

Assessing Suitability Of Abandoned Borrow Pits In Mt. Elgon Region For Economic Activities In Kenya

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Abstract: *Nearly half of the roads in Kenya are in poor state. The need to reduce the poor state of the roads in Kenya as well as maintaining the existing roads has resulted in establishment of borrow pits in different parts of the country. Once the road is complete, the borrow pits remain. This study aimed at assessing the suitability of three borrow-pits in Mt. Elgon area for water storage and fish farming. The methodology involved observation and interviewing owners of borrow pits. It also included measurement of the depths and areas of the borrow pits. The borrow pits range from 0.75 to 2 acres. Two-thirds of the quarry pits had silt/clay content suitable to hold water and hence ability to hold fish. The borrow pits were bare at the time of the study. It was reported that during the rainy season loss of life was witnessed. The borrow pits can be converted to fish ponds so as to increase the economic value of the borrow pit. There need to escalate this research to all parts of Western region of Kenya so as to increase fish production to avoid buying fish from as far as China.*

Keywords: *Borrow pit, Fish farming, Mt. Elgon, Roads*

I. INTRODUCTION

Achievement of seamless connectivity in terms of road network, air and water transport is the pride of any developing country like Kenya. Past and current governments in Kenya have been increasing infrastructural development budget. The construction of roads in every part of Kenya means increase in economic activity which will contribute to transformation of the country to a middle-income country by 2030 (GOK, 2007).

Kenya's ambitious plan to tarmac 10 000 kilometres of road (KRB, 2014) coupled with poor state of some roads means an increase in establishment of sources of materials in every part of the country including Mount Elgon area. Indeed, 43% of the road network in Kenya is in poor or very poor conditions and need improvement (KRB, 2018). The poor state of roads decreased from 50% in 2017. In Mt. Elgon and its environs over 300 km of road networks have been constructed. During the construction of these roads, sub base materials are normally excavated from private farms (borrow pits) and used in road construction.

Borrow pits as source of gravel have to be stripped of top soil before getting material good enough for making a road layer like sub base. To determine the size of the land for borrow pit, engineers have to estimate the amount of excavations based on the length of the road. For example, consider a road-width of 7.0 m and sub base layer of 0.2 m means 1400 m³ of gravel is required for every kilometre of road base constructed.

Some of the parameters used to determine the suitability of material for road construction are California Bearing Ratio (CBR), Plastic Index (The difference between liquid limit and plastic limit). CBR is an empirical value developed in United States of America in California for the evaluation of subgrade of roads (ELE, 2003). The minimum value for CBR for a given material is 50%. A material should have a maximum limit of 30% and 10% for liquid limit and plastic limit, respectively (Specification, 501). Finer particles in soil contain silt (0.002 to 0.05 mm) and clay with size particles of less than 0.002 mm) (agriLIFE EXTENSION, 2006). Therefore it is the responsibility of engineers to ensure that construction

materials meet the standard requirements for the durable, cheap and maintainable roads.

A borrow pit is a site from which material other than stone is removed for construction works (ROK, 1986) are pits left after gravel has been excavated. The practice in Kenya is that the engineer sites the place for borrow pit, however, contractors may propose a site after getting approval from the engineer. In Kenya, it is a requirement to clean borrow pits up on completion of road project while making sure that the borrow pit is excavated to regular widths and shapes. The standard goes further to say that the sides should be neatly trimmed and bottoms levelled and drained away from works. After work has been completed the faces of borrow pits should be trimmed to a slope flatter than 1 in 4. If this trimming is not possible then the place should be fenced and payment made for the works done (ROK, 1986). Despite these requirements by the engineer, it is not surprising to see borrow pits that do not adhere to these specifications. One reason for not filling a borrow pit is the costly nature of transporting stripped material from the source to the borrow pit.

Borrow pit establishment and use is an inter-ministerial activity bringing in ministries of Transport and Infrastructure, Environment, Lands, water and Agriculture. Road Authorities like Kenya Rural Roads Authority (KeRRA), Kenya Roads Board among others are under transport ministry, National Environmental Management Authority (NEMA) is under environment ministry, the issuance of land titles by National Land Commission is under Lands ministry while the water is under ministry of water and land on which the borrow pit displaced was initially being used for agricultural purposes. So for sustainable use of borrow pits there is need for an integrated approach by all the authorities in the different ministries.

Normally an environmental impact assessment report is conducted prior to the construction of a road with the aim of mitigating negative impacts. Such reports would propose that borrow pits be filled to origin level or left for use as a water pan. However, most of the borrow pits are normally left without filling because of many reasons. One reason being the utilization of the borrow pit in future should there be repairs on the constructed road or used in a new road. So when these pits are left, water will pond in them and can bring several benefits both negative and positive.

Economic activities such as converting the borrow pits into fish pond has been done in South Louisiana, United States when home owners were rebuilding their homes after hurricanes Katrina and Rita (LSU sea Grant, 2006). In Uasin Gishu, there is an abandoned borrow pit of around 5 acres which is now a very good source of fish. Fishing is now become a source of income for these people. The county government of Bungoma, where the area of study is one of the counties is promoting aquaculture through rehabilitation and stocking of dams (Bungoma IDP, 2013-2017). Indeed aquaculture is one of the blue economy bankable projects (Ondimu *et al.*, 2018) and there are no other economical and feasible ways of promoting aquaculture than the use of borrow pits for growing fish. Lake Victoria, the traditional source of tilapia fish, is experiencing reduction in Tilapia fish due to overfishing and hyacinth problem and hence the need for opening up new fish frontiers.

Borrow pits are useful to road construction, aquatic life, women and water storage. Once the water is stored it can be used for road construction, aquatic life and domestic use where women normally fetch water from. So we can say borrow pits can serve several purposes as shown in the conceptual framework in Figure 1.

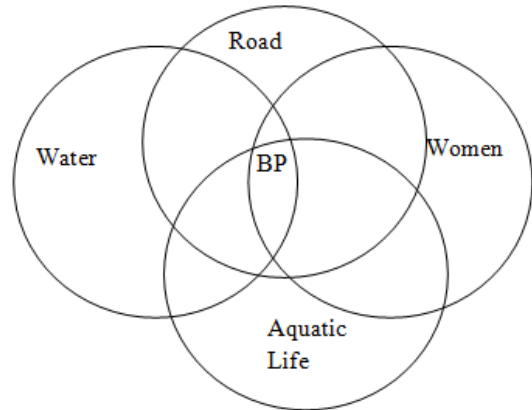


Figure 1.1: Conceptual Framework for Borrow Pit (BP)

Making borrow pits useful will limit them being converted as dumping sites for solid waste and a place for open defecation. Rehabilitated borrow pits will also prevent the borrow pit being used by criminal gangs as their hide-out where they plan and commit murder. Majority of fish farmers in Kenya use pond culture to produce fish. The ponds are either lined or earthen. These ponds have areas of 300 m² and depths of between 0.45-1.1 m (KMFRI, 2017). Shallow depths enable light to penetrate the water which makes water warm for fish like warm areas of the pond.

This study aimed to: determine the plan area, distance to the road and depths of borrow pits in the area; and gauge the views of borrow pit owners on challenges of borrow pits with a view of converting the borrow pits for various economic activities like fish farming.

II. METHODOLOGY

A. STUDY AREA

The borrow pits observed were Sangura (0.80°N, 34.74°E), Kazembeli (0.76°N, 34.51°E) and Kimabole (0.78°N, 34.52°E) as shown in Figure 2.1.

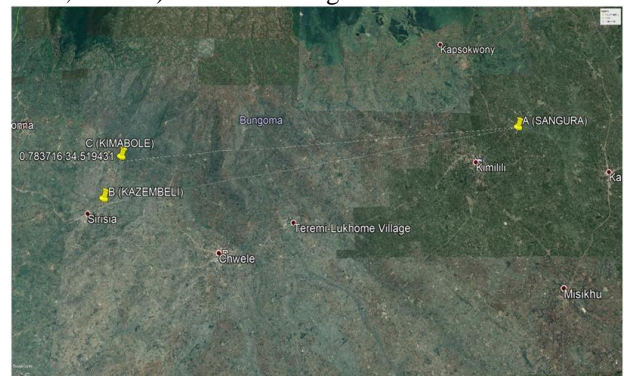


Figure 2.1: Google Earth Map showing Borrow pits

B. GEOLOGY OF MT ELGON REGION

The area consists of metamorphic rocks of Precambrian era and tertiary volcanic. According to Ingana, 1993, the area has basalt rock with nepheline (Sodium aluminosilicate) and with little augite.

C. DATA COLLECTION

Data collection was through observation, measurement and interview questionnaire. The area of borrow pits together with their corresponding depths were measured using tape measures. The interview questionnaire was administered to persons who live near the borrow pits on 10. 02. 19 after pretesting. The interview was to find answers to what were the initial use of land and what were the problems as well as benefits derived from the borrow pits. Determination of plastic index and California Bearing Ratio were done following the procedures outline in Laboratory testing manual (UROT, 2000).

III. RESULTS AND DISCUSSIONS

A. DEPTHS AND VOLUMES OF BORROW PITS

Borrow Pit	Acres	Area (m ²)	Depth (m)	Volume (m ³)
Sangura	1	4046.86	6	24281
Kazembeli	2	8093.72	5	40469
Kimabole	0.75	3035.15	5.5	16693

Table 3.1: Borrow pits depths and volumes

B. BORROW PIT BEFORE AND AFTER CONSTRUCTION

Once a contractor has identified a suitable source of gravel, the land owner is normally paid for the excavation to proceed. Before construction, the pieces of land at Sangura, Kazembeli and Kimabole were used to grow crops as shown in Table 3.2, however after the excavation of the gravel the land was left as pits and have resulted to some problems as shown in Table 3.2.

Borrow Pit	Economic activity before	Problems	Benefits
Sangura	Maize and beans	Loss of life through drowning.	Ground water
Kazembeli	Ground nuts, maize and beans	Blocked access to homesteads	
Kimabole	Groundnuts		

Table 3.2: Crop lost, problems and benefits as a result of borrow pits

Borrow Pit	Silt/Clay content (less than 0.05mm)	PI	CBR (%)
Sangura	12%	15	62
Kazembeli	37%	14	46
Kimabole	26%	9	54

Table 3.3: Gravel Properties (Clay content)

The borrow pits at Kimabole and Sangura met the CBR requirements for use as subgrade material while the one at Kazembeli did not meet and hence the need for stabilizing it before being used as a subgrade material. The PI values are less than 15 for wet areas and therefore acceptable (ROK, 1981).

Positive benefits include: water for both domestic and livestock use, water for irrigation, rock material for sell to be eaten by pregnant woman, water for growth of aquatic plants resulting in a wetland and source of firewood (Plate 3.1, 3.2, 3.3 and 3.4).



Plate 3.1: Photo: Borrow pit at Sangura as a source of firewood.



Plate 3.2: Borrow pit at Sangura as a source of water during rainy season

Negative impacts include: drowning of children playing around the pit, collapse of the sides of the borrow pits resulting in swallowing up of arable land or built up area and destruction of electricity poles as shown in Plate 3.3 and prevention of access to homes.



Plate 3.3: Accumulation of water at Kimabole that can result in drowning



Plate 3.4: Electricity poles at Kazambeli borrow pit

C. WHAT CAN BE LEARNT FROM THE BORROW PITS?

These borrow pits are close to houses of community. The borrow pits were initially agricultural land and now they have been left bare with little re-growth of grass. Some borrow pits have steep sides which are susceptible to collapse or sliding and hence the need to trim to a stable slanting position. Water in the pond can be a risk to both human and livestock. Such places become breeding places for mosquitoes and hence the need to introduce fish.

D. PROPOSED USES

Before a borrow pit is excavated, there is need to provide money in the bill of quantities for lining the borrow pit to hold water or other rehabilitation works like planting of trees.

If the bottom of the borrow pit intersects the ground water depth, it should be left so as to pond water and hence act like a dam. A borrow pit with water will assist in sequestration of CO₂ in the atmosphere and thus assisting reducing the effects of climate change on communities. A borrow pit with water and of sufficient surface area can be use for water sport where people can come and compete in boat rowing.

In addition, a borrow pit with water and of shallow depth, can be used for mixed farming for fish and chicken which are good source of proteins. Borrow pits with more than 20% soil content is good for holding water (LSU sea Grant, 2006). The ponds size range from 0.75 to 2.0 acres. These sizes are good for ponds as larger areas make them sustainable and with less management. Fish thrive well at depths of around 2 metres which means that the three sites are very good for fish farming. Kazambeli and Kimabole borrow pits have silt or clay content of more than 20% and hence good at holding water.

Borrow pits can be used to trap runoff during the rainy season. The water can then be used for irrigation as what is happening in South Sudan (AFRHINET, 2017). Since the borrow pits in the study are close to the homesteads they are good sources of water for irrigation. The problem of mosquitoes can be reduced by having tilapia in water or catfish. Catfish are preferred breed of fish because they can withstand conditions of no water in the borrow pit. In dry areas, the rate of evaporation can be reduced by covering the pond with non-harmful algae (AFRHINET, 2017).

If the borrow pit cannot hold water, there is need to plant trees particularly casurina which will not only assist in

sequestration of CO₂ but also provide firewood for the residents.

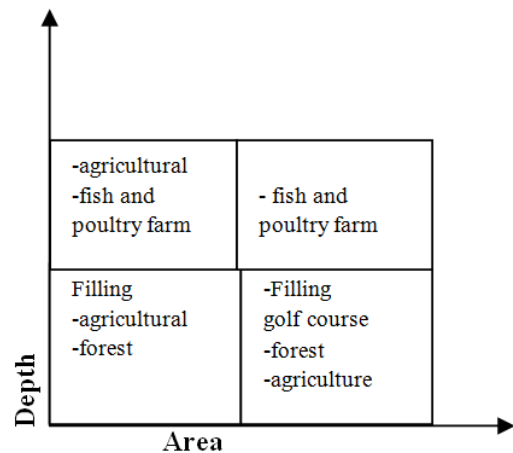


Figure 3.1 Several Economic uses of Borrow pits based on area and depths

IV. CONCLUSION AND RECOMMENDATIONS

An abandoned borrow pit should not be left bare. They should be put into economic uses like fish farming and forest. This research dealt on only three sites but there are so many such borrow pits in western Kenya and hence the need to assess all of them.

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