IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 10, Issue 2 Ver. II (Feb. 2016), PP 12-17
www.iosrjournals.org

The Impact of Discharging Of Catfish Effluents on the Quality of Water in Lagos, Nigeria.

Omofunmi O.E.[1], Adewumi J.K.[2], Adisa A.F[2]., and Alegbeleye S.O[4].

[1.] *Department of Agricultural and Bio-Environmental Engineering, Yaba College of Technology, Yaba-Lagos, Nigeria*

[2] *Department of Agricultural Engineering, Federal University of Agriculture, Abeokuta, Nigeria.*

[3] *Department of Fisheries and Aquaculture, Federal University of Agriculture, Abeokuta, Nigeria.*

Abstract: *Catfish effluent discharged into environment partly infiltrated into the soil and partly percolates downwards to groundwater. Only physical and chemical parameters were examined. This study was conducted to assess the impact of catfish effluent discharged on the quality of receiving water sources in Lagos, Nigeria Five fish farms with high stock densities were selected from each district zone for detail study covering water quality indicators, such as dissolved oxygen, water temperature, turbidity, pH and micro nutrients which were measured in line with the APHA (2005) standards which are all critical for fish growth. Results shows that 75 % of the water samples tested recorded turbidity levels within the range of safe limit and corresponding values for pH of water were (7.70- 8.40), manganese (Mn) (0.11 – 0.12 mg/l) and Iron (Fe) (0.2 – 0.5 mg/l) which are exceeded the permissible values 7.0, 0.05 mg/l and 0.10 mg/l respectively. Different trend was however recorded with Cl^- (16.30 – 19.6 mg/l) having value less than the recommended standard.* ***The*** *results indicating the improper discharges of catfish effluents into the environment resulted in environmental contamination and thus rendered water unsafe for human consumption and recreational activities.*

Keyword: *Catfish, Contamination, Effluent, Environment, Fish farm, Water quality*

I. Introduction

Fish culture is an important part of the aquaculture industry in Nigeria. Adekoya *et al.*, (2006) found that varieties of catfish are the most commonly grown species among which are *Clarias gariepimus, Heteroclarias spp.*, and *Heterobranchus spp.*,to mention few. Others fish culture include Tilapias (*Oreochromis,niloticus,Sarotherodon galilaue, Tilapia guinessis, Heteriotis niloticus, Gymnarchus niloticus, Mugil cephalus* and *Chrysichys nitrodigitatus* to mention few. These species thrive better even over the prevailing harsh condition predominantly in the tropical fresh water such as the diurnal water pattern and oxygen limited surface water as a result of pollution. *Clarias geriepinus* has been a preference for culture among fish farmers due to its adaptability, low maintenance required, easy of multiplication and require less demand of water quality. Further, catfish has the ability to fix oxygen directly into water by coming up to the surface via respiration.

There are numerous publications on the subject of effluents, however, it is difficult to draw conclusions because of their unique characteristics both in terms of quantity and compositions that varies with water used, location, site composition(unlined pond, clay rich soil reduce seepage), and fish farm management practices to mention few. The common methods of discharge catfish effluents among the local fish farmers in Nigeria are land disposal and dilution technique, each with its corresponding advantages and disadvantages. Disposal effluent into a body of water or water course is known as disposal by dilution. There has been a great concern about the level of safety of surface and underground waters, especially in developing countries where there is an exponential increase in water pollution and an inefficient system of waste management. Hence, there is the need for continual research on the impact of pollution on the aquatic ecosystem.

The toxic effects of fish pond effluents on surface water has been highlighted earlier by Boyd (1990, 2001, 2003, 2005); Stickney, (2002); Omofunmi, (2014); Tucker and Robinson (1990), and Tomasso, (2002), that it produces offensive odour, impacts negatively on the aesthetic value of adjacent rivers. Characterization of fish farm effluents and quantification of their environmental impacts in aquaculture provides required information for effective waste management systems: generation, collection, transportation, storage, treatment and ultimate disposal which are not currently coordinated in Nigeria. Almost all the fish farmers were not treating their effluents before discharging into the environment in the study area. This was due to the following:

1. To avoid additional cost of production
2. Lack of facility to treat the effluents
3. Some fish farmers were not aware of the negative effects of pond effluents to the environment
4. The fish farmers assumed that the effluents discharged into environment were very small especially for small scales (subsistence) farming and that the effects was minimized.

Quality of water depends on the type of source (such as rainwater, surface water and ground water), type of terrains and habitats, dissolved substances, chemical, biological and others environmental factors that transported into it. Water quality can be judged from physical, chemical, biological and aesthetic points of view. Physical parameters for water quality are colour, turbidity, total suspended solids, temperature, conductivity and odour. Chemical parameters are pH, dissolved oxygen (D0), biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved ions and chemicals and Biological parameters are bacteria, algae, virus, coliform and other biological pathogens.

In Nigeria, it has been assumed that volume of discharged pond effluents into environment so small to produced negative effect and also assumed that the environment has ability to assimilate the discharged effluent. The impact of catfish effluent in an environment has not been studied in Lagos State, Nigeria. This study was conducted to assess the impact of catfish effluent discharged on the quality of receiving water sources in Lagos, Nigeria and come up with appropriate technical practice to reduce negative effects.

II. Materials And Methods

Information on the existing location of fish farms in Lagos State of Nigeria was collected from the Fisheries section of the Ministry of Agriculture, in the State, along with other relevant Fishing agencies. Fifteen out of the forty fish farms were used as pre-testing base on their site proximity to water source, effluents disposal, fish stock density and access located at Ikeja, Badagry, Ikorodu, Lagos Island and Epe divisions. Only five farms were finally picked for detail investigation and data were sourced by administration of questionnaire to local fish farmers, in-depth interviews and taken water samples from nearby open and deep wells to the laboratory for further examination.

2.1 Experimental Methods

Five ponds were selected based on the environmental (swampy and inter-land) and highest stocking density. Water samples were collected sources of during the transitional period of end of dry season to the beginning of wet season. Water samples were collected from the top and bottom at a depth of 15cm of each pond in the morning (10.00 am). Samples were also collected from the water source (borehole/shallow well). Samples collected in 250 ml glass bottle were analyzed for DO and BOD, and other samples were collected in sterilized 1-litre plastic bottles for other physiochemical parameters. The required quality parametric analyses were done next day. Measured physic-chemical water quality parameters were pH, Turbidity, Total suspended solids (TSS), Total alkalinity, Total hardness, Specific conductance, Chloride, Total nitrogen and Total phosphorus. pH was measured in situ using pH meter. The others analyses were conducted according to standard method are as presented in table 1. .All measurements were replicated four times.

2.2 Measurements

2.2.1 pH: The pH (Hydrogen ion concentration) value were measured directly by a pH meter by dipping the electrode into the pond water (APHA, 2005).

2.2.2 Total nitrogen (mg/l): 100 ml of filtered water sample was collected in Kjeldahl flask fitted with distillation unit. 1g of Magnesium oxide (MgO) was added and distillation started; 25 ml of distilled was collected. 1g of devards alloy was added to the remaining volume of the flask and distillation started again. 25 ml of distilled was taken taken in two sepwrate Nessler tubes and 0.5 ml Nessler reagent was added to each tube. The mixed solution started developing colour. This colour after 10-15 minutes was matched against colour discs of a Nesslenizer (BDH Nesslenizer). Nitrogen content (ppm) is expressed as follows:

Total nitrogen (mg/l) = umber of matching division of the standard dics × 100 × 0.01 (APHA, 2005).

2.2.3 Phosphorus (mg/l): 50 ml of filtered water sample was put in a nessler tube. 2 ml of sulphomolybdic acid and 5 drops of stannous chloride solution were added. The mixtures were mixed thoroughly. The developed blue colour after 3-4 minutes was compared with nesslenizer standard colour discs. The phosphate content (P_20_5) in ppm is expressed as follows:

Phosphorus (mg/l) = disc reading for 50 mm × 2 × 0.01 (APHA, 2005).

2.2.4 Suspended solid (mg/l): 50 ml of samples through pre – weighted glass fibre paper dried for 30 minutes and weighed again. The suspended solid content of the sample is the difference in the weight of filters. For a given sample location, the experiments were repeated three times and average reading were taken (APHA, 2005).

2.2.5 Biochemical oxygen demand (BOD_5): The BOD was determined by winkler's method. Water sample for BOD were collected at each location in 100 ml BOD bottles without agitating. The initial DO content is determined as stated; stopper was carefully removed. 1 ml each of sodium iodide (Nal) solution and magnesium Sulphate ($MgSO_4$) solution were added with aid of 1ml pipette, the stopper was replaced and the content was thoroughly mixed, 2.0 ml of concentrated Sulphuric acid (H_2SO_4) was added mixture, 50ml of the solution was titrated with 0.025 N of Sodium thiosulphate ($Na_2S_2O_3$) with starch solution as indicator of the colorless end point. After 5 days, incubated bottles, DO was determined using the above procedure

The BOD_5 (mg/l): Initial DO of sample – DO of sample after 5 day X 100 /ml of percentage of sample added (APHA ,2005).

2.2.6 Chloride: 20 ml of water sample was put into a porcelain dish by pipette and same amount of distilled water into a second dish for a colour comparison. 1 ml of potassium chromate indicator was added to each dish. Standard silver nitrate solution was added to the sample by burette drops by drops by drop with simultaneous gentle stirring with a glass rod till the color changed reddish

Chloride (mg/l): (ml of $AgNO_3$ used – 0.02) X 500 / ml of sample (APHA, 2005).

2.2.7 Iron and Manganese (mg/l): 10 ml of water sample was put in a glass bottle with stopper. 200ml of Zinc sulphate ($ZnSO_4.7H_2O$), ferrous sulphate ($FeSO_4.7H_2O$) and Manganese sulphate ($MnSO_4.H_2O$) solution was added and shake for 30 minutes with a mechanical shaker. Their respectively solutions were flamed using atomic absorption at a wavelength of 213.8 nm photometer which determined the cement atom. (APHA, 2005).

2.2.8 Specific conductance: 20 ml of water sample was put into Erlenmeyer flask and 80ml of distilled water was added. The mixture was placed on shaker for one hour and then filter through Whatman No.1 filter paper. The conductivity electrode was washed with distilled water and rinsed with standard KCL solution. EC was determined by dipped the conductivity meter into the solution. The conductivity is expressed n mmhos / cm. (APHA, 2005).

2.2.9 Turbidity (mg/l): Turbidity was determined by Jackson's turbidity. Water sample was put into calibrated glass tube which recorded the depth of the water. (APHA, 2005).

2.2.10 Alkalinity (mg/l): 100 ml of water sample was put into conical flask.3 drops of phenolphthalein indicator was added. Alkalinity of water sample was measured by titrated with 0.02N of Sulphuric acid.

Alkalinity (mg/l): 0. 02 of H_2SO_4 used X 1000/ ml of water sample (APHA, 2005).

2.2.11 Hardness (mg/l): 100 ml of water sample was put in a conical flask. 1 ml of Ammonia buffer and 6 drops of Eriochrome Black T indicator to the flask Wine red colour was developed and then titrated with standard EDTA solution till the colour changed from wine red to blue.

Hardness (mg/l): ml of EDTA used X N X 1000 / ml of water sample. (APHA, 2005).

2.2 Data Analysis

SPSS program version 17.0 was used for statistical analysis. Mean values of each parameter measured was compared using Duncan`s multiple range test. The statistical inference was made at 0.05 (5%) level of significance.

III. Results And Discussion

The pH values of water examined were higher than 7, indicating alkalinity which is good for fish rearing. About 75% of the water samples tested recorded turbidity levels above the limit (1.0 NTU) specified by WHO (2004).This was due to feed biomass containing large suspended solids that can inhibit sunlight penetration in the ponds. The deeper the pond, lower transmits of sunlight into water bodies. The mineral content of water samples was highly influenced by the catfish effluent discharge on the area. Manganese and iron were higher in concentration in most cases above the safe level (0.05 and 0.10 mg/l respectively) recommended by WHO. Different trend was however recorded for chlorides in all tested waters which were below (20.0 mg/l) the WHO (2004) guidelines. The high mineral content of most of the water samples are as shown in Table 2, this indicates leaching and transport of minerals from other sources from pond or as result of seepage / infiltration of pollutants from effluents discharged site when pond site contain soil of low water holding capacity. The water quality on swampy areas were significantly higher ($p \geq 0.05$) than that of inter-land. Natural disaster such as flooding can affect the nature and the magnitude of occurrence of this menace. Catfish effluents discharge imparts odour, taste, toxic chemicals on water sources if discharges untreated. Filtration and percolation of catfish effluents rendering the ground water contaminated. This was indicated by the changes in physical and chemical characteristics water quality in the immediate environment of the effluent discharged site and ultimately the physiology of aquatic animals. The negative impact of catfish effluent has no significant on water quality for fish production, but it renders water unsafe for human consumption and recreational activities. These findings agreed with the findings by earlier researchers (Boyd, 2003 and Tucker, 2000) that catfish effluents have negative impact on the quality of the receiving water when discharge is untreated. Figures 1a, 1b, 2a and 2b are the graphs of Boreholes and Shallow wells test result of physical and chemical properties at selected fish farm sites.

Table 2: The Average concentration of Physical and Chemical characteristics of Water Sample from Water Source in the selected catfish culture Farms

Parameters	Swamp areas: Borehole. B.Sw.	Swamp areas: Shallow well SW.Sw.	Inter- land: Borehole. B. Int	Inter- land: Shallow well W. Int	WHO* standard
pH (standard units)	8.50a	7.90b	8.40a	7.70b	7.00
Total solids (mg/l)	385.00a	550.00b	379.00a	538.00b	500
Specific conductance (µmhos/cm)	5.40a	7.80b	5.30a	7.60b	NA
Turbidity (NTU)	1. 3a	2.40b	1.20a	2.20b	1.00
Hardness (mg/l)	128.00a	272.00c	116.00b	252.00d	200
Nitrate (mg/l)	0.60 a	1.30b	0.50a	1.10b	0.45
Phosphate (mg/l)	0.01a	7.40b	0.01 a	7.10b	NA
Manganese (mg/l)	0.12a	0.12a	0.11a	0.11a	0.05
Iron (mg/l)	0.40a	0.50b	0.20a	0.30 b	0.10
Chloride (mg/l)	19.60a	18.80b	18.60b	16.30b	20.00
BOD_5	Nil	0.01	Nil	Nil	Nil

Sources of the water samples in selected catfish culture farms

Means indicated by the same letter did not differ ($P \geq 0.05$) according to Duncan`s multiple range test (horizontal comparisons only)

Key:

B.Sw = Borehole at swamp areas. B.Int. land = Borehole at inter-land

S.Sw = Shallow well at swamp areas S.Int. land = Shallow well at inter-land

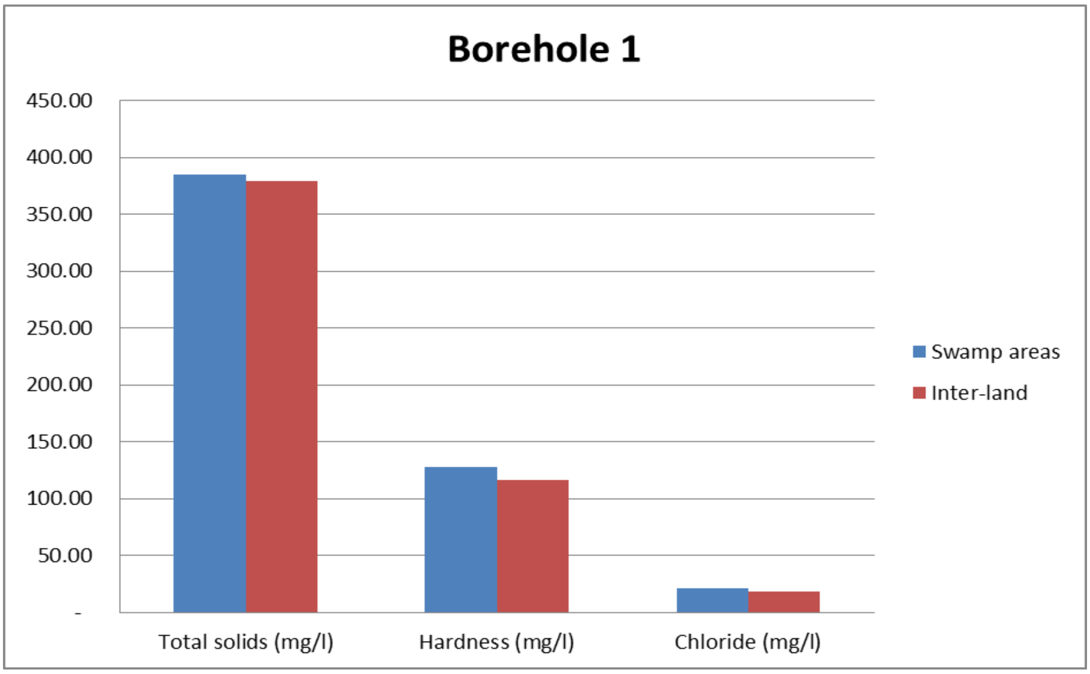

Fig.1a:Bar chart showing relationship between physical-chemical properties of borehole at swamp areas and inter-lands

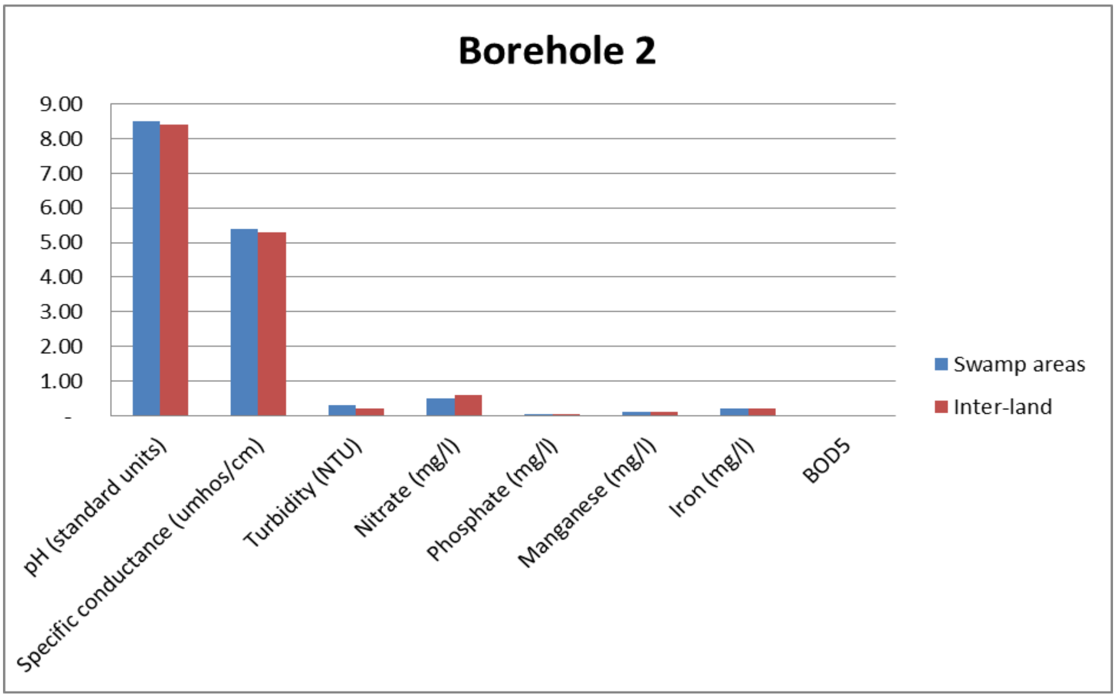

Fig.1b:Bar chart showing relationship between physical-chemical properties of borehole at swamp areas and inter-lands

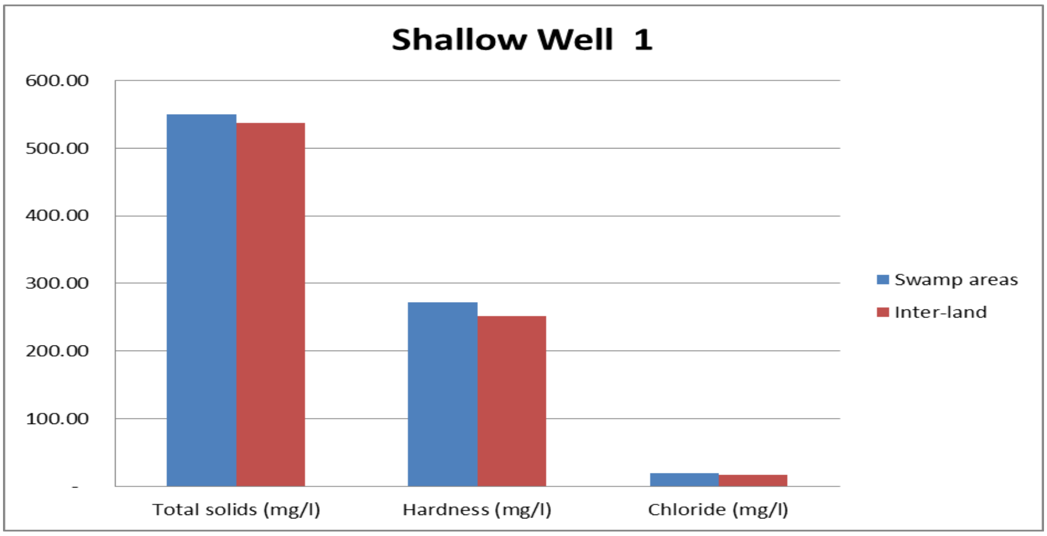

Fig.2a:Bar chart showing relationship between physical-chemical properties of shallow well at swamp areas and inter-lands

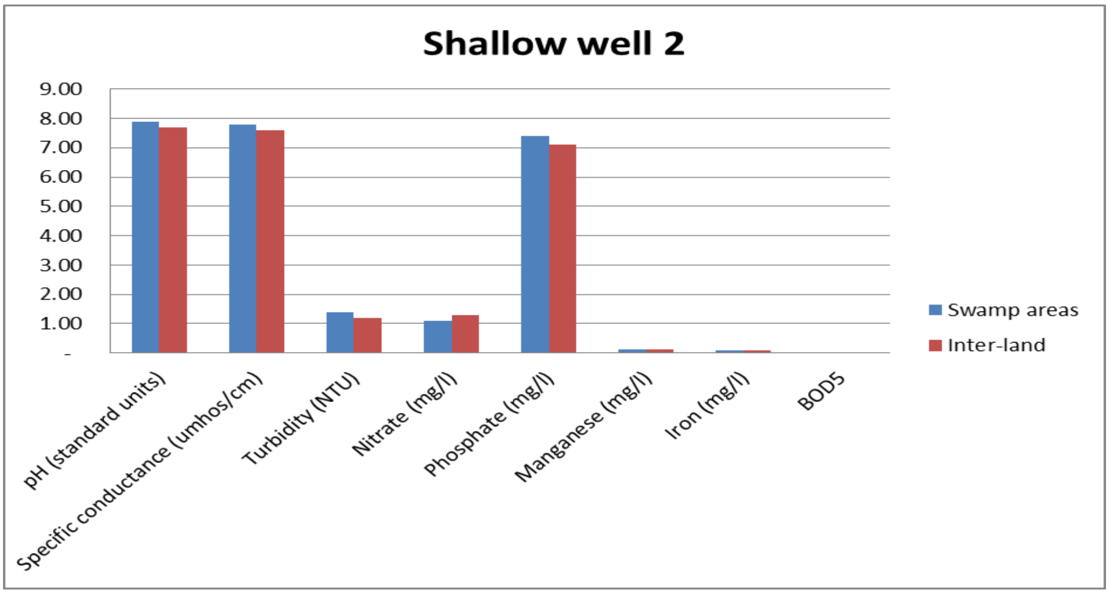

Fig.2b: Bar chart showing relationship between physical-chemical properties of shallow well at swamp areas and inter-lands

IV. Conclusions And Recommendations

The impacts of discharging of catfish effluents on water were investigated. The results of this study have shown that catfish effluents contaminant the water and also had an impact on water quality in the immediate environment of the discharged site. This was indicated by the changes in the water quality characteristics by macro and micro nutrients. The water qualities on swampy areas were significantly higher than that of inter-land. Almost of the water tested recorded turbidity, iron and pH levels above WHO (2004) specified limit. Catfish effluents discharging on bare soil surface should be discourage unless they are properly treated. Nutrients composition and effects of catfish effluent crop growth should be investigated. Biological parameters of water source should be investigated

Acknowledgements

I acknowledge the Nigerian Institute of Oceanography and Marine Research in water analyses**.** I also express my profound gratitude to Mr. T. O. Sanusi the secretary of Agricultural and Bio- Environmental Engineering Department,

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