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Anthropogenic Activities and the Future of the Ampidong Crater Lake in Central Plateau, Nigeria

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Abstract: The Ampidong Crater Lake is surrounded by settlements whose members are predominantly farmers, the tradition of the settlers and traditional beliefs some years back prevented farming on the slopes of the hills and banks of the Crater Lake but with the advent of Christianity and increase in population farming on the slopes of the hills and banks and rearing of animals are now a practice. Those anthropogenic activities add nutrients to the water in the lake through surface run-off which is seen as the possible cause of eutrophication.The laboratory results of the total nitrogen (TN) and total phosphorus [TP] showed increased nitrogen and phosphorus levels. This leads to increase plant growth reducing the expose water surface area .The solution to the increased plant growth in the water body is to prevent farming activities on the hills slopes and banks of the crater lake before it turns into a bog or marsh with the final results if not controlled may end up as a dry land. Government can take over the land surrounding the lake, fenced it and make it a center for ecotourism.

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I. INTRODUCTION

Man through his desires to make life comfortable for himself has changed the natural appearance of the earth's surface either positively or negatively. Industrialization, urbanization and agricultural practices meant at improving the quality of human life has left in its wake a myriad of problems which include environmental degradation, pollution and changes in the scenic beauty of the biosphere. Issues of pollution, particularly surface water pollution has attracted a lot of attention over the years because of its adverse effects on man and the environment (Elesanmi, 2006).

The Ampidong Crater Lake has never dried up and since it is always having water in its vent, it sustains a lot of green vegetation mostly grasses. This makes the banks of the Crater Lake a good site for the grazing of animals during the dry season. Irrigation is also practiced around the leveled banks where water is withdrawn and used in nourishing the plants. This makes much of the water to be lost through consumptive use as observed by (Cunningham et al, 2007) where he saw irrigation as being the major consumptive use of water in most parts of the world as sited by (Samaila et al, 2019).

The fairly steep slopes of the Crater Lake are under tillage during the rainy season where maize, guinea corn and Irish potato are grown. Being steep slopes water and soil particles are washed down the slopes by surface runoff into the Crater Lake including chemical fertilizers and other agricultural chemicals used on the farms to promote crop yield.

The banks of the lake are cultivated during the dry season for the production of Irish potato, cabbage, lettuce and other vegetables. Chemical fertilizer, organic manure and other agrochemicals are applied to the crops and as the crops are being watered with water from the lake part of the water flows back to the lake with dissolved nutrients and other particulates. Leaching from deep down the soil profile will also introduce chemicals applied to the soil into the water body.

The continuous entry of nutrients especially nitrogen and phosphorous will lead to eutrophication leading to excessive growth of algae and plankton in a water body as cited by[Andersen, 1982, Miller 1994, Bechmann, 1998 and Anderson et al 2002). Eutrophication to them alongside global warming, ozone layer depletion and large scale environmental disturbance are seen as being anthropogenic.

The human activities around the lake are not only seen as contributing to siltation. A slight siltation in water can be seen as normal and healthy but when the level of siltation is high it impacts on water quality negatively. Siltation results from heavy surface run-off during or after precipitation leading to erosion and other land disturbing factors like agricultural practices, mining and road constructions etc. Other human practices like overgrazing and deforestation can cause soil erosion leading to sediment spill into water bodies.

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The study wants to unravel the causes of the excessive plant growth that in almost covering the greater surface of the exposed water body and the changes in the colour of the water possible as a result of sediment spills into the lakes water.

The works of (Chislock, Doster, Zitomer and Wilson, 2013) saw human activities as a major contributor of eutrophication in lakes. According to them human activities have accelerated the rate and extent of eutrophication through both point and non-point loading of limiting nutrients such as nitrogen and phosphorus into aquatic ecosystems leaving behind dramatic consequences for drinking water sources, fishes and recreational water bodies.

II. THE STUDY AREA

The lake covers an area of about 0.5 hectare land is about 5-6 meters deep (Dung gwom, Gontul, Baklit, Galadima & Gyang, 2009].The area once experienced a lot of volcanic activities.The lake is located on latitude 90^0 18N and 90^0 12 E and it stands at a height of 1200m above sea level. It is the only Crater Lake in West Africa.

The Ampidong Crater Lake just like other Crater lakes like the Crater Lake Oregon, Lake Tritriva (Madagascar) and Kelimutu Lake in Indonesia etc, has a legend just like other lakes regarding its origin. The Crater Lake is under the control of the Bwonpe people in Bwonpe District of Plateau State, Nigeria. A mysterious olive tree that got broken not under any human influence or a strong wind some few years ago was only plugged when ripe by the traditional chief of Bwonpe who would in the process be dropping some of the ripe fruits into the water body. If this was not done the olive tree will move to the center of the Crater Lake until the rule is met.

Since the formation of the Crater Lake swimming has never been allowed in the water body. History has it that even if you fetch the water in the Crater lake into a container it will not pour out of the container elsewhere until it is brought back to the Crater Lake. But with the advent of Christianity most of these legends have given way. Farming was prohibited around the banks and slopes of the Crater Lake by the owners of the Crater Lake. But today because of increase in population and the pressure on land, cultivation of the banks and slope of the Crater are common happenings.

The Crater Lake does not have any river entering it and no matter the heaviness of rainfall for the year the lake has never overflowed its banks and has never dried up even under brief spelt of drought. The only sources of additional recharge to the lake are direct precipitation from the atmosphere, surface run-off from the slopes and underground recharge while the possible sources of water lost will be through ground water discharge, evaporation on the water surface and leaves of plants and transpiration from the plants. The consumptive use of water by the fauna and flora communities in an around the lake will also account for some water lost.

The main occupation of the people surrounding the lake is farming. The Crater Lake is yet to attract government attention in developing it into a tourist site to promote ecotourism. Areola, Irueghe Ahmed, Leong and Adeleke (2020) mentioned the Ampidong Crater Lake as a major volcanic land forms, its location is in Ampang West and not Kerang as documented by the authors. The human activities around the lake might overtime affect the chemical and nutrient status of the lake, agreeing with what [Cunningham and Saigo, 1997] said that lakes sediments and nutrients loads can increase as tributary streams bring in sediments and nutrients that can stimulate plant growth. But the Ampidong Crater Lake does not have a stream or river flowing into it. The only possible source of sediments and nutrients come from overland surface flow and nutrients applied to crops produced on the banks and slopes of the Crater Lake.

It is hoped that the work of [Karen, 1990] that said that as a lake ages steadily gets filled in with sediments and organic matter, it becomes more eutrophic overtime and can eventually become a bog or mash an finally turning into a dry land will not be applicable to the Ampidong Crater Lake.

Chislock, Doster, Zitomer and Wilson [2013] see human activities as accelerating the rate and extent of eutrophication through both point source discharges and non-point loadings of limiting nutrients such as nitrogen and phosphorus into aquatic ecosystems. In the 1960s and 1970s, scientists linked algal blooms to nutrient enrichment resulting from anthropogenic activities such as agriculture, industry and sewage disposal [Schindler, 1974]. Agricultural practices within and near riparian areas can significantly degrade water quality through nutrient runoff, sedimentation and eutrophication, increased turbidity and habitat degradation which are potential risks to life and human health.

➢ *Aims and Objectives of the Study*

The exposed water surface of the lake is decreasing over the years by excessive plant growth, so the main aim of the study is to unravel the reason for this, while the specific objectives would be;

- To determine the Total Nitrogen (TN) concentration in the water through laboratory examination.
- To determine the Total Phosphorus (TP) concentration through laboratory examination.

III. MATERIALS AND METHODS

Different authors have specified different methods for testing eutrophication levels in water samples. The test method adapted will depend on the intended use for which the water is being tested for. Sterilized plastic containers were used in collecting water samples from the lake. The water samples were taken to the laboratory on the same day of collection to prevent changes in the chemical concentration of the water sample as suggested by (Hutton, 1983). The Total Nitrogen (TN) and Total Phosphorus (TP) were tested in the laboratory. The results gotten were then compared with the (United States Environmental Protection Agency, April 22, 2025) suggested values where the critical values for Total Nitrogen (TN) and Total Phosphorus (TP) in lake water that can trigger eutrophication are generally considered to be

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0.8mg/l for TN and 0.05mg/l for TP, though depending on the type of lake. Exceeding these thresholds according to them can lead to excessive algal growth thereby stimulating other aquatic floral growth. The lakes sampled by them had TN concentrations ranging from 0.59 to 5.95 mg/l with TP concentrations ranging from 0.04 to 1.22mg/l.

Table 1 TN and TP for 2020

MONTH	TN (m/l]	TP(m/l)
May	1.70	0.30
June	1.80	0.32
July	2.00	0.50
August	2.20	0.52
September	1.50	0.42

Average TN Value for 2020 = $\frac{9.2}{5}$ =1.84

Average TP value for 2020 = $\frac{2.06}{5}$ = 0.41

Laboratory result

Table 2 TN and TP for 2021

MONTH	TN (mg/l]	TP(mg/l)
May	1.54	0.65
June	1.70	0.72
July	1.30	1.10
August	1.35	1.25
September	1.20	1.05

Average TN value for 2021 = $\frac{7.09}{5}$ = 1.42

Average TP value for 2021 = $\frac{4.77}{5}$ = 0.95

Laboratory result

Table 3 TN and TP for 2022

MONTH	TN (mg/l]	TP(mg/l)
May	1.80	0.60
June	1.90	0.80
July	2.50	1.25
August	2.60	1.40
September	1.40	1.30

Average TN value for 2022 = $\frac{10.2}{5}$ = 2.04

Average TP value for 2022 = $\frac{5.35}{5}$ = 1.07

Laboratory result

Table 4 TN and TP for 2023

MONTH	TN (mg/l]	TP(mg/l)
May	1.50	0.45
June	1.70	0.85
July	1.80	1.30
August	2.40	1.42
September	1.90	1.25

Average TN value for 2023 = $\frac{9.3}{5}$ = 1.86

Average TP value for 2023 = $\frac{5.27}{5}$ = 1.05

Laboratory Result

Table 5 TN and TP for 2024

Months	TN(mg/l)	TP (mg/l)
May	1.80	0.65
June	1.90	0.75
July	2.10	1.20
August	2.30	1.35
September	1.80	1.25

Average TN value for 2024 = $\frac{9.9}{5}$ 1.98 mg/l

Average TP value for 2024 = $\frac{5.2}{5}$ 1.04 mg/l

Laboratory Result.

The laboratory results for the years 2020-2024 are plotted on a live graph to see their variations from the United States Environmental Protection Agency, April 22, 2025 values that can trigger eutrophication in lakes.

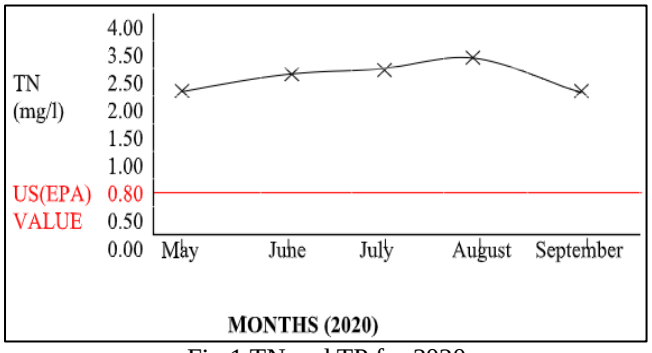
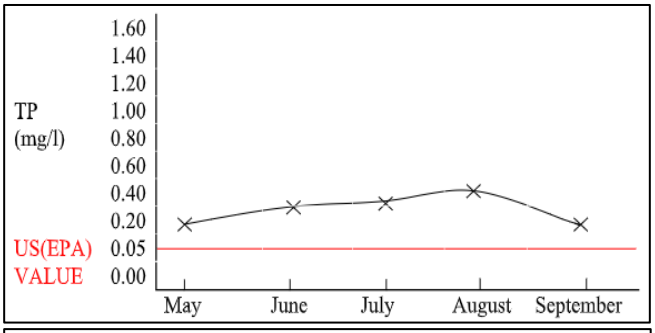
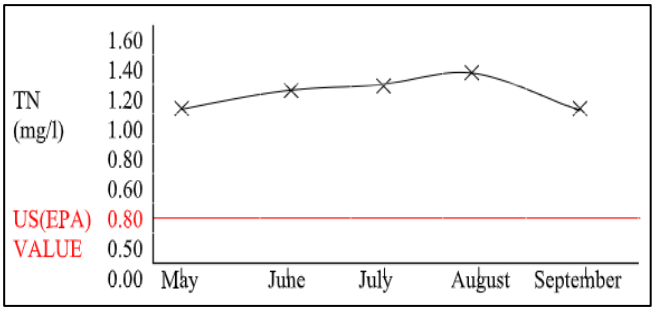


Fig 1 TN and TP for 2020





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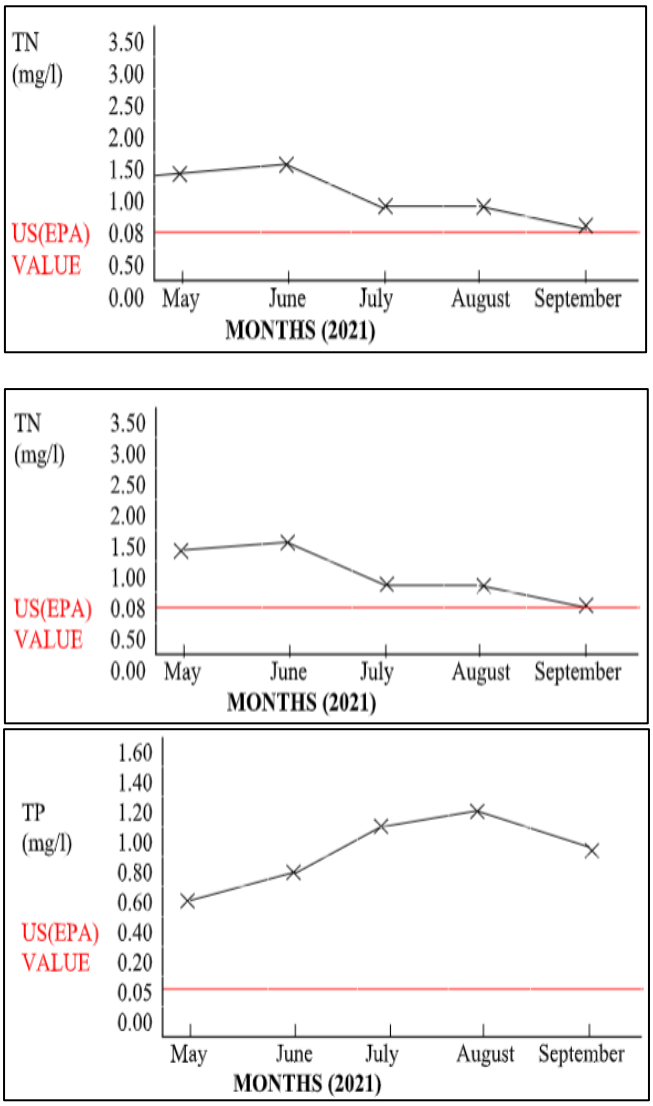

Fig 2 TN and TP for 2021

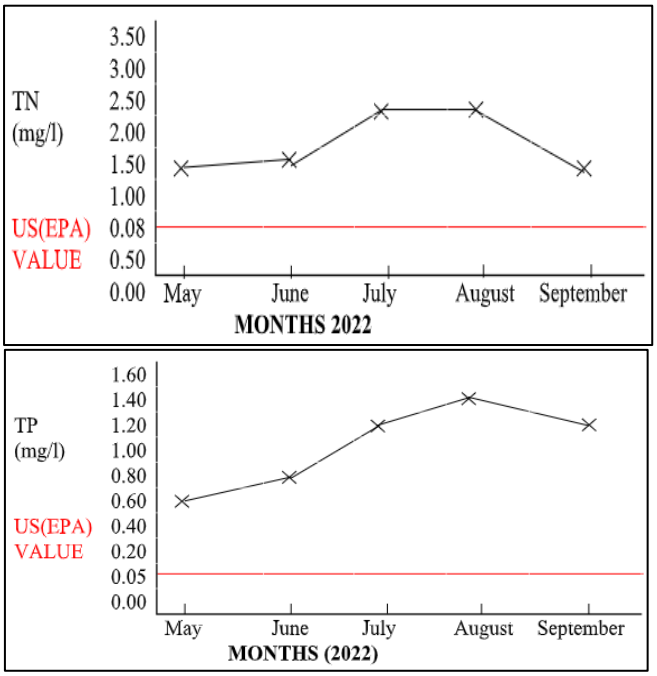

Fig 3 TN and TP for 2022

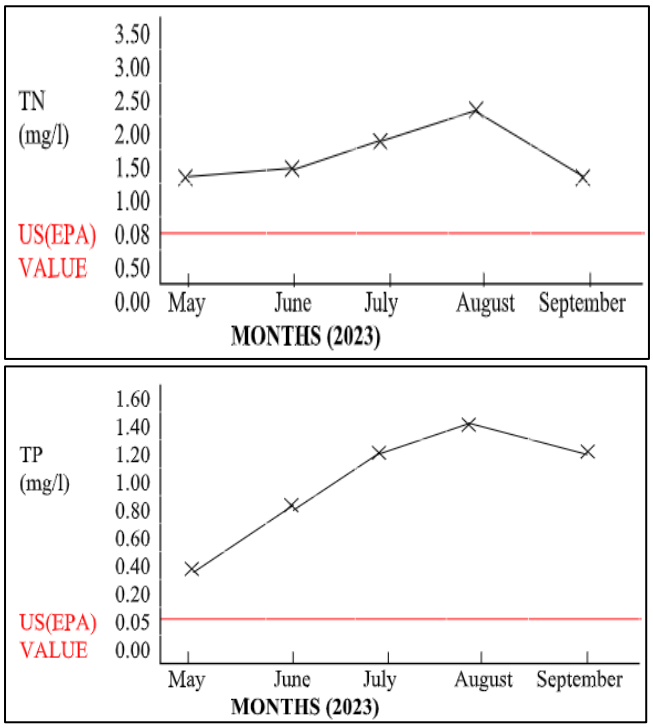

Fig 4 TN and TP for 2023

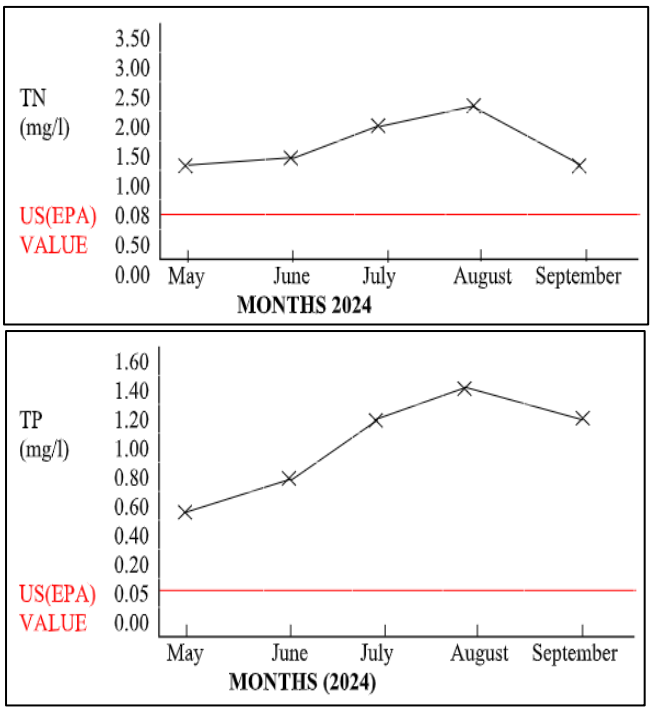

Fig 5 TN and TP for 2024

Looking at the plotted line graphs for the five years [2020 – 2024], the Total Nitrogen and Total Phosphorus are all above the critical values of 0.8mg/l for TN and 0.05mg/l for TP put forward by the United State Environmental Protection Agency [April 22, 2025] which to them, values exceeding these suggested thresholds can lead to excessive algal growth.

The continuous tillage of the banks and slopes of the Crater Lake and the raring of animals contribute nutrients in

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the water body, leading to algal growth and other floral growth. The eventual absence of the enforcement of the traditional practice of preventing farming and raring of animals around the banks and slopes of the Crater Lake have resulted from decay in traditional practices as a result of the advent of Christianity.

IV. CONCLUSION

Anthropogenic activities like the continuous tillage of the banks and slopes of the lake, rearing of animals and the application of chemical fertilizers, introduce nutrients and sediments and other agrochemicals through surface runoff and the decay of plants and animals parts that add nutrients to the water body. This produces and promotes eutrophication of the lake. The human activities around the Crater Lake are major sources of pollutants that enter the lake.

RECOMMENDATION

Based on the results of the research, the below recommendations are put forward.

Farming and rearing of animals around the slopes and banks of the Crater Lake should be prohibited to reduce the entry of agrochemicals and sediments into the lake.

Government can take over the Crater Lake and have it fenced to control human interference. This will reduce the entry of nutrients and sediments into the lake.

The number of people and educational institutions that come for sightseeing and exposure of students to some realities of nature can be used by the Plateau State government by making it an ecotourism site. This will be a source of revenue to the government being the only natural Crater Lake in West Africa.

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