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Analysing Impact of Sand Mining in Ekiti State, Nigeria Using GIS for Sustainable Development

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***Abstract*— This study is based on the impact of sand mining within Ado Ekiti metropolis. Four locations were chosen for this research. The paper aim at analysing the extent and amount of sand been mined in the study areas. A Global Position System (GPS) unit was used to acquire the coordinates and elevations of the mined site areas this is to enable the researchers produce a topographical map and extents of the degraded (mined) areas.To determine the volume of sand mined in the study areas, a Triangulated Irregular Network (TIN) analysis was carried out using ArcGIS software. The result obtained from topography shows that the volume of sand mined in Afao, Ijan, and Federal Polytechnic, Ado was 3,624,000m3, 1,342,500m3, 510,780m3 respectively. However, the result of this research will go to great extent in assisting in the developing sustainable development policies in term of discriminatory sand mining.**

***Index Terms*— Land Degradation, GIS, Sand Mining, ArcGIS, Triangulated Irregular Network (TIN).**

I. INTRODUCTION

Soil is a natural resource made up of gravel, sand, clay, loam which constitutes the different types. Pit sand, river sand and gravel are components of soil which takes years to be formed but extracted in a matter of days (Draggan, 2008). Sand is an underground geological resource formed from eroded mountain rocks carried by streams and rivers. According to Mwangi, (2007), soil has many uses, it is needed for agriculture, as a habitat and in construction, but the genesis of cash economy brought many profit driven companies to be involved in its mining both legally and illegally with little or no regard to the environment. Soil mining has both positive and negative environmental impacts.

According to Draggan, (2008), sands are crucial resources to economic development activities in developed and developing nations. Recovery from river channels, flood plains and glacial deposits as well as processing of those resources is costly but valuable in construction and industry. The use of soil as a source of raw material is depleting the resource and has adverse impacts.

Mining of sand occurs both on small and large-scale in major parts of the country. With an estimated 16 million housing deficit (Ezekiel, 2010; Isah, 2011) and infrastructural development in Nigeria, there will continue to be great demand for sand and other construction materials in developing areas such as Ado-Ekiti the capital of Ekiti state in southwest Nigeria (Omole and Ajakaiye, 1998). Ado-Ekiti has experienced rapid population growth and physical expansion especially since the mild 1980s due to the influx of people from different part of Ekiti state as the capital. These in turn have exerted pressure on the needs for housing provision, in addition to the already existing demand for civil works such as construction and repair of bitumen roads, bridges, buildings by public works and house repair and construction by individuals (Hemalatha *et al.*, 2005).

The increasing rate of urbanization across Ado-Ekiti has brought with it several challenges ranging from physical, economic, social to environmental among other issues (Ezekiel, 2010; Isah, 2011). To cater for the rapid urbanization, several site are now been explored for the mining of sand and other building materials. Traditionally, site for sand mining are rivers and beaches, however, sand is mined from river mouths, banks and even at inland sand deposits. Many inland sand deposits, which are lateritic in nature, are under immense pressure due to various kinds of human activities among which indiscriminate extraction of sand is the most disastrous (Kondolf, 1994; Sayami and Tamraker, 2007).

Typically, inland sand mining operations begins with the removal of overburden is often hauled to the perimeter of the mine site and piled into beacons. Once the overburden has been removed, the sand is excavated. Depending upon the geological formation, blasting may be used to make the sand containing materials more amenable to excavation. Large tracked excavations or rubber-tired front-end loaders typically perform excavation. In most of the inland sand mining sites in Ado-Ekiti, the excavated sand materials are loaded on trucks by hired labourers using shovels.

Rapid urbanization is a major cause for sand demand and is responsible for unsustainable extraction of sand from many illegal inland sand mining pits found in many part of Ado-Ekiti. The interaction between sand mining operations, citizen neighbours and government becomes more confrontational as a result of more sand excavation sites located in Ado-Ekiti. Conflict have centred on environmental and social issues such as noise, truck traffic, dust stream water quality, reclamation, bio-degradation, pollution and visually unpleasant landscapes (Willis and Garrod, 1999), and the citizens concern on the adequacy of regulating effort of the government to control these negative effects.

Environmental impacts of sand mining are well documented and the literature abound with environmental impacts to biodiversity and habitat, deforestation of land with

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the consequent elimination of the vegetation, pollution (water, air, land and even noise pollution) (Willis and Garrod, 1999; Abdus-Saleque, 2008). It is noted that large-scale mining activities generally continue to reduce the vegetation of most of the mining communities to levels that are destructive to biological diversity (Akabzaa, 2000; Akabzaa and Dorimant, 2001). Davis and Tlton (2005) also suggest that the local communities tend to bear the negative impacts of sand mining be the social, economic or environmental. It is therefore important to make effort to stem these problems through informed decision-making.

However, making informed decision in many areas including monitoring sand mining activities often involves complicated processes. For optional decision-making, information from various sources is required such as spatial information, which is essential to address activities of sand mining and their impacts on the environment (Burrough and Mcdonnell, 2002). Therefore, Geographic Information System (GIS) can play major role in the management of mapped or spatial date prior to, during, and after sand mining activities (Chindo, 2011). It can provide maps of sand mining sites showing the level of degradation and serve as a decision support capability (Heywood *et al*., 2006). As Ado-Ekiti develops, there is likely to be a disturbance of the environment. Nigeria conference on Environment and Development Report (2002) supported proper use of the environment and urged government to develop but recognizing conservation and rehabilitation of all natural resources. Impact of sand mining can be classified onto three categories as presented by Stebbins, 2006). There are physical impacts which are a result of mining from stream bed causing alteration of channel slope and changes in channel morphology. Water quality impacts are caused by sand mining and dredging activities, reducing water quality for downstream users and increase treatment costs. Again, excessive extraction of soil lead to excavation, destruction of ecosystems, and exposure of buried pipelines. In some case there is depletion of water resources leading to flood shortages and hardship for people.

Lawal (2011) discussed sand mining in Ado-Ekiti and highlighted that the activity is rapidly becoming an ecological problem as demand for sand increases, it was noted that the rate of soil mining in Ado-Ekiti is so alarming that the government agency (i.e. National Environmental Management Authority) had to apply policy to all mining activities. This policy was put in place to ensure proper and sustainable mining of soil.

Therefore, the study assessed and evaluated environmental impact of sand mining within Ado-Ekiti metropolis. This is with the aim of establishing the trend and the current state of sand mining in Ado Ekiti and its environment with its social economic implications. Also, to estimate the volume of sand extraction, examine the environmental impacts of sand mining areas (flooding, deforestation, depletion of soil nutrients, capture both geometric and attribute data of these location, know how the place can be reclaim for future use.

II. Methodology

Study Area

The study was conducted in Ekiti state, Nigeria. The State has 16 Local Government Areas (LGAs) with population of 1.8 million. The State is mainly an upland zone, rising over 250meter sea level National Population Census Report (NPC), (2007). The State enjoys tropical climate with two distinct seasons. These are rainy season (April – October) and the dry season (November – March). The State is buoyant in agriculture resources with cocoa as its leading cash crop. Others are forest resources, food crops like yam, cassava and also grains like rice and maize.

Sample and Sampling Techniques

Multi stage sample technique was used to select the study area. Ekiti state in southwest Nigeria was purposively selected because is one of the recent created states in southwest region of Nigeria. Ado-Ekiti the state capital was purposively selected because of the massive construction going on there as the State capital. Ado-Afao and Ado-Ijan along Polytechnic mining locations were purposively selected because of their nearness to state secretariat and Higher Institutions (i.e. Federal Polytechnic and Afe Babalola University), since massive constructions are going on there.

Nature, Sources and Data Analysis

Primary data were collected using a Garmin 76 GPS a handheld device for capturing geographic coordinates; this was done by capturing the outer, edge and inner part around the sand mining areas. Attribute data were captured using a 100m measuring tape, and also by checking of background information coupled with field visits, participant observations, and interviews. A digital camera was used to capture photographs from affected areas on the field

III. Result and Analysis

Fig 1, shows the mined area of Ado-Afao, while Fig 2, show the shallow part of the mining site area, with least elevation of 310m and maximum elevation to be 356m, the average depth area of the whole sand mining area in Ado-Afao with least elevation of 190m. The total volume of sand mined in the site area using Simpson rule was $362400m^{3.}$ However if the mined area is to be at elevation 250.The $1400m^3$ volume of sand we be cut off and $1,046,000m^3$ volume of sand we be needed to fill the mined area. Therefore more volume of sand of about $904,000m^3$ will be needed for filling the mining area.

Therefore, economic impact of the mining activities in the study area revealed that $81,057,000 will be required to sand fill the mined area. Also, the environmental impact of the mined area on the communities as revealed in the study area includes the attendant valley that is being created and the enhancement of erosion activities in the community. Again, the farming activities can no longer take place in the mined areas, because the top soil has being removed.

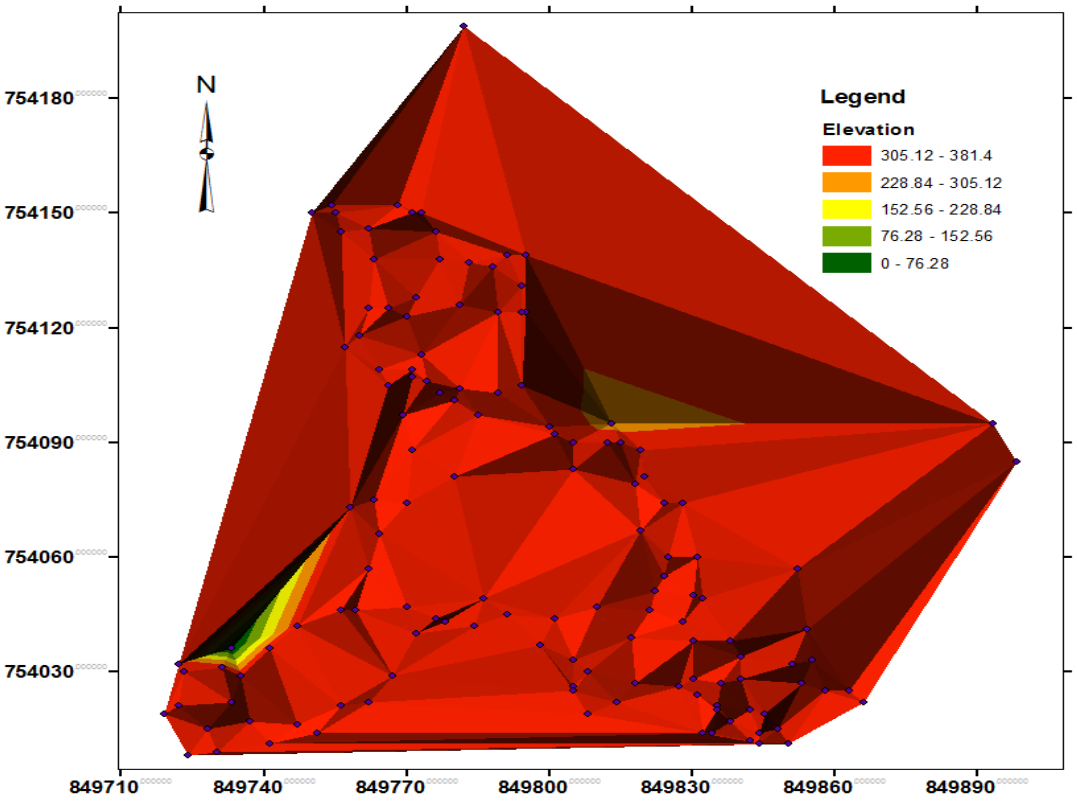

Figure 1: Shape of the mined area in Ado-Afao Road mining site.

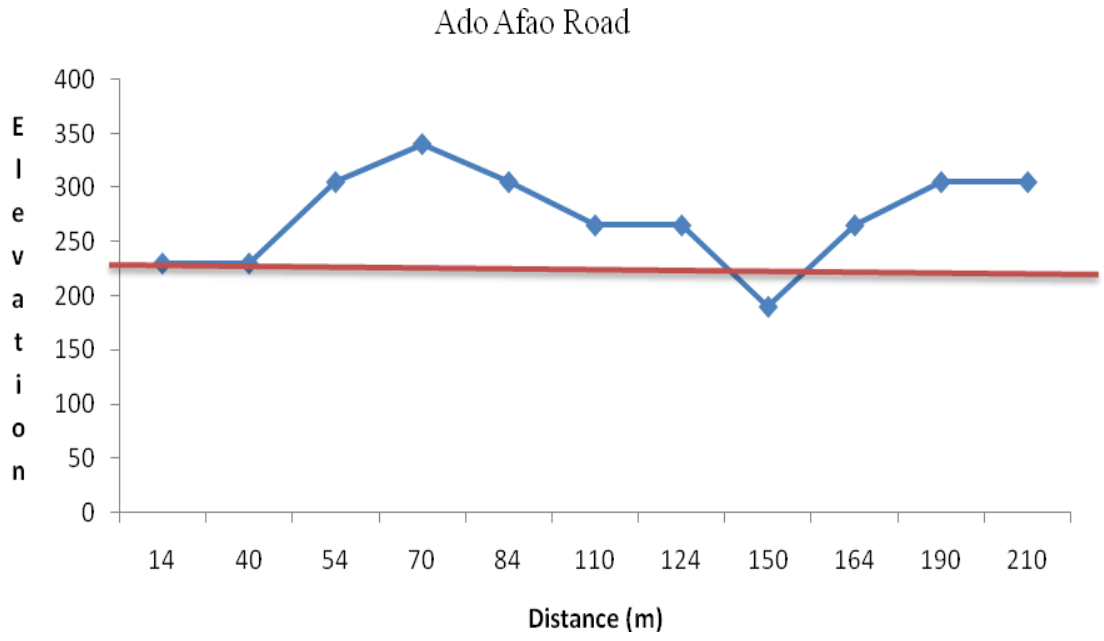

Fig.2: Showing average area of the mining site.

Excess volume = 904,000m^3

Fig 3 shows the mining area of Ado-Ijan and Fig 4 is showing the shallow part of the mining site area, with least elevation of 265 and maximum elevation of 385, the total volume of sand mined in the site area using Simpson rule 1342500m$^{3.}$ However if the mined area is to be at elevation 350, then700,000m^3 volume of sand we be cut off and 1,110,000m^3 volume of sand we be needed to fill. Therefore more volume of sand of about 1,100,000m^3 will be needed for filling.

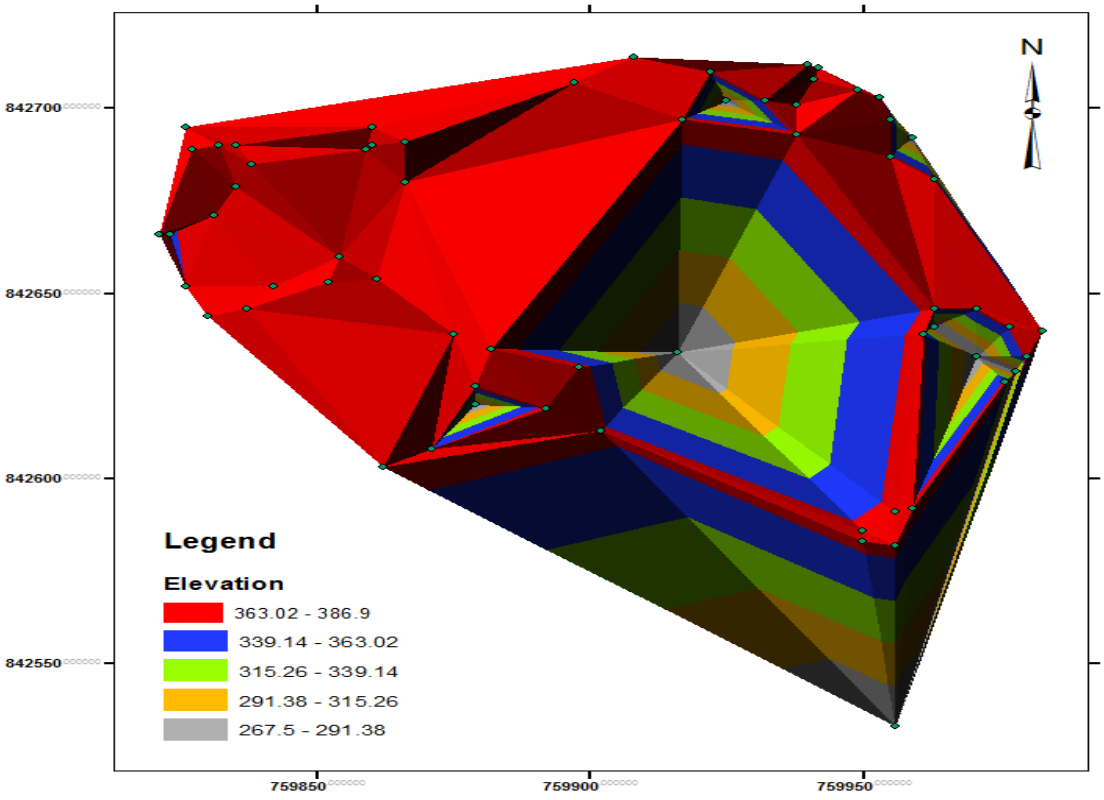

Fig.3:Shape of the mined area in Ado-Ijan road mining site

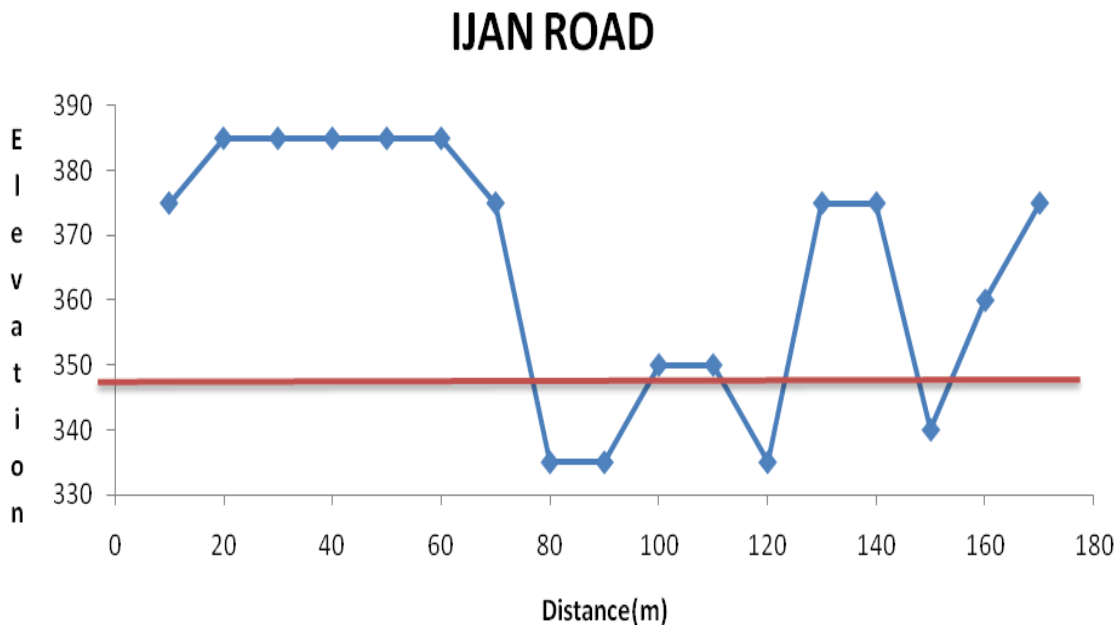

Fig. 4: Shows average area of the mining site.

Calculations for Cut and Fill of Ado Ijan Mining Site

Excess volume = 410,000m3

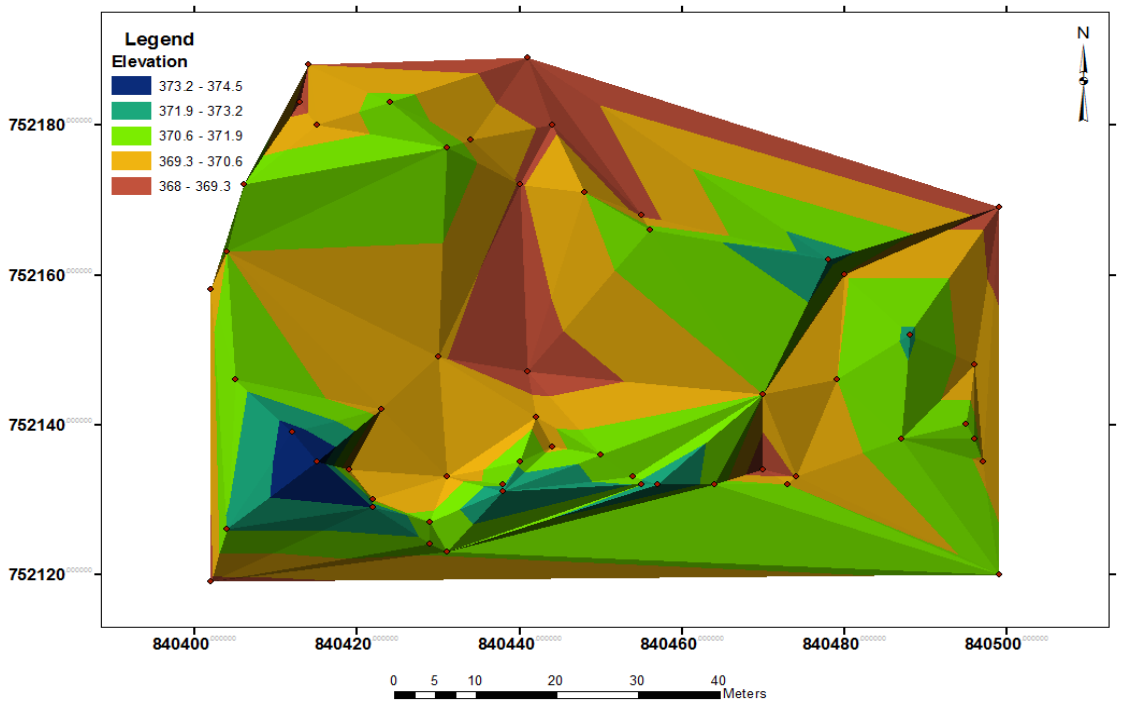

Fig.5: Shows the shape of mined area in The Federal Polytechnic Ado Ekiti mining site.

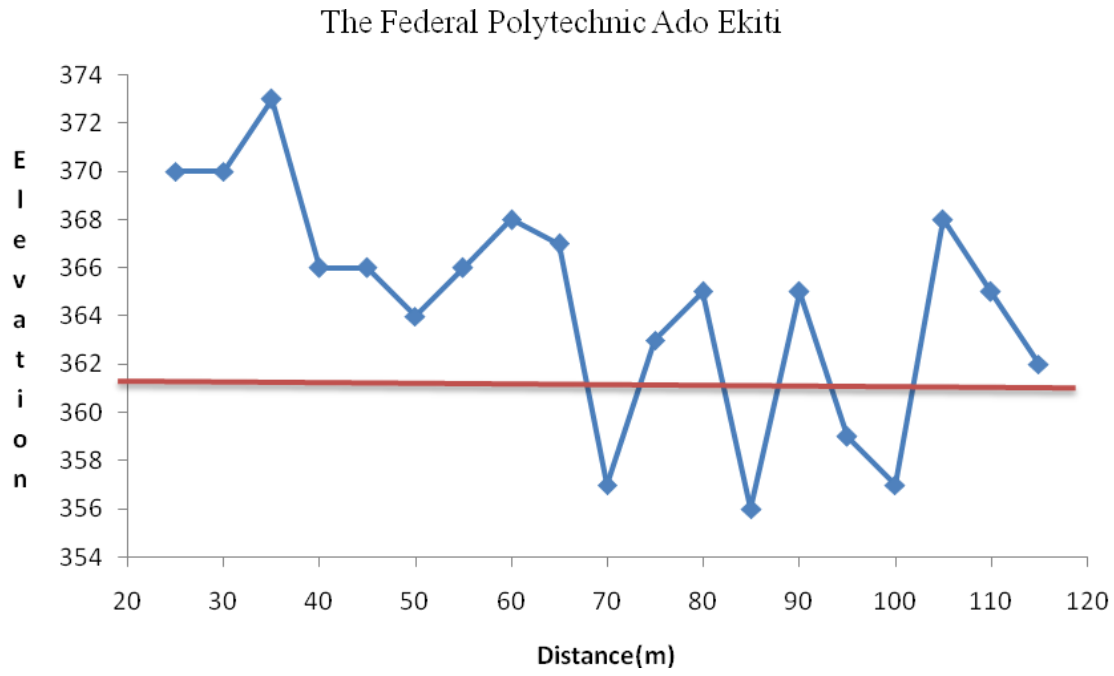

Fig.6 showing average area of the sand mining site.

Calculation for Cut and Fill for Federal Polytechnic, Ado-Ekiti Mining Area.

Excess volume = 10,480m3

Fig 5and Fig 6 shows the mining area of Federal Polytechnic Ado Ekiti and the shallow part of the mining site area, with least elevation to be 355 and maximum elevation of 374, the total volume of sand mined in the site area using Simpson rule was 1342500m^3. However if the mined area is to be at elevation 350.then 700,000m^3 volume of sand we be cut off and 1,110,000m^3 volume of sand we be needed to fill. Therefore more volume of sand of about 1,100,00m^3 will be needed for filling.

IV. Conclusion and Recommendations

The study on impacts of sand mining within Ado Ekiti metropolis revealed both positive and negative effects. It highlighted the views of environmental degradations, accidents caused and general damage to ecosystem. It was observed that most of the sand mined are used for construction purpose, however if these locations are to be used for these purposes, the level of cut and fill will be minimum. It is important to have an Environmental Assessment Management and Monitoring Program. Close

monitoring ensures that there is proper mining and no sand recruitment downstream. Department of Roads and Transport with the help of Police Service should restrict tipper trucks transporting sand through the villages.

Also, constructing temporary roads out of villages to reduce air and noise pollution is necessary. Mining operations must be conducted in a manner that minimizes or eliminates adverse impacts on both in stream components of ecosystems comprising of biota and habitats. Authorities are to strengthen laws on not allowing people to enter mining areas through close monitoring of the mining activities in all areas. Restriction of mining time and days to normal working hours that is 07:30am-4:30pm on week days is important to reduce illegal mining when there is tight security. Covering sand with nets: when transporting the resources to be a prerequisite to reduce damage of other motorists' windscreens from falling stones. Compensation of farmers: whose animals drown in pits and die from measles after eating waste should be done by the miners.

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