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ASSESSMENT OF INORGANIC FERTILIZER ON FRESHWATER FISH CULTURE IN NIGERIA

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ABSTRACT

The application of inorganic fertilizers to aquaculture ponds has the potential to boost fish production. Pond fertilization makes available nutrients such as nitrogen, phosphorus, and other compounds to induce phytoplankton, forming the food web base to enhance fish production. The research was carried out to assess the performance of inorganic fertilizers in freshwater fish ponds. Catfish post fries with an initial mean weight of 0.045kg and N: P: K fertilizer of ratio 15:15:15 were used for the bi-weekly experiment, which lasted six weeks. Six aquaria (Tanks), each with an area of 60cm2 X 30cm2 X 30cm2 and a depth of 12.10cm, were used. Three out of six tanks were fertilized with N.P.K 15:15:15 at 0.05kg/ha, and the other three remained unfertilized and served as control experiments. The average pH of 6.77 in fertilized tanks was higher but better than the unfertilized tanks throughout the experimental period. The mean length-weight performance of Clarias gariepinus post fries was observed to be better in tanks fertilized compared to unfertilized tanks under both stocking densities. The water quality parameters in fertilized Tanks were significantly higher (P≤0.05) than the unfertilized ones for six weeks. Based *on this analysis, it became evident that pond fertilization with inorganic fertilizer could bring faster fish growth than unfertilized ponds, which would go a long way in enhancing and boosting fish culture.*

Keywords: Aquaria (Tanks), Inorganic Fertilizer, Assessment, Catfish Post-Fries, Water Quality Parameter

INTRODUCTION

Fish culture aims to produce high-quality food for human consumption and provide sufficient fingerlings to restock open waters and ponds. Fish culture also provides additional income to farmers and their families, alleviating poverty, particularly among the rural populace (Bamidele, 2007; Oladele, 2010; Boyd, 2018). The quest to enhance protein levels and supply to Nigerian people has mandated putting into use all available waters for rearing fish of different species (Gamal *et al*. (2014). Using and applying fertilizer, the unfit waters for aquaculture can be made fit and suitable for fish culture (Sebastian, 2015). This is possible because fertilizer application enhances pond primary productivity, directly or indirectly boosting fish production. (Boyd, 2018). Planktons are good supplements to artificially formulated feed because fertilized ponds can turn out fish that will reach market sizes in a few months, thereby fulfilling the sole aim of aquaculture, which is profit maximization in fish production (Adigun, 2005; Ovie *et al*., 1993; Adeyemo *et al*., 1994; Oladele, 2010).

It has been observed that the continuous utilization of fish ponds for rearing fish usually results in the removal of nutrients, causing low fertility. The physical and chemical parameters will also be affected beyond the range of aquaculture practice. Several studies have indicated the excellent performance of fish production through the abundance of plankton (Ovie *et al*., 1993; Oladele, 2010). This is not so with unfertilized ponds, as they are characterized by less productivity because of the unavailability of plankton. This study assessed the influence of inorganic fertilizer on Nigerian freshwater fish culture. There is an urgent need to increase fish production by applying inorganic fertilizer. These fertilizers have different proportions of nitrogen and phosphorus, potentially improving primary producers' quantity (Kumar *et al.,* 2014). The study compares the water quality properties of the unfertilized and fertilized aquaria and the fish length and weight improvement within six weeks.

MATERIALS AND METHODS

The Research was carried out at the Federal University of Technology Minna, Fisheries Laboratory, at Bosso in Minna, Niger State, Nigeria. The N.P.K (15:15:15) fertilizer for the experiment was bought from Minna Central Market, while the catfish of an initial weight of 0.045 kg were procured from the University fish farm. Six aquaria (tanks) were used, each with an area of 60 cm^2 by 30 cm^2 and a depth of 12.10 cm. The tanks were supplied with healthy water, and three out of six tanks were fertilized with N.P.K 15:15:15 at 0.05 kilograms, while the other three aquaria remained unfertilized as the control. Initially, *Clarias* post fries were fed with a supplementary diet of artemia twice daily and later changed to 0.2–0.5mm size of Coppen feed. The tanks subsequently received biweekly fertilizer applications after the tanks had been completely drained and refilled with fresh water. Temperature, dissolved oxygen level, pH, conductivity, hardness, and total alkalinity were experimented on one day before and after the tank's biweekly–fertilization. Temperature measurements were taken twice daily for water analysis using a Thermometer on a linear scale of degrees Celsius, while the fish growth was monitored biweekly, coinciding with fertilization days. The pH of the aquaria water was measured using an electronic pH meter. An electrical conductivity meter was used to measure the conductivity, while other parameters such as dissolved oxygen, total alkalinity, and hardness were determined through the chemical analysis method (Titration method).

RESULTS

Table 1 shows the interrelationship of the various parameters between fertilized and unfertilized water. It helps to explain the summary of the mean values, significant differences in physical and chemical properties, and the length-weight Fish performance in fertilized and unfertilized water. The water quality parameters considered in these analyses were pH, conductivity, hardness, total alkalinity, dissolved oxygen, and length-weight fish performance in the fertilized and unfertilized tanks.

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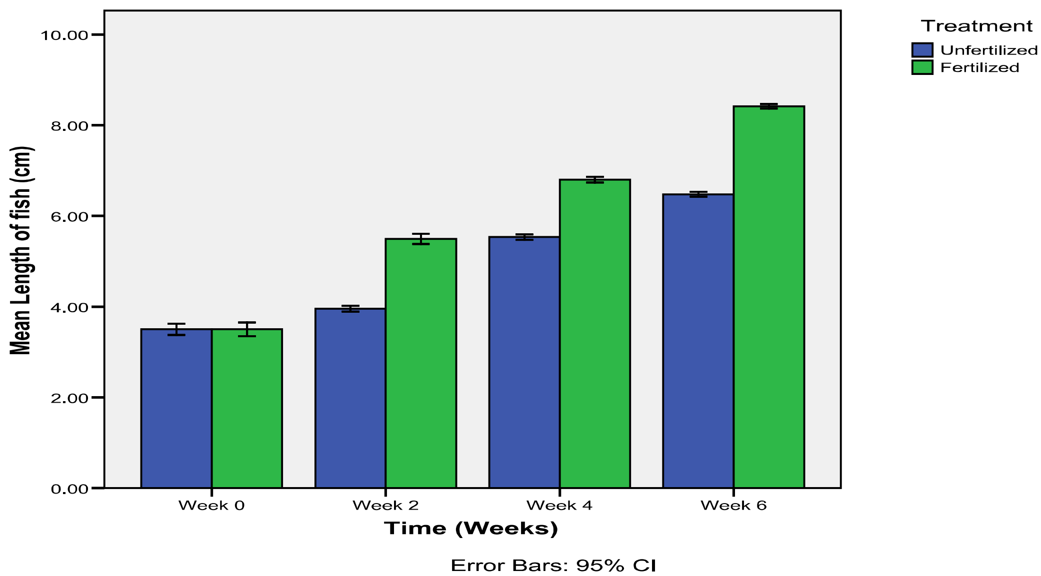

Figure 1: Mean Length (cm) of Fish of the Fertilized and Unfertilized Aquaria

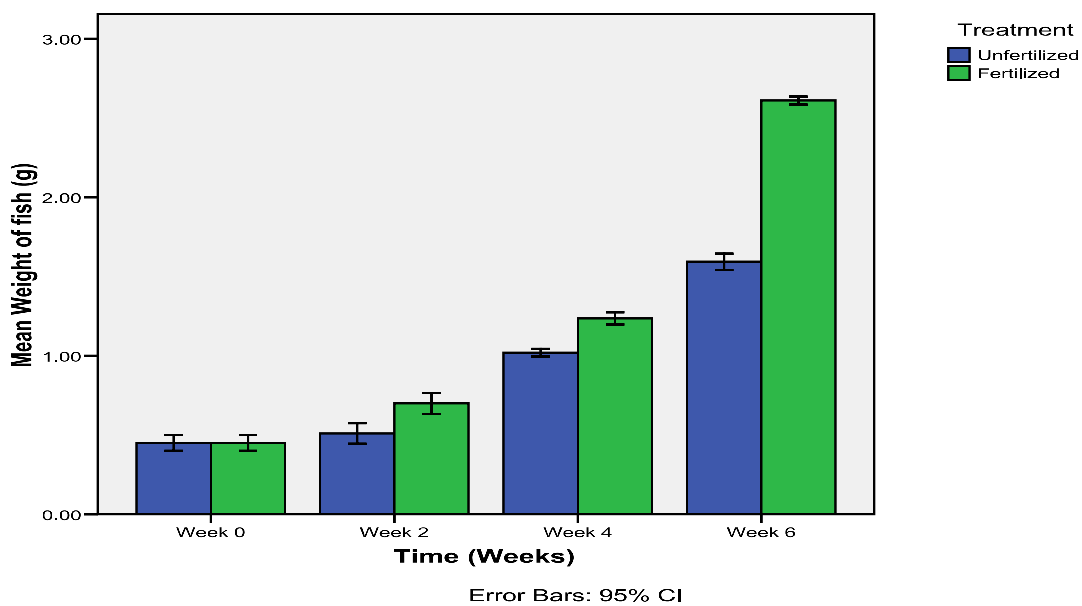

Figure 2: Mean Weight of Fish (g) of the Fertilized and Unfertilized Aquaria

Table 1: Total Summary of the Water Quality Parameters and Length–Weight Fish Performance of fertilized and unfertilized Tanks

(weeks)/ Properties	0	2	4	6	Average
pH					
Unfertilized	7.17 ± 0.015^{a}	6.86 ± 0.199^{a}	7.07 ± 0.020^{a}	6.90 ± 0.021^{a}	7.00 ± 0.155^{a}
Fertilized	6.73 ± 0.208^{b}	6.85 ± 0.050^{a}	6.60 ± 0.010^{b}	6.88 ± 0.030^{a}	6.77 ± 0.148^{b}
Sig.	0.023*	0.916	0.000*	0.330	0.001*
Conductivity(µs/cm)					
Unfertilized	146.40 ± 0.700^{b}	582.67 ± 15.535^{b}	703.33 ± 1.528^{b}	370.67 ± 1.155^{b}	450.77 ± 221.815^{b}
Fertilized	1574.00 ± 1.000^{a}	4530.00 ± 10.000^{a}	3440.00 ± 62.450^{a}	3046.67 ± 20.817^{a}	3147.67 ± 1106.085^{a}
Sig.	0.000*	0.000*	0.000*	0.000*	0.000*
Hardness (mg/l)					
Unfertilized	86.00 ± 2.000^{a}	108.33 ± 2.082^{a}	85.00 ± 1.000^{b}	85.73 ± 0.643^{a}	91.27±10.38
Fertilized	76.07 ± 0.0306^{b}	92.00 ± 0.200^{b}	150.07 ± 0.306^{a}	74.00 ± 0.400^{b}	98.03±32.21
Sig.	0.001*	0.000*	0.000*	0.000*	0.496
Total alkalinity (mg/l)					
Unfertilized	108.00 ± 4.000^{b}	106.67 ± 6.110^{b}	86.67 ± 6.123^{b}	31.20 ± 1.114^{b}	83.13±32.79
Fertilized	116.07 ± 2.403^{a}	151.93 ± 0.503^{a}	165.33 ± 4.163^{a}	140.33 ± 1.528^{a}	143.42±19.03
Sig.	0.040*	0.000*	0.000*	0.000*	0.000*
Dissolved oxygen(mg/l)					
Unfertilized	6.93 ± 0.503^{a}	9.33 ± 1.153^{a}	7.33 ± 1.155^{a}	4.00 ± 0.400^{b}	6.90±2.130
Fertilized	5.07 ± 0.115^{b}	8.40 ± 0.200^{b}	3.00 ± 1.000^{b}	7.67 ± 0.200^{a}	6.01±2.27
Sig.	0.003*	0.033*	0.002*	0.000*	0.218

Temperature (^0C)					
Unfertilized	24.90±1.054^a	26.04±0.055^a	24.23±0.058^b	24.03±0.058^a	24.80±0.933
Fertilized	26.50±0.600^a	26.10±0.100^a	25.07±0.513^a	24.27±0.252^a	25.48±0.982
Sig.	0.084	0.391	0.049*	0.193	0.095
Length of fish (cm)					
Unfertilized	3.50±0.050^a	3.96±0.025^b	5.53±0.025^b	6.48±0.021^b	4.87±1.251
Fertilized	3.50±0.062^a	5.49±0.045^a	6.80±0.026^a	8.42±0.021^a	6.05±1.882
Sig.	0.000*	0.000*	0.000*	0.000*	0.083
Weight of fish (g)					
Unfertilized	0.45±0.020^a	0.51±0.026^b	1.02±0.010^b	1.59±0.021^b	0.89±0.482
Fertilized	0.45±0.020^a	0.70±0.026^a	1.24±0.015^a	2.61±0.010^a	1.25±0.872
Sig.	1.000	0.001*	0.000*	0.000*	0.229

Key* significantly different at 95% confidence ($p<0.05$) values with the same letter are not significantly different from each other ($p>0.05$) values with different letter are significantly different from each other. R: replicate

In Table 1, the results showed that the unfertilised water with a neutral pH of 7.0 was significantly higher than that of the fertilised water with a slightly acidic pH of 6.77. The average conductivity of the fertilised water (3147.67µs/cm) was significantly higher than that of the unfertilised water source (450.77µs/cm). The fertilised water's total alkalinity (mg/l) was 7.17, significantly higher than that of the unfertilised water (4.17). The average dissolved oxygen for the whole week was insignificantly higher in the unfertilised water than in the fertilised water. In week 4, fertilised water temperature recorded a higher significance level than unfertilised water. Figure 1 shows the relationship between the length of fish (cm) and the period of growth (week) of the fish in the two treated water. Duncan multiple range test showed that at weeks 2, 4, and 6, the length of fish in fertilised water (5.49 cm, 6.80 cm, and 8.42 cm, respectively) was significantly higher than that of the unfertilised water (3.96 cm, 5.53 cm, and 6.48 cm, respectively). At week 0, the fish had the same length, 0.45 cm. Figure 2 shows the relationship between the weight of fish and the period of fish growth. Duncan multiple range test showed that at weeks 2, 4, and 6, the weight of fish in fertilised water of 0.70g, 1.24g, and 2.61g, respectively, were significantly higher than those in the unfertilised water (0.51 g, 1.02 g, and 1.59 g, respectively).

DISCUSSION

The average pH of 6.77 in fertilised ponds was high but better than the unfertilised tanks. The higher pH value recorded in fertilised ponds is in line with Boyd (2018), who reported that the application of ammonium and urea-based fertilisers can cause pond water to become acidic due to a high concentration of nitrification producing two hydrogen ions from each ammonium ion. Fish weight in fertilised tanks had a higher significance over those not fertilised, which agrees with the findings of Craig and Charles (2016), who reported that fertilised ponds could have fish yields three to four times over that of the unfertilised ponds. Results also showed that at weeks 2, 4, and 6, the lengths of fish in fertilised water (5.49 cm, 6.80 cm, and 8.42 cm, respectively) were of more significance than the unfertilised water of 3.96 cm, 5.53 cm, and 6.48 cm respectively. This agrees with Sebastian (2015), who reported that the specific growth rate of *Clarias gariepinus* post-fries was better in tanks fertilised than unfertilised tanks under both stocking densities. Sebastian (2015) also said that adding manures and fertilisers to the ponds for culturing fish can improve the level of phytoplankton responsible for fish growth. Notably, fertiliser plays a critical role in inducing plankton production, which serves as fish food organisms, promoting productivity and high yield in fish production. Using fertiliser to generate plankton for fish production is suitable for fish farmers, especially those who cannot afford the purchase of artificial fish feeds in adequate quantity that can sustain and enhance their fish culture. Since aquaculture generally aims to make a profit, fertiliser applied to the pond reduces the cost of feeding and will help the fish farmers make more profits in their fish farming business.

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