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ORIGINAL RESEARCH ARTICLE

Morphometric Analysis and Growth Patterns of *Oreochromis niloticus* (Linnaeus, 1758) in Tiga Dam and River Wudil, Nigeria

Akeem Babatunde Dauda[1]*, Ibraheem Kabir[2], Mansur Abdullahi Dambatta[3], Abdulsalam Muhammad Abdullahi[3], Kamisu Nuhu Muhammad[3] and Hauwa Ohunene Sadiq[4]

[1]Department of Fisheries and Aquaculture, Federal University Dutsin-ma, Katsina State, Nigeria
[2]Department of Fisheries Technology, Hassan Usman Katsina Polytechnic, Katsina, Nigeria
[3]Department of Fisheries and Aquaculture, Aliko Dangote University of Science and Technology Wudil, Kano State, Nigeria
[4]Department of Fisheries, Aquaculture and Wildlife, University of Abuja, Nigeria

ABSTRACT

This study examined the morphometric features and growth patterns of *Oreochromis niloticus* in Tiga Dam and River Wudil, Kano State, Nigeria. A total of 60 fish samples were collected over a period of three months (June to August 2024), with 10 fish per month from the two water bodies. The data was analyzed for length-weight relationship and condition factor, and the parameters were compared between the two water bodies using a T-test, with significance at $P<0.05$. The results showed marginal but not significant differences ($P>0.05$) in length, weight, and condition factor between the two populations. River Wudil had a slightly higher average length (13.16 ± 0.16 cm), while Tiga Dam had a slightly higher average weight (42.27 ± 1.91 g) and condition factor (1.94 ± 0.05). The length-weight relationship demonstrated strong positive correlations, with R^2 values of 0.70 for Tiga Dam and 0.77 for River Wudil. The growth exponents indicated negative allometric growth, meaning the fish become slimmer as they grow longer. The condition factor values suggested that the fish in both populations are in good condition. This study offers valuable insights into the growth patterns and health of the *O. niloticus* populations, supporting fisheries management and conservation efforts. Regular monitoring, conservation initiatives, and further research are recommended to ensure the sustainability of these populations.

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Oreochromis niloticus; morphometric characteristics; growth patterns; length-weight relationship; condition factor; Tiga Dam, River Wudil

INTRODUCTION

Fisheries play a crucial role in supporting the economic, nutritional, and social well-being of communities worldwide. It plays a vital role in national development and provides a livelihood for numerous individuals (Dauda *et al.*, 2016; Ubaid *et al.*, 2020). In Nigeria, Tilapia is a significant commercial fish species, widely distributed across various water bodies (Adewolu 2008; Dauda *et al.*, 2014). Recent studies have shown that Tilapia growth performance is influenced by various factors, including water salinity levels (Dawood *et al.*, 2023), feed quality and composition (Melaku *et al.*, 2021), and genetic materials (Nugroho *et al.*, 2024).

Tilapia encompasses around 100 species of cichlid fish, predominantly inhabiting freshwater environments such as ponds, lakes, and rivers, with some species tolerating brackish waters (Dauda *et al.*, 2014).

Length and weight are key parameters in describing biological growth, enabling the calculation of indices that measure biological well-being (Jenyo-Oni *et al.*, 2014). In fisheries science, assessing growth quality typically begins with determining the length-to-weight ratio of fish species (Demirel and Dalkara, 2012). This ratio is a crucial tool in fisheries science, particularly for population dynamics, ecology, and resource management (Salele *et al.*, 2023). Additionally, Dambatta *et al.* (2021) emphasized its importance in biology, ecology, physiology, and conservation. The condition factor of fish serves as a vital indicator of their physiological state and welfare (Jenyo-Oni *et al.*, 2014), while also helping to differentiate between populations influenced by varying food availability and climate conditions (Dan-kishiya *et al.*, 2018). As a crucial parameter, condition factor enhances our understanding of fish life cycles, informing effective management strategies and ecosystem balance (Imam *et al.*, 2021). The usual approach to studying the biological condition of fish species is to study a single water body at a time. Dambattat *et al.* (2021) documented the condition of *O. niloticus* in River Wudil, while Salele *et al.* (2023)

Correspondence: Akeem Babatunde Dauda. Department of Fisheries and Aquaculture, Federal University Dutsin-ma, Katsina State, Nigeria. ✉ tdabak@gmail.com.

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reported the status of Cichlids in Zobe reservoir, Katsina State. While these studies provided useful information, comparing more than one population within the same region will definitely provide more robust output and help to understand if the occurrence in a water body is an isolated situation or it reflects the status of a whole region, which might call for a more intense management approach. Therefore, this study examined the length-weight relationship and condition factor of *O. niloticus* in Tiga Dam and Wudil River, with a view to understanding the status of the fish species in Kano State and providing useful data for sustainable fisheries management.

MATERIAL AND METHOD

Study area

Tiga Dam

Tiga Dam, situated in Bagauda under Bebeji Local Government in Kano State, Northwestern Nigeria, is a significant water body rich in diverse fish species (Abdulrahman *et al*., 2020). Kano State, spanning 20,709 square kilometers, lies within the Sudan savannah zone and has a population of approximately 9,383,682 inhabitants, primarily Hausa and Fulani, with agriculture being the major source of employment (NPC, 2007). The state's climate is characterized by mean daily maximum and minimum temperatures of 33.1°C and 15.85°C, respectively.

Wudil River

Wudil Local Government Area in Kano State, Nigeria, is situated approximately 44 km from Kano City along the Maiduguri road (Adebayo and Oladipo, 2018). The area's geographical coordinates are 11° 49' N latitude and 8° 51' E longitude. Fishing and sand mining are significant occupations for the local population due to the presence of River Wudil, which is a tributary of River Hadejia (Iloeje, 2001). River Hadejia is part of the larger Hadejia-Jama'are river system, occupying a total land area of approximately 16,386.01 km² within the Chad Basin (Dambatta *et al*., 2021).

Data collection

A total of 60 *Oreochromis niloticus* samples were collected from Tiga Dam and River Wudil in Kano State, Nigeria, over a three-month period (June to August 2024). Sampling was conducted every two weeks, with 10 fish specimens collected from each location (Tiga Dam and River Wudil) during each sampling event, totaling 20 fish per sampling event (10 fish/location × 2 locations) and 60 fish over the entire study period (20 fish × 3 sampling events). Fish samples were obtained from fishermen using gillnets and traps at landing sites and immediately chilled in ice blocks before being transported to the laboratory of the Fisheries Department at Aliko Dangote University of Science and Technology, Wudil, in plastic containers for further analysis.

Laboratory analysis

The fish samples were gently blotted dry with filter paper to remove excess water from their body surfaces. The total length (TL) of each specimen was measured using a metre rule to the nearest 0.01 centimeters. The TL was defined as the distance from the tip of the snout to the end of the caudal peduncle. Following measurement, each fish was weighed using a top-loading Mettler balance (LP502.A) to the nearest 0.01g after excess water was removed with filter paper. One person did all the measurements to avoid variations due to multiple hands.

Length - weight relationship

The length-weight relationship was determined using a conventional formula (Le Cren 1951)

$$W = aL^b$$

Where W = Weight of fish in grams

L = Length of fish in centimeters

a = exponent describing the rate of change of weight with length (=the intercept of the regression line on the Y axis.

b=the slope of the regression line (also referred to as the growth coefficient)

The length-weight relationship was analyzed using the logarithmic transformation of the equation W = aL^b, which becomes:

$$Log\ W = Loga + bLogL$$

Where:

W = weight of the fish in grams, L = length of the fish in centimeters, a = constant (intercept),

b = exponent (slope)

Condition factor

The condition factor (K) was calculated for individual fish using the conventional formula (Ricker, 1975):

$$K = \frac{W\ x100}{L\hat{}3}$$

Where:

K = condition factor, W = weight of the fish in grams, L = length of the fish in centimeters

Data analysis

The morphometric data were presented using descriptive statistics, while an independent sample T-test was used to compare the means of the parameters (at $P<0.05$) between

the two water bodies. Simple linear regression was used to analyse the length-weight relationship of the fish.

RESULTS

The morphometric analysis of *Oreochromis niloticus* from Tiga Dam and River Wudil is shown in Table 1. The fish from River Wudil had a slightly higher mean length (13.16 ± 0.16 cm), whereas those from Tiga Dam had slightly higher mean weight (42.27 ± 1.91 g) and condition factor (1.94 ± 0.05). Nevertheless, these differences were not significantly different (P > 0.05) (Table 1). The length-weight relationships are presented in Figures 1 and 2, and Table 2. The coefficient of determination (R^2) was 0.70 for *O. niloticus* Tiga Dam and 0.77 for *O. niloticus* from River Wudil. The growth exponents (b) were 2.75 for the fish from Tiga Dam and 2.55 for those from River Wudil, both indicating negative allometric growth.

Table 1: Length, Weight, and Condition Factor of *Oreochromis niloticus* from Tiga Dam and River Wudil

	TIGA DAM	RIVER WUDIL
Length (cm)	12.91 ± 0.18	13.16 ± 0.16
Weight (g)	42.27 ± 1.91	42.23 ± 1.45
Condition factor, K	1.94 ± 0.05	1.84 ± 0.03

*mean±SD, n=30
Different letters as superscript across the rows indicate significant differences (P<0.05)

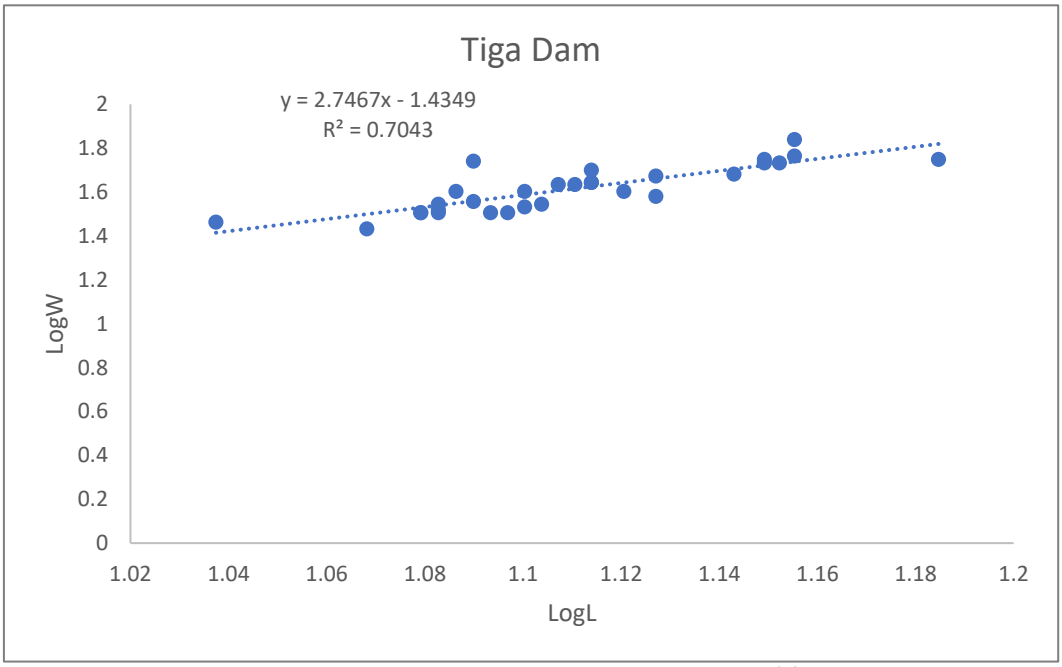

Figure 1: Length-weight relationship of *Oreochromis niloticus* in Tiga dam

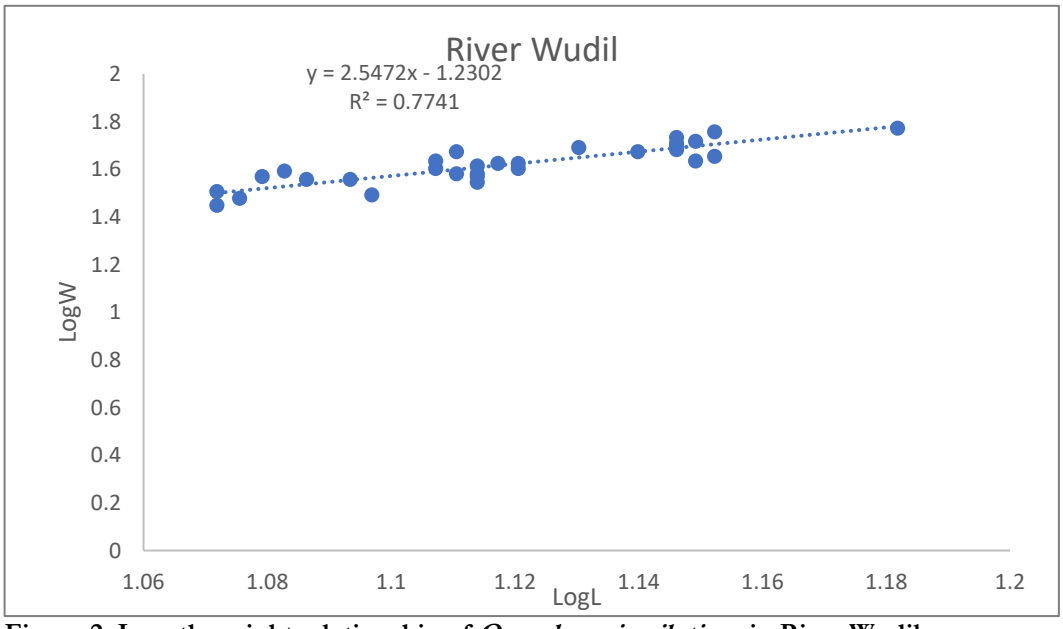

Figure 2: Length-weight relationship of *Oreochromis niloticus* in River Wudil

Table 2: Length-weight relationships of *Oreochromis niloticus* in Tiga dam and Wudil River

	TIGA DAM	RIVER WUDIL
A	1.43	1.23
B	2.75	2.55
R^2	0.70	0.77
Growth type	Negative allometric	Negative allometric
LWR Equation	LogW = 2.75LogL - 1.43	LogW = 2.55LogL - 1.23

DISCUSSION

The length-weight relationship is a crucial aspect of fisheries research, providing insights into growth patterns and well-being (Froese *et al*., 2019). The morphometric analysis of *Oreochromis niloticus* from Tiga Dam and River Wudil revealed variations in length, weight, and condition factor, although these differences were not statistically significant ($P > 0.05$), suggesting that the populations may not be drastically different (Salele *et al*., 2023). The coefficient of determination (R^2) values of 0.70 for fish from Tiga Dam and 0.77 for fish from River Wudil indicate a strong positive relationship between length and weight. Similar findings have been reported in other studies (Adebayo *et al*., 2020; Adeyemi *et al*., 2022). The mean length was slightly higher for *O niloticus* from River Wudil (13.16 ± 0.16 cm), while the mean weight and condition factor were higher for the fish from Tiga Dam (42.27 ± 1.91 g and 1.94 ± 0.05, respectively). These findings are consistent with previous research on *O. niloticus*, which has shown variations in morphometric characteristics across different environments (Dauda *et al*., 2021; Jenyo-Oni *et al*., 2014). The growth exponents (b) of 2.75 for the fish from Tiga Dam and 2.55 for those from River Wudil reflected negative allometric growth, which is consistent with findings from other studies (Lawal *et al*., 2023). Negative allometric growth can be attributed to environmental conditions, food availability, and genetic factors. This growth pattern suggests that the fish become more slender as they increase in length.

The condition factor, in particular, is a crucial parameter in understanding fish physiology and welfare (Jenyo-Oni *et al*., 2014). The mean condition factor values suggest that the fish in both populations are in good condition. A condition factor value above 1 is commonly considered indicative of good condition, indicating that the fish are robust and healthy. The condition factor (K) is an indicator of well-being and robustness (Bolger and Connolly, 1989; Blackwell *et al*., 2020).

The condition factor of fish can be influenced by factors such as water quality (Béné *et al*., 2015), food availability (Kolding and van Zwieten, 2016), and habitat characteristics (Lorenzen, 2016). The lack of a significant difference in condition factor between the two populations ($P > 0.05$) suggests similar environmental conditions, as noted in other studies (Julius *et al*., 2025). The results of this study have implications for the management and conservation of *O. niloticus* in both Tiga Dam and River Wudil. Understanding the morphometric characteristics and growth patterns of fish populations is essential for developing effective management strategies. The findings of this study can inform fisheries management decisions, such as setting size limits for catch and developing conservation plans.

CONCLUSION

The morphometric analysis of *Oreochromis niloticus* from Tiga Dam and River Wudil revealed non-significant variations in length, weight, and condition factor, indicating the population in the two water bodies shared similar conditions. The length-weight relationship showed a strong positive correlation, and the growth exponents indicated negative allometric growth. The condition factor values suggested that the fish in both populations are in good condition. The study recommends continuous monitoring of the biological condition of the fish populations in the two water bodies and continuous education of the fisherfolk on the gear used to ensure sustainable harvest.

ETHICAL PERMITS

The research was carried out in compliance with local ethical standards as approved by the ethical committee of Federal University Dutsin-Ma, Katsina State, Nigeria.

DATA AVAILABILITY

Data is available with the corresponding author, and it will be made available on request.

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