



LANDSCAPE RECLAMATION FOR ABANDONED MINING SITE FOR OUTDOOR RECREATION ON THE JOS PLATEAU

Emmamoge Orewere¹, Ayodele Owonubi¹ & Sada Zainab²

¹Department of Horticulture and Landscape Technology,
Federal College of Forestry, Jos

²Department of Architecture, Faculty of Environmental Design,
Ahmadu Bello University, Zaria

Abstract

The Sustainable Development Goals adopted by the United Nation particularly (goal fifteen) subtitled: LIFE ON LAND: protect, restore and promote sustainable use of terrestrial ecosystem, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss targeted for year 2030 and Nigeria's Vision 20:2020 (NV 20:2020) Economic Transformation Blueprint cannot be overemphasized. Illegal mining is one of the biggest problems with regard to environmental destruction and ecological disruptions. It presents a plethora of environmental, social and economic problems. Thus using abandoned quarries as sites for new construction is a useful form of reclamation, one that has occurred throughout history. The main thrust of this paper, is to reclaim an abandoned mining site through landscape development for outdoor recreation to tourist who needs to recreate either actively or passively on the Jos Plateau. The study objective is to develop the conceptual framework to serve as a basis for creating a suitable design of an abandoned mining area. It focuses on Guut-Rayfield area in Jos-South Local Government Area of Plateau State. The methodology employed for this study is physical site survey, case studies and literature search. The paper submits by way of conclusion that land reclamation strategies through landscape development should be implemented alongside mining plan for effective restoration after mining operation ceases. Working closely with community dwellers, allied professionals, and the government would ensure sustainable development is achieved.

Keywords: Landscape reclamation, Mining site, Outdoor recreation, Plateau

INTRODUCTION

As adopted by the American Society of Landscape Architecture (ASLA), landscape architecture is the art of design, planning or management of the land, arrangement of natural and man-made elements thereon through application of cultural and scientific knowledge, with concern for resource conservation and stewardship to the end that the resultant environment serves a useful and enjoyable purpose (Ayeni, 2012). This emphasis

unconditionally unveils the fact that there is a wide variety of elements that make up the human community and define its quality of life. These elements are possibly not limited to employment opportunities, the supply of quality housing, or cultural and social opportunities but extend to the quality of natural environments that often come through open spaces, parks and recreational planning (Simon, 2015).

Mankind's activities on the environment in his quest for development have resulted in a continuous and serious degradation of the ecosystem, thus posing a threat to both his present and future living (Babanyara, et al., 2010). Contextual to this paper, mining is the extraction of valuable minerals or other geological materials from the earth, usually from an ore body, vein or coal seam. The term also includes the removal of soil (Ediawe, 2011). Furthermore, it is described as the extraction of mineral resources from land, water and sediments of rivers, lakes, seas, and oceans. (Mwangi, 2015). Surface mining refers to extraction from the earth that involves removing the required resources without first stripping out a top layer from the earth's surface, or simply stripping out a minimal layer of top soils (Mwangi, 2015). With regard to the type of resource to be exploited, the types of surface mining method include; open-pit (open-cast or quarrying), strip mining, solution method and dredging (Mwangi, 2015).

The tin mining areas of the Jos Plateau has produced landscape features such as mine dumps, pits and ponds. These render the land uncultivable, leaving the land derelict. In general, mining activities cause land degradation. These activities range from prospecting and exploration to exploitation (Ladan, 2004). However, the need to control land degradation in Nigeria is to achieve a sustainable environment which is in line with Goal 15 sub-titled Life on Land: *protect, restore and promote sustainable use of terrestrial ecosystem, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss* in the newly developed Sustainable Development Goals (Sustainable Development Goals, 2015) so that Nigeria will also conform to the global quest for developing nations sustainably.

The mining of some minerals in the country has caused land degradation in those areas where mining activities are being carried out (Ladan, 2004). For many years past, Jos Plateau has witnessed incessant soil destruction by mining operations (Ladan, 2004; Ndace, et al., 2012). Mined ponds, pilot ponds, reservoirs, mine dumps and mounds are some harmful effects to human beings, animals and the landscape of the Jos Plateau leaving an indelible disfiguration (Ladan, 2004; Ndace, et al., 2012). A cursory observation reveals how lands are mined extensively in the study area and it may take not less than 15 years to be reclaimed. Despite the existing laws, little or no attention is paid to reclamation of the derelict mining ponds (Author's observation, 2020). Thus using abandoned quarries as sites for new construction is a useful form of reclamation, one that has occurred throughout history. A commodification of leisure and recreation facilities is necessary in these modern times with increase of leisure time and disposable income.

Recreation is an essential part of human life and exists in many different forms, which are shaped naturally by individual interests but also by the surrounding social construction. Recreational activities can be communal or solitary, active or passive, outdoors or indoors, healthy or harmful, and useful for society (Ezeamaka, et al., 2016). Recreation was defined by Ezeamaka, et al., (2016) as an activity engaged in by the individuals after work, an activity that rejuvenates, recreates and builds the individual anew. In addition, recreation is all actions in leisure time that are not directed to achieving financial reward (Dağistanlı, et al., 2018). However the understanding of outdoor recreation are "activities that take place in a natural setting, as opposed to a highly cultivated or managed landscape such as a playing field or golf course" (Tourism BC, 2013, p. 47). According to Dağistanlı, et al., (2018), recreation has been divided into three components, namely house activities, indoor activities and outdoor activities. Outdoor recreation has been widely studied and is considered as one of the most important cultural activities. Outdoor activities involve protecting, preserving, developing, using and enjoying scenery, water, landscapes and archaeological and historical sites.

In this paper, in order to determine site suitability for outdoor recreation at the local scale, outdoor recreation value was assumed to be dependent on environmental conditions and landscape attributes, such as type of vegetation and land use/land cover, soil, topography, climate, slope, and cultural assets. In addition, some infrastructure such as public utility services are also important factors influencing the levels of utilization and convenience of recreational areas. Again going through existing literature, there is an apparent gap that this paper helps attempts to abridge by exploring the potential contributions of outdoor recreation in reclaiming derelict landscape. The focus of this paper, therefore, is to reclaim an abandoned mining site through landscape development with a view to promoting outdoor recreation to tourist who need to recreate either actively or passively on the Jos Plateau. Consequently, the objective of this study is to develop the conceptual framework to serve as a basis for creating a suitable design of an abandoned mining area.

LITERATURE REVIEW

Conceptual Framework to Reclamation of Mines

According to Mwangi, (2015) reclamation and rehabilitation should be planned parallel with mining activities. The main objective of reclamation is to minimize the effects of degradation and restore the landscape to its original state or reduce the effects of contamination to soil and water streams. Prior planning helps with monitoring mining activities that destroy ecosystems and post mining plans are implemented soon after excavation to reduce the number of years the land would take to reconcile itself.

Design Approaches to Reclaiming Mine Sites

A study of landfill and sewage treatment by (Mwangi, 2015) have analysed suitable methods to rehabilitate mining sites using natural and human intervention technique to restore landscapes to its functional and aesthetic façade. Reclamation is seeking to minimize the negative impact of open cast mines which are a necessity to any growing economy as this quarries provide construction materials and job opportunities for many. Nine approaches for mining reclamation are discussed in Table 1:

Table 1: Engler’s design approach

Engler’s list	Description
Natural	Allow nature to reclaim site with no or minimal human influence
Camouflage	Conceal mining facility using screen and buffers
Restoration	Return the land to its applicable original contour
Recycling	Use site for public amenities
Mitigation	Repair a mined out site from extensive human and natural damage
Sustainable	Recycle manmade or natural resources on site
Educative	Common mining or other resource information through outreach
Celebrative	Treat a site as a work of beauty and unique experience
Integrative	Combination of approaches integrating art and science

Source: Adapted from Mwangi, 2015.

The above approaches have their advantages in regards to reclamation. The most common approach is camouflage fencing using barbed wire and vegetation which may not restore the site but be a barrier to keep off people. For smaller quarries nature over a short while will fill up the quarry and vegetation cover will manifest itself. Quarries of larger areas will require human interventions to speed up reclamation (Mwangi, 2015).

Vegetation Approach to Reclaim a Mine Site

Re-vegetation is a cost effective, long term method of rehabilitation. This approach is effective in that it is not only aesthetically appealing but also functional in that it minimizes water and air pollution as it provides a ground cover. Re-vegetation also prevents soil erosion and would be the best option to reclamation after back filling is employed (Mwangi, 2015). Consequently, experimentation has been undertaken at mine sites to attempt to elucidate and overcome limitations to vegetation establishment, allowing large-scale re-vegetation schemes to be formulated. Although such schemes have often been successful at specific sites, their widespread application is limited owing to the great variation in physical, chemical and biological factors which exist between mine wastes”. Current approaches to re-vegetation and reclamation involve both ameliorative and adaptive strategies to allow plant growth (Mwangi, 2015).

Case Study of Reclamation in Mines Resort City, kualar Lumpur

Mines Resort City is built around the former Sungei Besi Mine which was at one time the largest and deepest (>100m deep) open cast alluvial tin mine in the world. Located on an area of 405ha of land around it with all the features of a derelict environment. A major challenge the developers faced during construction and land reclamation include presence of a large thickness of peat in the alluvium over the limestone bedrock. The developers decided to flood the mine pit and turned it into a huge lake and built a resort city. It comprises of a high-tech musical fountain laser show and a parade of lighted floats, a snow house, an 18-hole golf course on the undulating eastern side of the lake built over uneven granite terrain. Other facilities include 500 bungalows lots, town houses, sport facilities, shopping malls, fish farm, duck farm. Duck droppings are easily used to fertilize the ponds for fish rearing and planting vegetables and fruits (Lee, et al., 2002). The developers used the recycle and education approach to reclamation.

Case Study of Reclamation in Australia

The mine pit lakes of Collie pit Lake District, evolved as a need to establish recreational centres for its growing population. With a population of 9, 104, the abandoned mines were turned into recreational areas. Both males and females used the pit lakes with a slightly higher percentage of males using the lakes for recreational purposes. The recreational activities amongst others include skiing, boating, swimming, wading, and picnicking, camping, walking, fishing and marooning (Source: www.preprints.org) (see Plate i). The developers used the recycle and education approach to reclamation. The existing rocks were used to create sculptures, terraces and water streams.



Plate i: Water skiing on abandoned mine pit Lake Stockton in Western Australia

Source: www.preprints.org.

METHODOLOGY

The Study Area

Geographically, the area is located in Guut-Rayfield in Jos-South Local Government Area of Plateau State, Nigeria and occupies an area of 2.54 hectares (Figure 1). According to Nigerian population and housing census data of 2006 (NPC, 2008), Jos South has a population of 306, 716 people. The population consists of middle and lower class income earners in the state. With this congestion a suitable recreation facility will help to solve problems relating to some social vices like drug abuse, kidnapping, armed robbery, juvenile delinquencies, etc. to mention but few.

Method of Data Collection

The research made use of both primary and secondary data. The primary data were obtained by photographic means, soil and field survey to have accurate three dimensional views of the study site, to capture the extent of mining operations that took place. Elevation mapping was facilitated using the Shuttle Radar Topographic Mission (SRTM) 30m resolution elevation data. The secondary data include documented information of internet,

Landscape Reclamation for Abandoned Mining Site for Outdoor Recreation on the Jos Plateau

electronic journals, dissertations and geographical maps of study site and Plateau State, Nigeria.

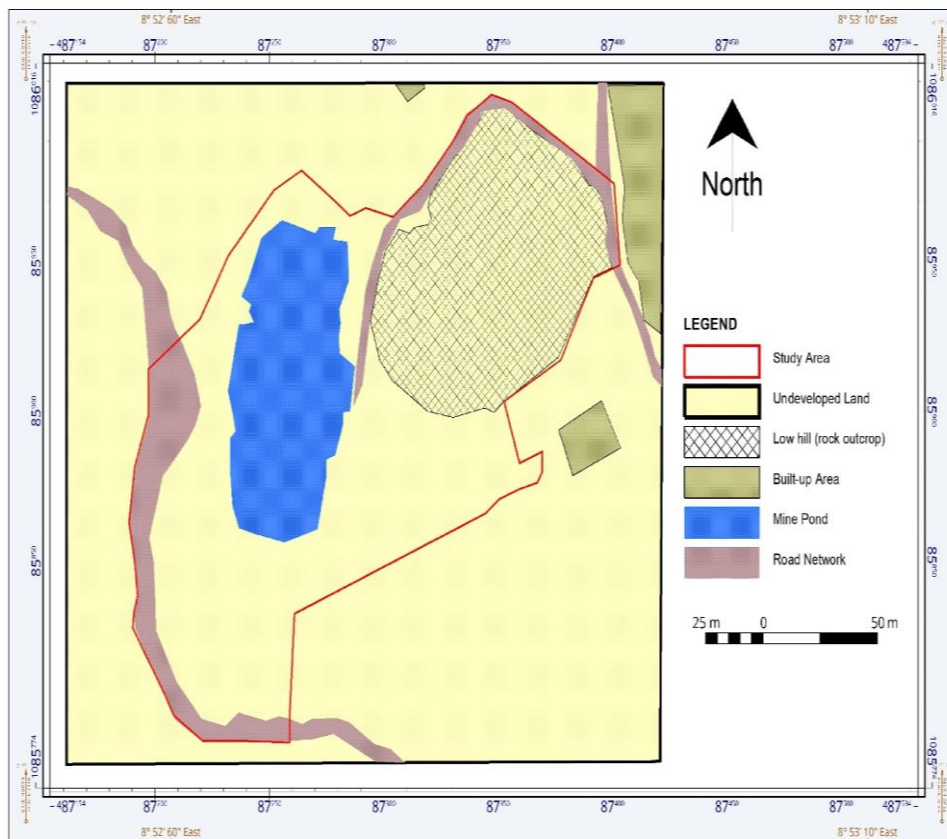


Figure 1: Base Map (Source: Authors 'drawing, 2020.)

Case Study: The researchers' used two case studies from Australia and Malaysia (Kuala Lumpur). This provided a large platform of information on reclamation through an insight analysis of before and after reclamation. The studies were based upon degraded lands that were reclaimed using human efforts to come up with a recreation facility.

RESULTS AND DISCUSSION

Site Analysis

A site analysis map was produced considering the on-site and off-site views, weather and climatic elements (Figure 2). The study area has a mine pond which is characterized by stagnant water, indiscriminate dumping of wastes, stone quarrying, (see Plate ii a & b) and cattle grazing. Mining activities has distorted the original topography of the site. An elevation map of the site

is shown in Figure 3. The major baseline geology of the site is younger granites. The soil types are presented in Figure 4. Sheet, rills and gully erosion are a major environmental problem on the site.

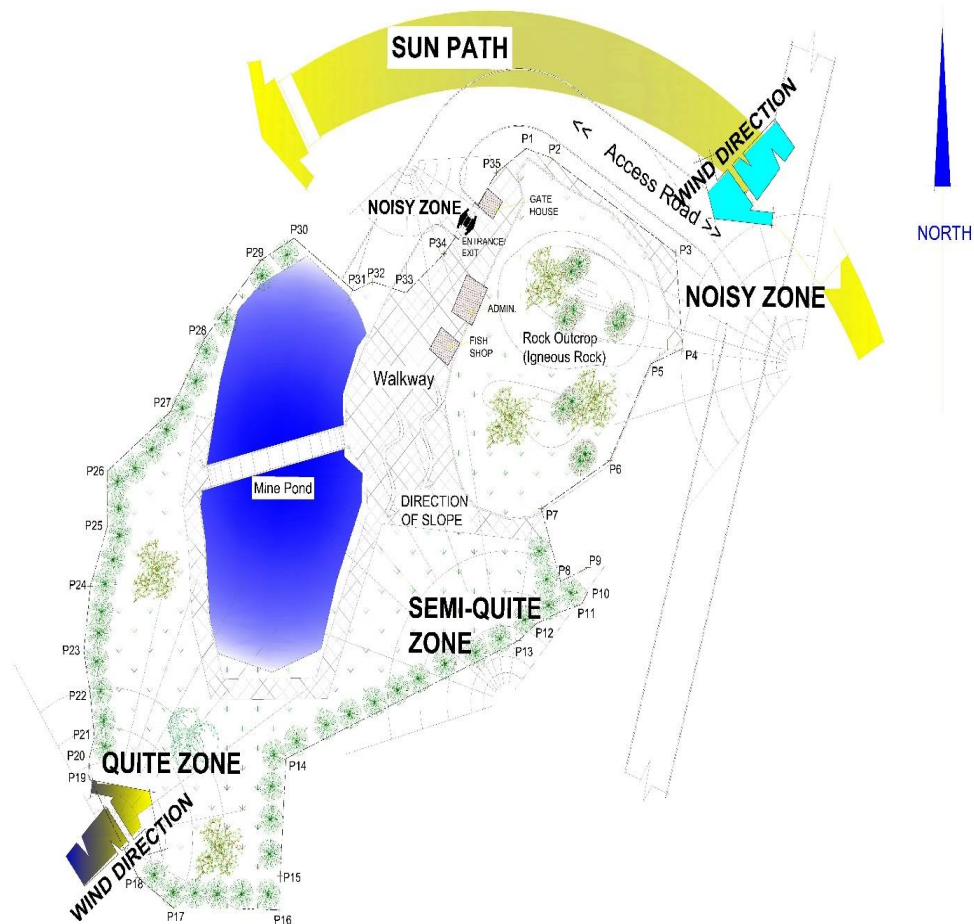


Figure 2: Site Analysis

Scale: To sketch (Source: Authors 'drawing, 2020.)

Climate and Vegetation

Human activities such as mining, stone blasting has greatly affected the land use and land cover of the site over a 25-year period. Jos city has an equable climate with average monthly temperatures ranging between 21° and 25° C (69° and 77° F), average humidity of 60% and average annual rainfall of 1,400mm (56"). These average numbers however obscure substantial diurnal and seasonal variations which are of great

significance in the design for comfort and energy efficiency (Archives of National Centre for Remote Sensing, Jos, 2007). The site falls largely within the northern guinea savannah zone which consists mainly of shrubs, grasses (see Plate iii a & b) and the plateau type of mosaic vegetation. Plants identified on the site included: Sweet bay (*Laurus nobilis*), Jasminum sambac (*Arabian jasmine*), common lantana (*Lantana camara*), cayenne snakeweed (*Stachytarpheta cavennensis*), Bur-mallow (*Urena lobata L*), Beefsteak-mint (*Perilla frutescens*), Shrubby false buttonwood (*Spermacoce verticilata*), Americana sicklepod (*Senna obtusifolia*), Tectona grandis (*Indian oak*), Three-thorn-acacia (*Gleditsia triacanthos*)



Plate ii a & b: Aerial view of abandoned mining area (Source: Authors' field work, 2020)



Plate iii a & b: Some existing native vegetation on granitic rock outcrop. (Source: field)

Landscape Reclamation for Abandoned Mining Site for Outdoor Recreation on the Jos Plateau

work,2020)

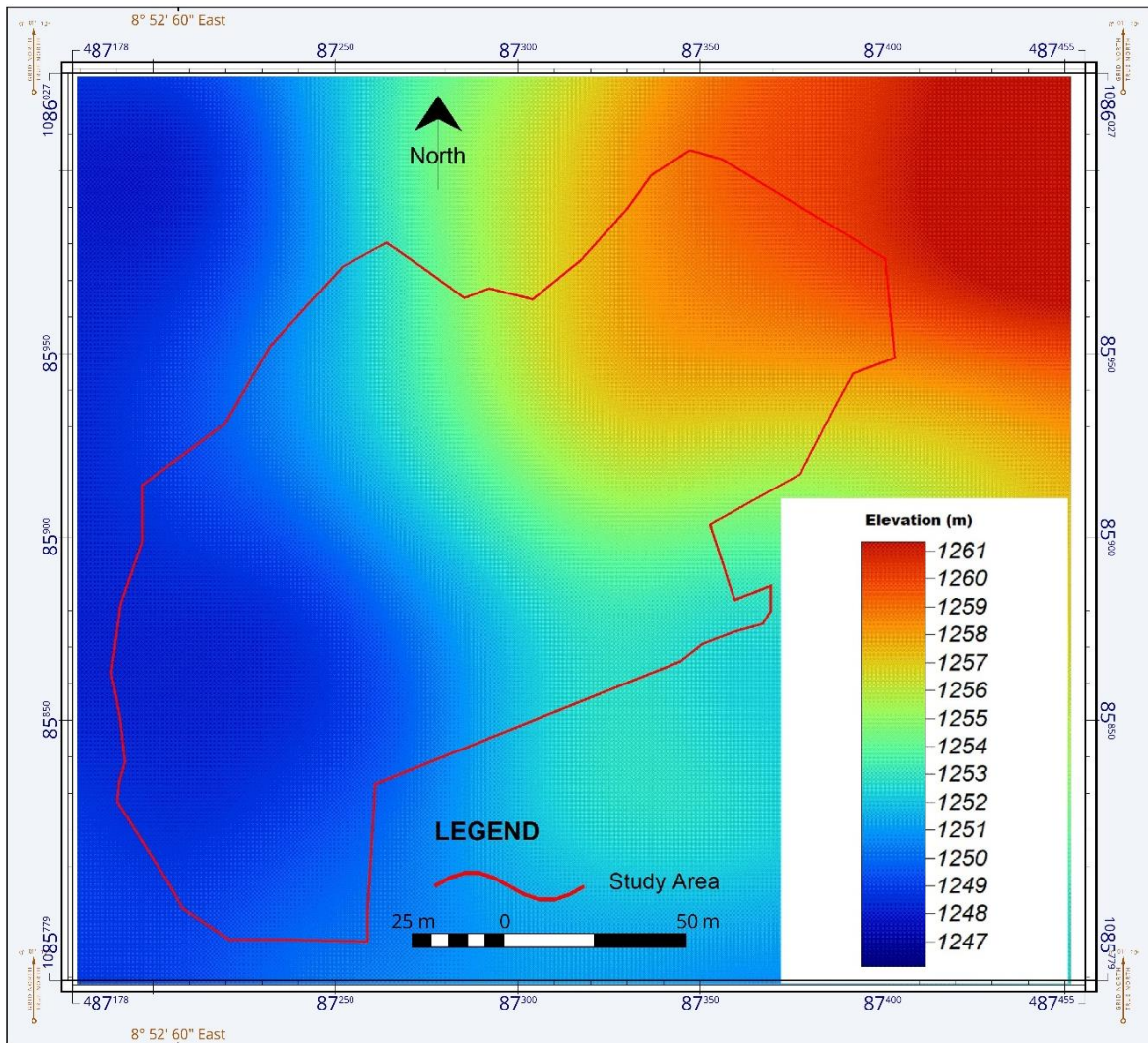


Figure 3: Site Elevation Map (Source: Authors 'drawing, 2020)

Table 2: Summary of Analysis Chart

S/N	Element	Quantity	Function	Opportunity	Constraint	Remark
1.	Main Entrance	1	Entry/Exit	Yes	None	Improve
2.	Pedestrian walkways	-	Circulation	Yes	None	Improve
3.	Rock outcrop	1	Outdoor sitting	Yes	None	Retained
4.	Mine Pond	1	Water body	Yes	None	Retained
5.	Tree	-	Provision of	Yes	None	Retained

			shade/Aesthetic s/ Erosion control			& Introduced
6.	Shrubs	-	Provision of shade/Aesthetic s/ Erosion control	Yes	None	Retained & Introduced

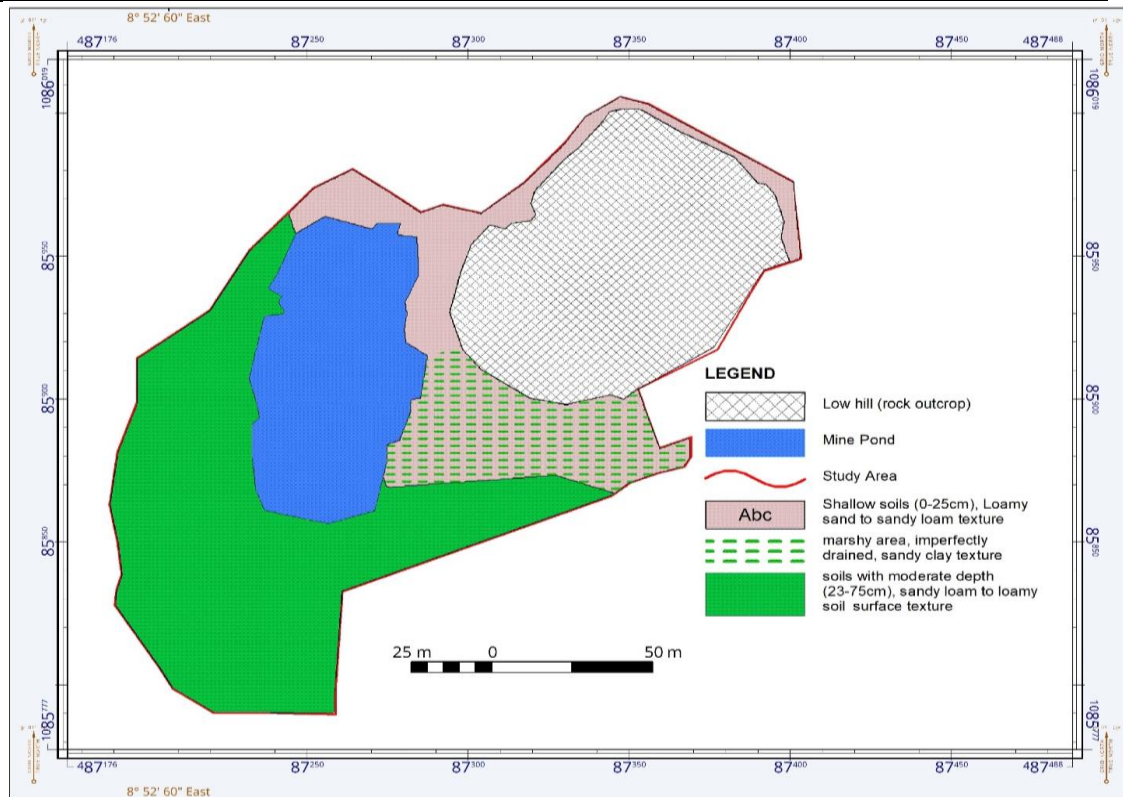


Figure 4: Soil Map (Source: Authors 'drawing, 2020)

Design Conceptualization

With the number of open mined ponds on the Jos Plateau, back filling will not be suitable. Rather restoration, mitigation, recycle and sustainable approaches to reclamation will be required for the majority of mining areas. An educative design approach works best for it creates awareness to all stakeholders on the negative effects if restoration plans are not implemented. From Engler's design approach, the author's used the recycling approach to create a landscape development for the study area. Integrative approach using design guidelines will be implemented to revive the grounds to a recreational facility. The design was conceptualized into different user groups based on gender, age and families. Developing suitable programs to cater

for the needs of the various user groups. Three conceptual plans (with conceived spaces for reclamation) were developed using aesthetics, circulation, economy, and functionality. We believe the ideal conceptual plan will be developed fully by imputing required details and scale to bring it through an evolutionary process from concept to landscape master plan to resuscitate the degraded landscape to a sustainable design:

1. Conceptual Plan I – Green areas and outdoor sitting
2. Conceptual Plan II – Children play area/Outdoor games
3. Conceptual Plan III – Mini Zoo

Conceptual Plan I - Green areas and Outdoor sitting

The basic focus of this concept is to provide a serene environment for relaxation and recreation especially for middle age to people who are elderly. This conceptual plan is composed of the existing (Figure 5):

- a) mine pond which will be used for fishing purposes and provision will be made for a fish shop
- b) rock outcrops which will be converted to a rock garden with sit outs,
- c) designated relaxation spots and variety of shade trees, shrubs and ground covers. Trees recommended for quick vegetal cover of erosion sites include *Terminalia catappa* which has strong spreading roots that can hold the soil together. *Anacardium occidentale*, *Pinus caribaea*, *Eucalytus citriodora*, *Acioa barteri*, *Oxytenanthera abyssinica*, *Bambus vulgaris*, *Dacryodes edulis* (Etukudo, 2000). Exotic species certified good as efficient green manure crops include *Leucaena leucocephala*, *Gliricidia sepium* (Etukudo, 2000).
- d) Water plants would be planted along the mine ponds and in marshy areas of the study area (Figure 5). Examples of water plants to be used include water purslane, waterweed plants, African water fern plant, and Anubias. Some of the best floating water plants on ponds are duckweed and the mosaic flower, water lilies, lotus, water hawthorn plants, and mosaic flower.

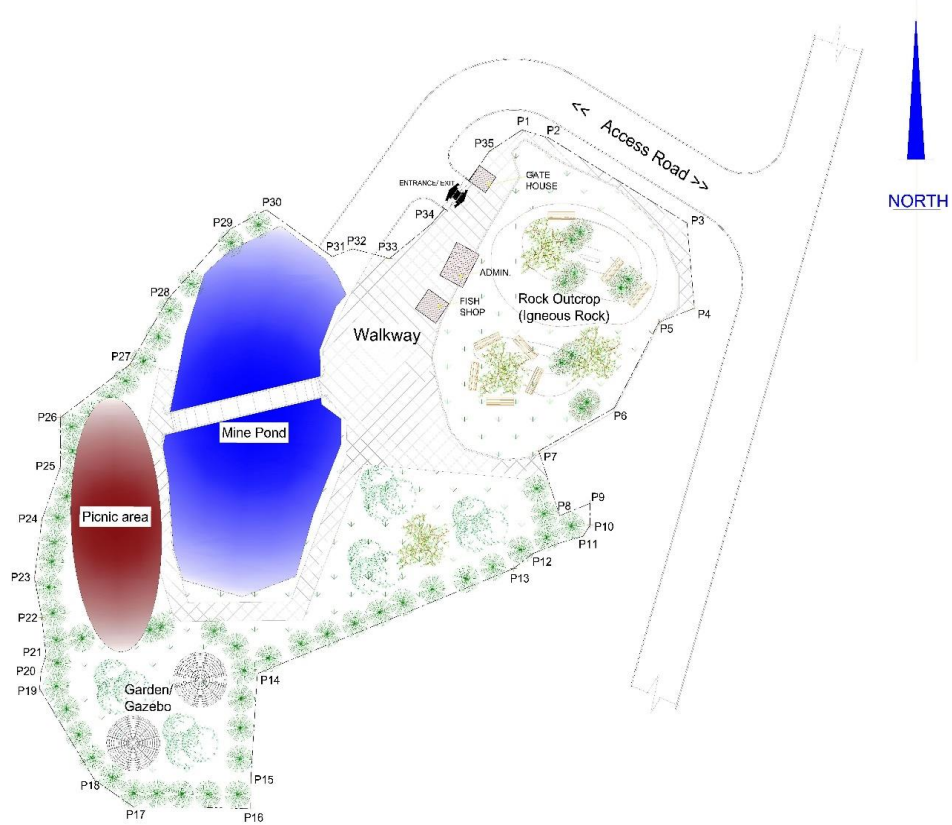


Figure 5: Conceptual Plan I
Scale: To sketch, (Source: Authors' drawing, 2020.)

Conceptual Plan II - Children play area/Outdoor games

The main focus of this concept is to create recreational facilities for children basically within the age group of three to fifteen years of age. This second conceptual plan is composed of the existing (Figure 6):

- a) mine pond were mini boating activities can take place,
 - b) rock outcrops with facilities for exciting activities,
- Other proposals include children play area with variety of indoor and outdoor games i.e. bouncing castle, swings, slides and a merry-go-round, just to mention a few.

Landscape Reclamation for Abandoned Mining Site for Outdoor Recreation on the Jos Plateau



Figure 6: Conceptual Plan II

Scale: To sketch (Source: Authors' drawing, 2020)

Conceptual Plan III – Mini Zoo

The mini zoo concept is to provide a conducive environment for selected animals that are not harmful to humans to thrive on free range. While at the same time making the environment exciting for tourists. Specialized animal cages would be erected mainly for breeding purposes. The third conceptual plan is composed of the existing (Figure 7):

- mine pond around which the habitat for aquatic animals will be developed. Some of these animals include pond snails, turtles, ducks, swans. In addition, the pond can be stocked with small, inoffensive fish varieties, including Platies (*P. variatus*), Paradise Fish (*Macropodus opercularis*), Florida Bluefin Killiefish (*Leucania goodei*), and Persian Killiefish (*Aphanius mento*), among others.
- rock outcrops, for animals like beaver, squirrel, antelopes and tortoise just to mention a few.
- Trees and shrubs would be planted for attracting various bird species: These will include amongst many the oak, willows, cherries, Juniper, and black berry.

d) Furthermore, fruit trees would be planted for the enclosure for animals like monkeys.

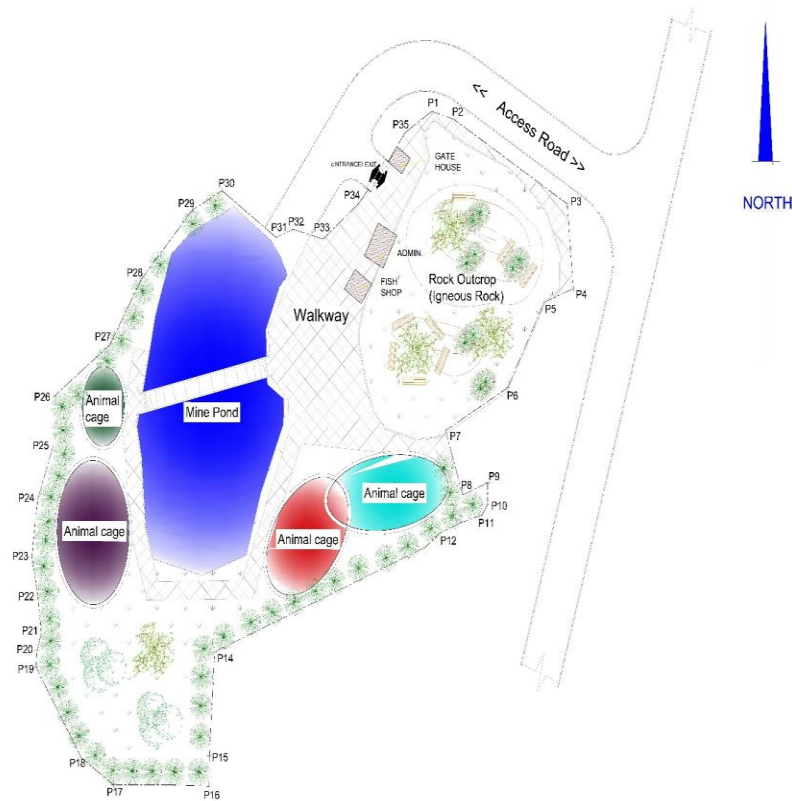


Figure 7: Conceptual Plan III

Scale: To sketch (Source: Authors' drawing, 2020)

Planting Scheme and Specifications

Planting scheme is the art of installation and spacing of plants around the centre, (Acquaah, 2009) this is meant to provide an aesthetical appeal and enhance circulation within the environment (Table 3). At this stage, plants are introduced to their appropriate locations based on the planting scheme. Watering is done afterwards and carried out during the dry season.

Table 3: Generalized Planting Scheme and Specifications

Landscape Reclamation for Abandoned Mining Site for
Outdoor Recreation on the Jos Plateau

S/N O	COMMON NAME	BOTANICAL NAME	MAX HEIGHT(M)	SPREAD(M)	SPACING (M)	QTY	USE
1.	Lawn grass	<i>Cynodon dactylon</i> <i>Axonopus compressus</i> <i>Zoysia tennifolia</i> <i>Polytrias praemorsa</i>	0.1	-	-	-	Lawn
2.	Alternanthera	<i>Alternanthera spp</i>	0.5	0.5	0.2	50	Ground Cover
3.	Eucalyptus	<i>Euclalyptus spp</i>	10	6	4	25	Shelterbelt
4.	Teak	<i>Tectona grandis</i>	20	6	4	25	Shelterbelt
5.	Jacaranda	<i>Jacaranda filicifolia</i>	12	6	4	10	Shade
6.	Araucaria	<i>Araucaria heterophylla</i>	8	2.5	-	10	Specimen
7.	Agave	<i>Agave americana</i>	2	2	3	10	Specimen
8.	Albizia	<i>Albizia lebbek</i>	3	3	2	15	Specimen
9.	Queen of the night	<i>Cestrum nocturum</i>	3	6	4	20	Scent plant
10	Roses	<i>Hibiscus rosa-sinensis</i>	1.5	1.2	1	20	Scent plant
11	Aquatic plants	<i>Specified in plan</i>	0.8	0.5	0.2	50	Ornamental
12	Morning glory	<i>Ipomea learil</i>	-	-	-	10	Cripping
13	Africa never die	<i>Targetis erecta</i>	0.2	0.5	0.2	50	Bedding

14	Indian shots	<i>Cana indica</i>	0.2	0.5	0.2	50	Bedding
15	Green oleander	<i>Cascabela thevetia</i>	3.5	2	0.5	50	Border
16	Jos private	<i>Lantana camara</i>	3.6	0.4	1.5	50	Border plant
17	Sun flower	<i>Helianthus annus</i>	1.8	0.5	0.2	25	Bloom
18	Indian blood	<i>Prunus persica</i>	1.8	0.5	0.2	25	Bloom
19	Conifers (yellow)	<i>Chamaecyparis obtusa</i>	12	3	3	50	Avenue
20	Begonia	<i>Begonia obliqua</i>	0.2	0.5	0.2	50	Hedge
21	Pictum	<i>Athyrium niponicum</i>	2	1.8	1	100	Hedge
22	Chrysanthernums	<i>Chrysanthernums spp</i>	0.1	0.5	0.2	50	Hedge
23	Oleander	<i>Nerium oleander</i>	2.5	2	0.5	100	Hedge
24	Acalypha	<i>Acalypha spp</i>	3.6	0.4	1.5	100	Hedge
25	Pictum	<i>Athyrium niponicum</i>	2	1.8	1	100	Hedge
26	Ixora	<i>Ixora coccinea</i>	2	2.5	2	50	Hedge
27	Euonymus	<i>Euonymus spp</i>	1.2	1.2	0.5	50	Hedge
28	Croton	<i>Codiaecum variegatum</i>	1.2	1.8	1	100	Hedge
29	Yellow bush	<i>Duranta ruper</i>	1.2	1.2	0.5	100	Hedge
30	Thuja	<i>Thuja plicata</i>	8	3	2	40	Shrub
31	Terminalia	<i>Terminalia mantaly</i>	20	3.5	4	40	Shrub
32	Pine	<i>Pinus caribae</i>	4	3	3	20	Shrub

(Source: Authors'

Landscape Reclamation for Abandoned Mining Site for
Outdoor Recreation on the Jos Plateau

drawing, 2020)

Landscape Maintenance Plan

Maintenance is the work undertaken in order to keep, restore or improve a facility. Lack of proper maintenance of a facility or building leads to rapid dilapidation of the facility or building (Acquaah, 2009). Maintenance activities are activities meant to keep the environment beautiful and pleasing. These activities include: watering, mowing, fertilizer application, staking, weeding, pesticide application, mulching and provision of mechanical support (see Table 4).

Landscape Reclamation for Abandoned Mining Site for Outdoor Recreation on the Jos Plateau

Table 4: Phasing Programme for Maintenance Schedule

Operations	January				February				March				April				May				June			
Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Irrigation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*								
Lawns - Mowing												*						*		*		*		*
Weeding												*								*				
Blooms – replanting																		*						
Hedge Pruning																								*

Operations	July				August				September				October				November				December			
Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Irrigation													*	*	*	*	*	*	*	*	*	*	*	*
Lawns- Mowing		*		*		*		*				*				*				*				*
Shrubs- Weeding				*								*								*				
Blooms – replanting																								
Hedge – Pruning				*				*																

*= For irrigation it denotes three times a week, while for lawn mowing and shrub weeding it is once
 (Source: Authors’ drawing, 2020)

CONCLUSION

This paper discussed landscape development for an abandoned mining site for outdoor recreation on the Jos plateau. Field study had shown that mining activities and erosion are the major contributors to the degraded landscape of the community. More acute measures need to be put in place as more and more mines lay waste and pose as a threat to health and the environment at large. These measures need to be instigated by the relevant authorities who need to take responsibility for the duties assigned them. The design guidelines for reclamation according to Engler constitute bringing back the degraded land through human factors to an aesthetically functional space for the community. Landscapers have the mandate to advice stakeholders on sustainable approaches to reclamation that are long term and cost effective.

RECOMMENDATION

The authors recommend that the design guidelines discussed in this article could be replicated to all local government areas of the state to reclaim mining ponds to useful recreational facilities. A major hindrance with these projects is that they cost millions of naira to build and maintain. Alternative measures may be used to develop basic parks like the mixed used facility in Kuala Lumpur, Malaysia (Mine City) where natural resources are utilized from the existing quarry in creating a park. Literature review has indicated that reclamation plan should be implemented alongside mining plan for effective restoration after mining operation ceases. There is need for participation by the local private sector in the mining sector to build a whole eco-system that will boost capacity and improve productivity in the extractive industry.

The conclusions from this study create a basis for the improvement of our environment to make it more sustainable in line with the Vision 2030. This necessitates the following recommendations:

1. Measures should be put in place by all stakeholders NGOs (non-government organization), CBOs (community based organization), governments, both private and public developers to mitigate the effects and impacts of tin-mining exploitation and exploration on the environment.

2. Measures should be put in place to check and regulate building activities by the inhabitants in the absence of planning authority in the study area.
3. The areas should be constituted within the jurisdiction of the planning authorities both in the state and local government level to regulate artisanal mining activities to prevent similar occurrence in other areas;
4. Research institutions should be established to proffer solutions for environmental management of the derelict areas.

REFERENCES

- Acquaah, G. (2009). *Horticulture – principles and practices* (4th ed.). New Jersey: Pearson Education Inc.
- Archives of National Centre for Remote Sensing, Jos, 2007.
- Ayeni, D. A. (2012). Emphasizing Landscape Elements as Important Components of a Sustainable Built Environment in Nigeria. *Developing Country Studies* 2(8), pp.33-42
- Babanyara, Y.Y., Usman, H.A., & Saleh, U.F. (2010). An Overview of Urban Poverty and Environmental Problems in Nigeria. *Journal of Human Ecology*, 31(2), 135-143.
- Dağistanlı, C., Turan, I.D., & Dengiz, O. (2018). Evaluation of the suitability of sites for outdoor recreation using a multi-criteria assessment model. *Arabian Journal of Geosciences*. 11:492 doi.org/10.1007/s12517-018-3856-0
- Ediawe, J.R. (2011). *An Assessment of the Environmental Impact and Rehabilitation Practices of Artisanal and Small-Scale Miners in Okpella, Edo State, Nigeria*. Unpublished M.Sc. Thesis Institute for Development Studies University of Nigeria, Enugu Campus.
- Etukudo, I. (2000). *Forests: Our Divine Treasure*. Dorand Publishers. ISBN 978-001-924-3
- Ezeamaka, C.K., & Oluwole, O.A. (2016). Assessment of Recreational Facilities in Federal Capital City, Abuja, Nigeria. *Indonesian Journal of Geography*, 48(1), pp. 21 – 27
- Ladan, I.S. (2004). The phenomenon of land degradation in Nigeria: A review of effects and current solutions. *A Journal of Applied Science and Technology*. 6(1), 1-8.

- Lee, C.P., & Yeap, E. B. (2002). Reclamation after Tin Mining in Malaysia. Chapter 18. Retrieved from worldscientific.com on May 25, 2020 pp 211-221
- Mine Pit Lakes Stockton, Western Australia. Retrieved August 13, 2020 from www.preprints.org
- Mine Resort City, Kuala Lumpur Malaysia. Retrieved August 13, 2020 from http://en.wikipedia.org/wiki/Mine_Resort_City
- Mwangi, R (2015). *Redesigning the Reclaimed Landscape for Sustainable Recreation in Kayole*, Unpublished M.Sc. Thesis University of Nairobi, Kenya
- National Population Commission (NPC), (2008), 2007 population census figures. Abuja. Retrieved May 18, 2020 from www.population.gov.ng
- Ndace, J.S., & Danladi, M.H. (2012). Impacts of Derived Tin Mining Activities on Landuse/Landcover in Bukuru, Plateau State, Nigeria. *Journal of Sustainable Development* 5(5), 90-100
- Simon, F.R. (2015). *Prevalence and Usage of Open Recreational Spaces in Ibadan, Southwest Nigeria*. Unpublished Ph.D. Thesis, Covenant University, Ogun State, Nigeria.
- Sustainable Development Goals | UNDP. Retrieved August 12, 2019 from <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html>
- Sustainable Development Goals. Retrieved August 12, 2019 from https://en.wikipedia.org/wiki/Sustainable_Development_Goals
- Tourism BC. (2013). *2009/2010 Outdoor recreation study*. Retrieved April 23, 2020 from www.destinationbc.ca/getattachment/Research/Research-by-Activity/All-Research-by-Activity/Outdoor-Recreation-Study-2009-2010.