of small scale private miners, who were offered license and operated under "Federal office of Natural and Mineral Resources and Private Mining Title Owners" and illegal miners (whose identity were not known) were still active. These two categories of miners recruited their labours from nearby cities, especially from Ilesa and Ile-Ife. This in effect did not generate any economic benefit to the communities except the owners of the land where gold is found.

All FGD participants unanimously agreed that gold mining in their communities did not generate employment opportunity to any member of their communities. They maintained that miners, including those who operated in the past and those who were still active on the land, were using none-indigenes as labours, mostly the Hausas (the Northerners). These workers, who did not reside in their villages, were brought on motorcycle every morning by their employers for illegal mining from town. They added that instead of creating job for them, the illegal miners, who had no regard for land, destroyed their lands and source of their livelihood.

Moreover, there was a mixed feeling among the discussants that mining induced development of social amenities into their communities. While some attributed the few available infrastructure to government efforts to compensate them for the resources found on their lands, others attributed it to community efforts and few philanthropists who single-handedly provided few amenities. However, none of the discussants ascribed the infrastructure in their communities to miners. They lamented that the dispensary hospitals, schools, roads, etcetera, were in deplorable situation and they never saw the impact of researchers at luring development to their communities. They said in their own word *"Oti sua, gbogbo iwe kie mi ko, era sayipada sile ria",* this means the expression of their minds to the researchers never brought a change to their lands. Almost all the FGD participants agreed that mining activities publicized their local community and brought it to limelight (Table 8).

Conclusion

Mining of any type in any where brings about exposure of the environment to certain damages depending on the levels of control that show the difference (Gosh 2002). It is obvious in this study that mining has introduced some adverse effects on the social and physical environment of the study area. This is evident at the discovery of 354 mining pits, in 37 mining sites, in ten selected mining communities. These pits in various depths and sizes were found on farmlands, forested areas and around the settlements, which posed dangers to the inhabitants of the area. Most of the mining sites located around the settlements were clustered together probably because of the concentration of the ownership of the land around the same area. This calls for investigation in further research. The opinions of FGD participants were not different from the respondents of questionnaire survey, as they all agreed that mining activities led to loss of farmlands, vegetal cover, degradation of lands, pollution of drinking water, and biodiversity loss. However, some respondents did not deny that mining activities attracted socio-economic benefits

Table 8 Response of FGD participants on positive effects of mining

Communities	Gender	Number	Age group composition	Ethnic group	Source of income	Source of employment	Social and infrastructural development	Popularity and publicity
Ibodi	Male	6	40–70	Yoruba	_	_	_	+
	Female	3			+	_	+	+
Itagunmodi	Male	6	50–75	Yoruba	_	_	+	+
	Female	2			+	_	_	+
Igun	Male	6	30–35	Yoruba	+	_	_	+
	Female	3			_	_	+	+
Epe	Male	5	45–60	Yoruba	_	_	_	+
	Female	4			+	_	+	+
Iyemogun	Male	4	60–90	Yoruba	_	_	_	_
	Female	3			+	_	+	+
Iwara-Odo	Male	5	20–50	Yoruba	_	_	_	+
	Female	3			+	_	+	+
Faforiji	Male	6	40–70	Yoruba	_	_	+	+
	Female	1			+	_	_	+
Ifewara	Male	6	50–68	Yoruba	_	_	_	+
	Female	2			_	_	+	+
Atorin	Male	5	50–71	Yoruba	_	_	_	+
	Female	3			+	_	+	+
Iperindo	Male	5	25–60	Yoruba	_	_	+	_
	Female	4			+	_	_	+

into their lands, which include, development of social infrastructure, increase in sales of goods and services, which consequently improved their standard of living and finally recognition of their local environment. In conclusion, this study advanced the frontier of our knowledge on the state of mining communities and gave insight to the perception of people on the effects of mining activities on social and physical environment. To ensure sustainable mining environment, there should be adequate monitoring and implementation of environmental law by relevant stakeholders. Besides, in all the locations where mining pits were created, proper landfilling should be embarked upon by government to prevent future disasters, which some communities experienced in time past. This will go a long way to check aggression that is common to mining communities in Nigeria.

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Appendix 1

DEPARTMENT OF GEOGRAPHY
OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

QUESTIONNAIRE SURVEY ON LAND DEGRADATION OF MINING COMMUNITY

Introduction
This research is meant to elicit information on the activities of miners and the effects on social and physical environment of the mining communities. You are to respond to the questions raised and any answer given will be treated with strict confidence as it is meant for academic exercise.

Thank you.

SECTION A: Socio-economic characteristics of respondents
1. Gender: (a) Male ( ) (b) Female ( )
2. Age: (a) 20-40 ( ) (b) 40-60 ( ) (c) 60 and above ( )
3. Marital Status: (a) Married ( ) (b) Single ( ) (c) Widow ( ) (d) Widower ( ) (e) Separated ( )
4. Occupation: (a) Farming ( ) (b) Trading ( ) (c) Miner ( ) (d) Civil servant ( ) (e) others, specify _____
5. Monthly income: (a) ₦10,000 - ₦20,000 ( ) (b) ₦21,000 - ₦30,000 ( ) (c) ₦31,000 -₦40,000 ( )
   (d) ₦41,000 - ₦50,000 ( ) (e) ₦51,000 above
6. Religion: (a) Christianity ( ) (b) Islam ( ) (c) Traditional worshipper ( )
7. Level of education: (a) Primary ( ) (b) Secondary ( ) (c) Tertiary ( ) (d) Vocational training ( )

SECTION B: Perception of the effects of mining
8. How long have you lived in this settlement/community? (a) 10-30 years (b) 30 -50 years (c) 50 years & above
9. Are you aware that gold is found or mined in this community? (a) Yes ( ) (b) No ( )
10. If yes to Q9, How did you know? _____
11. How long has mining been taken place in this community? _____
12. Have you or any member of this community been involved in mining activities before? (a) Yes ( ) (b) No ( )
13. If yes to Q12, how much did you realize from mining of gold? _____
14. Did you obtain permission from appropriate authority before mining? (a) Yes ( ) (b) No ( )
15. Give the name of the authority that permitted you._____
16. Were you given any license? (a) Yes ( ) (b) No ( )
17. If yes to Q16, when did the license expire or was it a life time license? _____
18. If no to Q12, has gold been mined by government or licensed private individuals? (a) Yes ( ) (b) No ( )
19. If yes to Q18, mention the name of the agencies. _____
20. Did you notice any damage on land since mining has been taken place in this community?
    (a) Yes ( ) (b) No ( )
21. If yes to Q20, what is the kind/type of the damage? _____
22. What other damage(s) did you notice apart from land degradation? (Name them).
    i. _____ii. _____iii. _____
    iv. _____ v. _____ vi. _____
23. Can you say that you or any member of this community has benefitted from mining? (a) Yes ( ) (b) No ( )
24. If yes to Q23, itemize the benefits i. _____ ii. _____
    iii. _____ iv. _____ v. _____
25. In your own opinion, can you say mining has not benefitted you or any member of this community?
    (a) Yes ( ) (b) No ( )
26. Give reason(s) for the choice of your answer. i. _____
    ii. _____ iii. _____
    iv. _____ v. _____
27. Have you or any member of this community been sick before and the sickness was attributed to mining?
    (a) Yes ( ) (b) No ( )
28. If yes to Q27, name the sickness (es). i. _____ ii. _____
    iii. _____ iv. _____ v. _____
29. If no to Q27, give reason for your answer. _____
30. Has mining generated employment opportunity to the people of this community? (a) Yes ( ) (b) No ( )
31. Give reason for the choice of your answer. _____
32. Has mining influenced any physical development in terms of inducing social amenities to this community?
    (a) Yes ( ) (b) No ( )
33. If yes to Q29, Name the social amenities and the organization that provided it.
    i. _____ ii. _____ iii. _____
    iv. _____v. _____vi. _____
34. If no to Q32, give reason for your answer. _____
35. Are there people who have lived in this community and had left for another location because their farmlands were ceased from them due to mining on their lands? (a) Yes ( ) (b) No ( )
36. If yes to Q35, were they adequately compensated? (a) Yes ( ) (b) No ( )
37. If yes to Q36, how much were they given? _____
38. In your own opinion, what can government do to sustain enabling mining environment? _____

Thank you for your attention.

Appendix 2

DEPARTMENT OF GEOGRAPHY
OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

FGD QUESTIONNAIRE ON LAND DEGRADATION OF MINING COMMUNITY

Introduction
This research is meant to elicit information on the activities of miners and the effects on social and physical environment of the mining communities. You are to respond to the questions raised and any answer given will be treated with strict confidence as it is meant for academic exercise.

Thank you.

SECTION A: Perception of the effects of mining
1. How long have you lived in this settlement/community?
2. Are you aware that gold is found or mined in this community?
3. If yes to Q2, How did you know? _____
4. How long has mining been taken place in this community? _____
5. Have you or any member of this community been involved in mining activities before?
6. If yes to Q5, how much did they realize from mining of gold? _____
7. Did they obtain permission from appropriate authority before mining?
8. Give the name of the authority that permitted them._____
9. Were they given any license?
10. If yes to Q9, when did their license expire or was it a life time license? _____
11. If no to Q9, has gold been mined by government or licensed private individuals?
12. If yes to Q9, mention the name of the agencies. _____
13. Did you notice any damage on land since mining has been taken place in this community?
14. If yes to Q13, what is the kind/type of the damage? _____
15. What other damage(s) did you notice apart from land degradation? (Name them).
    i. _____ii. _____iii. _____
    iv. _____ v. _____ vi. _____
16. Can you say that you or any member of this community has benefitted from mining?
17. If yes to Q16, itemize the benefits i. _____ ii. _____
    iii. _____ iv. _____ v. _____
18. In your own opinion, can you say mining has not benefitted you or any member of this community?
19. Give reason(s) for the choice of your answer. i. _____
    ii. _____ iii. _____
    iv. _____ v. _____
20. Have you or any member of this community been sick before and the sickness was attributed to mining?
21. If yes to Q20, name the sickness (es). i. _____ ii. _____
    iii. _____ iv. _____ v. _____
22. If no to Q20, give reason for your answer. _____
23. Has mining generated employment opportunity to the people of this community?
24. Give reason for the choice of your answer. _____
25. Has mining influenced any physical development in terms of inducing social amenities to this community?
26. If yes to Q25, Name the social amenities and the organization that provided it.
    i. _____ ii. _____ iii. _____
    iv. _____v. _____vi. _____
27. If no to Q25, give reason for your answer. _____
28. Are there people who have lived in this community and had left for another location because their farmlands were ceased from them due to mining on their lands
29. If yes to Q28, were they adequately compensated?
30. If yes to Q28, how much were they given? _____
31. In your own opinion, what can government do to sustain enabling mining environment? _____

Thank you for your attention.

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