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Mines and Differential Environmental Degradation in Kakamega County, Kenya

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Abstract:
Mining is an economic activity that has been practiced for time immemorial. Land degradation from old mines operations is known in almost all the countries but they have been few systematic surveys to quantify the nature of associated problems so as to prioritize remediation action. There is knowledge in the techniques of rehabilitating both operational and abandoned sites yet there is still delay in remediation action. The enforcement of the Environmental Management and Co-ordination Act (EMCA) of 1999 was envisaged to go a long way in managing negative impacts of mining, quarrying and sand harvesting. The National Environment Management Authority on the other hand, controls the restoration fund meant for the mitigation of environmental degradation. There is however very little rehabilitation works that have been done on old mines and quarries in the country. The study was conducted in Kakamega County and the study population drawn from 18 mine pits in Kakamega County. The respondents were drawn from the Sub-County Environment Committees, Mine Geologist Experts, Miners, Constituency Roads Committees, Association of mining companies, Construction Companies, County Government Environment Committees, local Administration, land owners of mine pits and residents neighboring the pits. The researcher employed evaluation research design, purposive sampling and systematic random sampling techniques. It was found that there were several mining activities; sand harvesting, soil mining for bricks, gold mining, marram and quarry. The mine pits are now a nuisance to the community by endangering lives, destroying the environment, limiting farming areas, occupying grazing fields, facilitating crime areas and have provided breeding grounds for mosquitoes.

Keywords: *gold mining in Kakamega, environmental degradation, Kakamega County, sand harvesting, quarry etc.*

1. Introduction

Mining is an economic activity that has been practiced for hundreds and in some cases, thousands of years (UNEP, 2001). According to some estimates, there are between 700,000 and 800,000 abandoned mines in the United States. Many of them are in the vicinity of abandoned towns, often referred to as "ghost towns" (Morrison, 1992). (Encycl, 2008)

Africa has experienced environmental problems with mining. Abandoned pit shafts are found in West Africa and Zambia and they pose safety risk to local populations and animals. In Johannesburg, we have tailing dumps from past mining activities which are a source of dust affecting health of neighboring populations and cleanup cost are likely to be very high (Boocock, 2002). South Africa initiated a programme to develop a national strategic framework to guide the mining and minerals sector to sustainable development. Among the key objectives it aimed to achieve was to identify and rehabilitate ownerless mines (Swart, 2003).

Mining in Kenya is regulated by the Mining Act of 2012. The National Environment Management Authority (NEMA) is responsible for ensuring that the impacts from extraction of resources are minimized and that the affected lands are reclaimed and usable after extraction (Mining Act, 2012). In Kakamega County, Kakamega, Butere and Mumias districts are famous for a number of economic minerals that have been mined from early 1920s. Sand harvesting, quarrying, murram and gravel extraction for building materials also takes place in the county. Part of the rehabilitation funds under the Ministry of Environment and Mineral Resources, has been used to rehabilitate the Rosterman disused mines by fencing off the affected grounds and planting of fast growing vegetation (NEMA, 2009). Major gold mining by Rosterman Gold Miners in Ikolomani Constituency closed operations in 1952.

2. Materials and Methods

2.1. Study Area

This research was conducted in Kenya, Kakamega County. Kakamega County has a population of 1,660,651 people (KNBS, 2009) and is the second most populous county after Nairobi. Poverty levels in the County stand at 57%. The county has 12 constituencies and 12 Sub-counties as shown in Figure 1 below. The local inhabitants are mainly Luhya tribe, whose main economic activity is farming. The average population density is 495 persons per km². The county lies within altitude 1,250m-2000m and lies between latitude 0° 07' 30" North and 0° 15" of the Equator and longitude 34° 32" and 35° 57' 30" east of the Prime Meridian.

Kakamega was the scene of the Kakamega gold rush in the early 1930s (Shilaro, 2000). This site was chosen because there are several mine pits like the Rosterman Goldmines in Ikolomani constituency. Other mine pits can be found in Lutonyi and Mumbetsa areas of Lurambi Constituency, Lubinu in Mumias and Mayoni in Matungu. (NEMA, 2007).

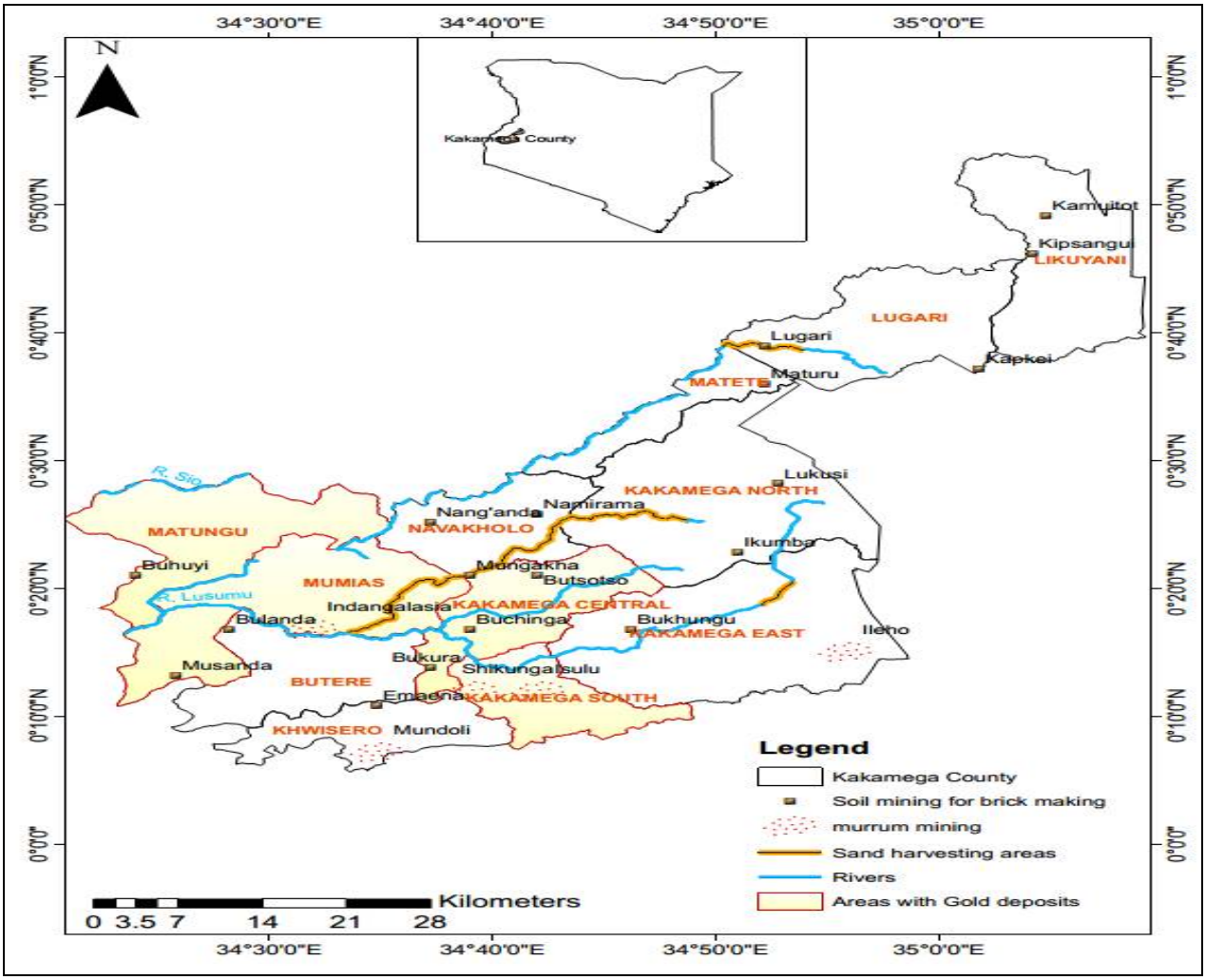

Figure 1: Map of Kakamega County showing various mineral sources in Kakamega County Kenya
Source: The Kenya County map (2010)

2.2. Determination of Degradation Levels

In this paper, degradation level was reached at by considering the tree density, land size under mining activities and soil extraction volume. This is discussed in the following subsections.

2.2.1. Tree Density

The abundance of a particular species was achieved by dividing the density for a given species of plant by the total density for all types of plants and then multiplying by 100 to get the percentage. It is important to note that shrubs which grow in clumps were counted as single plant units.

$$\text{Density of a plant species (X) \%} = \frac{\text{Tree species}}{\text{Total number of all tree species}} \times 100\%$$

Source: (Obiri and Lawes, 2000)

2.2.2. Size of Mining Area

The data about the size of mining area was obtained from the land owners who were asked to give the size of land under mining activities. The sizes were then used to approximate size of mined and abandoned pits.

2.2.3. Soil Extraction Volume

Extraction volume was determined from the data that was found at the Kenya Rural Roads Authority (KERRA) Roads design manual (1987). The information included the total length in kilometers of the road network in the county, and the amount of murrum material used for construction.

Total road network in Kakamega County is 1683.35km

Gravel per Km = (depth of murrum layer) x (width of the road)

3. Results and Discussion

3.1. Types of Mines

The analysis of the types of mining activities in Kakamega County is presented in the Figure 2 below.

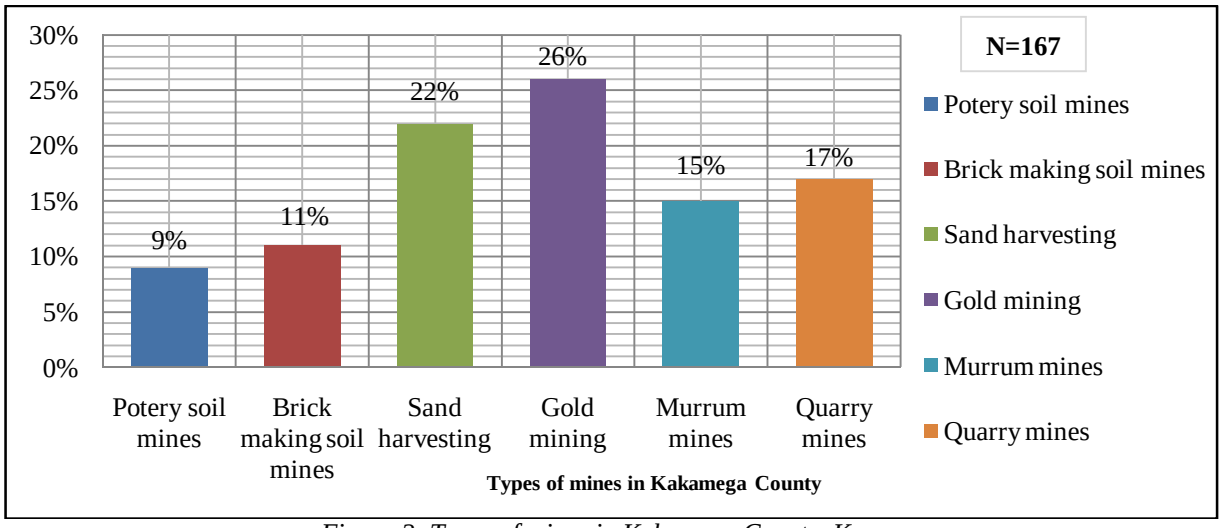

Figure 2: Types of mines in Kakamega County, Kenya
Source; Author (2015)

The research identified several types of mining activities in Kakamega County as shown in the Figure 4.4. Gold mining 26% (38) was the most known type of mining in the region. Sand harvesting was another mining activity accounting for 22% (37) commonly practiced along major rivers, flood plains and surface run off channels in Kakamega County. Many rivers have been degraded in quality because of this activity. Rivers affected by sand harvesting activities include; Shatsala, Yala and Isiukhu. Quarry mine 17% (28) is commonly practiced especially in rocky areas in the County. According to the administration area chief, the biggest quarry is on Buliba's farm, where quarry mining took place during the years of 1990s. Since then, the site has been abandoned, and remains a threat to people and animals neighboring it. It has claimed many lives of both people and animals. Mining for murrum 15% (25) has been on the increase because of the increased demand of construction materials for houses and roads. Murrum mining has been widely practiced in the County, and its impacts on the environment in some areas are unbearable. Soil mining for brick making and pottery is very common 20% (14) and a source of income for residents in the county. Bricks are the main raw material for building and pots used as containers or for decorations.

3.2. Size of Mined Areas

Sizes of mined areas in the study areas were used to determine the area of degraded land. The mine pits sizes are presented in the Table 1 below.

Size of mined areas	Frequency	Percent
0.5 to 2.5 acres	11	61
2.6 to 4.5 acres	5	28
4.6 to 14.5 acres	2	11
Total	18	100

Table 1: Size of mined land in Kakamega County, Kenya
Source: Field Data

The total mined land acreages for the selected 18 pits were as follows, 61% (11) of the mine pits being between 0.5 to 2.5 acres, 28% (5) were between 2.6 to 4.5 acres, while 4.6 to 14.5 acres were 11% (2). This shows that a large area of production land is degraded and the land quality, in terms of productivity, is adversely affected. Mining is bereft with its own problems and challenges. The "footprints" it usually leaves behind are tremendous especially when it is not managed well because poorly managed impacts of mining on the environment or the social fabrics of society can reflect negatively on economic parameters countrywide" (World Bank & International Finance Corporation, 2002).

3.3. Murrum Extraction Volume

The extraction volume for mining material was done for murrum mining. According to the Kenya Rural Roads Authority (KERRA), the total length of road network is 1683.35km in all the constituencies. From field observations and the information from KERRA, murrum is the main raw material used in road construction. There is continuous need for murrum, for construction and rehabilitation of roads in the county. The extraction volume can be determined from the calculation below as adopted from the Roads design manual (1987) and used by Kenya Rural Roads Authority.

Total road network in Kakamega County is 1683.35km

Gravel per Km = 1000 x 0.15 m (murrum layer) x 6 m (width of the road) = $900m^3$

900 x 1683.35 ≈ 1, 515, 015 m^3

This is the amount of murrum that has been extracted to build and rehabilitate roads in Kakamega County. The need for murrum is continuously increasing with the new roads being created and rehabilitated, as well as other construction activities. This shows that the exploitation and destruction of land is not to end any time soon as long as life has to go on. These construction activities require very large amounts of murrum leaving open mine pits deep down the land. According to the Key informant from the mining and geological departments, the restoration strategies adopted by these companies are not practical and therefore these areas end up being unproductive and very dangerous to both people and animals.

3.4. Level of Environmental Degradation Due to Mining

The level of degradation in this study was measured by indications observed at mining areas. This included land bareness, root exposure and land clearing. The research sought to bring out the indicators of degraded environment in Kakamega County. Figure 3 depicts the indicators reported by the residents of the areas around the mine pits. Loss of vegetation as reported by 45% (75) of the respondents was one of the main indicators of degraded land. Interestingly, 20% (33) respondents compared their agricultural yield before and after mining, and reported that their poor agricultural yield was an indicator of degraded land, caused by poor mining activities.

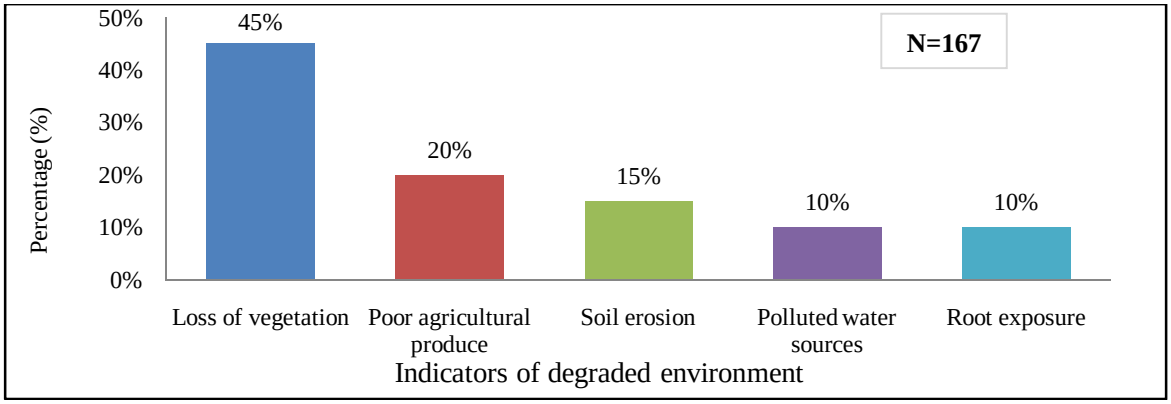

Figure 3: Indicators of degraded environment in Kakamega County, Kenya
Source; Author (2015)

Soil erosion was reported as an indicator of land degradation by 15% (25) of the respondents, contamination of water bodies and root exposure at 10% (17) each was also an indicator of degraded land. The observation in the field showed increased sediment load in many rivers. Nzoia River showed a higher level of sediment load resulted from soil erosion on less vegetated lands, and cultivation activities up to the river banks. Soil erosion also had effects on lose soils, which were carried downstream exposing plant roots, this make plants unstable therefore falling off due to high intensity wind and heavy runoff.

3.4.1. Degradation of Water Bodies

Sand and gravel have been used in the construction of roads and buildings in the County. The demand for sand and gravel continues to increase (Isaac *et.al.*, 2015). Residents reported that sand mining from the rivers is of great demand due to its purity and is inexpensive in that it doesn't require a lot of sieving. Excessive in stream sand-and-gravel mining has caused the degradation of rivers in the County. The banks of Isasala, Iguhu and Isiukhu rivers, have been highly eroded, as a result of farming activities along riparian zones.

Effects of sand harvesting	Percentage (%)
River pollution	45%
Erosion of river banks	30%
Frequent flush floods	25%

Table 2: Effects of sand mining in Kakamega County
Source; Author (2015)

From the observation, severe sand mining has led to encroachment of river banks. Most rivers in the region, like river Shatsala had severely eroded banks, but still sand mining was at its heights, and not showing any signs of ending soon. This agrees with NEMA (2007) findings which state that in Kakamega County, quarrying and sand harvesting activities have increased as noted by great demand on materials for construction and thus interfered with the natural environment.
Sand-and-gravel mining in stream channels can damage public and private property. Channel incision caused by gravel mining can undermine bridge piers and expose buried pipelines and other infrastructure. Several studies, (Mahandara, 2009; Roe, 1997; and Richling, 2000) have documented the bed degradation caused by the two general forms of in stream mining: (1) pit excavation and (2) bar skimming. Bed degradation, also known as channel incision, occurs through two primary processes: (1) head cutting, and (2)"hungry" water. In head cutting, excavation of a mining pit in the active channel lowers the stream bed, creating a nick point that locally steepens channel slope and increases flow energy. During high flows, a nick point becomes a location of bed erosion that gradually moves upstream. Many people along River Nzoia have had their crops swept away by flood waters, raising fears of food insecurity.

4. Conclusion

The various types of mines found in Kakamega County are the main economic activities especially in the affected regions. The mining activities practiced in the region are pottery and brick mining, sand harvesting, murrum and gold mining which are concentrated around Ikolomani constituency. Impact of mining on land environment gets reflected in land-use pattern of the respective area because the more the land gets exposed to erosion by losing its green cover or by getting disturbed otherwise due to mining (excavation, overburden dumping etc.) and related activities, its water resources get damaged, soils get contaminated, part or total of flora and fauna get lost, air and water get polluted and the more damages go on proceeding in accelerated rates and the cumulative effects push the land towards degradation. The process works through a cycle known as land degradation cycle.

5. Recommendation

According to the report on Nation newspaper on Monday February 27th 2017, a British exploration firm Acacia Mining discovered gold deposits worth an estimated Sh165 billion in Kakamega County. This coupled with other mining activities, the County Government should come in strongly to advocate for sustainable mining of gold and other minerals to protect the environment through legislations and enforcement.

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