

GROWTH PATTERN AND MORPHOLOGICAL FEATURES OF NILE PERCH (*Lates niloticus*, Linnaeus, 1758) IN KANYE DAM, KANO STATE

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ABSTRACT

Lates niloticus is widely spread in most African waters and despite the wide geographic distribution of this species, only few studies have been conducted on its growth pattern and morphological characters within localized environments in Nigeria. This study examined the growth pattern and morphological features of Nile perch (*L. niloticus*) in Kanye Dam, Kano State, Nigeria. A total of 60 specimens were randomly collected and analyzed using standard morphometric techniques. Measurements include total length (TL), standard length (SL), head length, body depth, and body weight. The length-weight relationship was established using the power regression model, while the condition factor (K) was determined to assess the well-being of the fish population. Males exhibited negative allometric growth ($b < 3$), females showed positive allometric growth ($b > 3$), and combined sexes displayed negative allometric growth. The condition factor (K) varied between 0.923 and 3.375, with males having significantly higher mean K value than females and the combined sexes. Regression analyses showed strong linear relationships ($R^2 > 0.90$) between total length and most morphometric traits, indicating proportional body development. Male specimens had total length ranging from 6.70 cm to 51.20 cm, while females ranged from 13.30 cm to 25.50 cm. Findings indicate that *L. niloticus* in Kanye Dam is predominantly young, actively recruiting, in good condition and exhibiting sex-related growth differences showing ecological influences. This study has broadened knowledge on growth patterns and morphological features of *L. niloticus* in Kanye Dam, informing fisheries management in similar African reservoirs.

Keywords: Nile Perch, length-weight relationship (LWR), condition factor, morphometric characteristics, Kanye Dam

INTRODUCTION

The Nile perch, *Lates niloticus* (Linnaeus, 1758), is among the largest freshwater fishes of economic and ecological importance in Africa. It can reach length of up to 200 cm and weight exceeding 200 kg (U.S. FWS, 2014). According to Froese and Pauly (2023), it belongs to the family Latidae and is widely distributed in major river and lakes such as the Nile, Congo, Senegal, Niger, Lake Chad, Volta, and Lake Turkana basins. This species is primarily carnivorous and plays a major role in shaping the fish community structure within its habitat. The Nile perch is characterized by a streamlined body, large mouth, and silvery coloration with a bluish-grey dorsal surface, all these are key features that make it an effective predator in aquatic ecosystems (Snoeks, 2000).

In the 1950s, the species was deliberately introduced to Lake Victoria from Lakes Albert and Turkana to boost fishery yields (Pringle, 2005). By the 1980s, its population had adapted well and exploded, turning it into a key commercial fish as pointed out by Kitchell *et al.*, (1997). This is further supported by FAO (2022), which highlights its role in one of Africa's largest inland fisheries. However, the Nile perch's strong predatory nature caused major ecological problems. It led to serious imbalances in the ecosystem and played a big role in the dramatic decline of many native fish species in Lake Victoria (Witte *et al.*, 1992). This clearly show how fast *L. niloticus* can adjust to a new ecological condition across Africa, attributed to its remarkable ability to change its body shape, behavior,

and physiology when needed. This flexibility is one of the key reasons the species has thrived so widely.

Study of the morphological features of fish populations helps us understand how species adapt to their surroundings, how they grow, and how they are related to each other in terms of taxonomic classification (Widayati *et al.*, 2024). Muchlisin *et al.*, (2010) reported that morphometric and meristic traits are largely genetically determined, while Masood *et al.*, (2015) further demonstrated that these characteristics are also modified by environmental factors such as temperature, water quality, food availability, and habitat structure. When fish from the same species show differences in these traits across various groups, it usually points to how they have adjusted to local environmental challenges or specific survival pressures in their area (Akter *et al.*, 2019). This kind of research help assess genetic diversity within populations, understand growth patterns, and defining stock boundaries all of which are fundamental to managing fisheries in a sustainable way.

Morphometric studies have long been used as a practical and cost-effective method for identifying population variations in fish (Turan, 2004). They provide details on how environmental and biological factors shape body form and functional morphology. For *L. niloticus*, these studies can reveal how individuals adjust morphologically to local habitat conditions, including those influenced by human activities, climate, and water quality.

Ayoade (2011) noted that although *L. niloticus* is widely distributed across African waters, there has been relatively little literature on its growth and morphological characterization within localized Nigerian aquatic systems, a gap that Dan-Kishiya (2022) further highlighted especially for aquatic environments in Kano State. Kanye Dam, a key reservoir in the region, homes a range of fish species and plays a key part in supporting livelihoods through fishing, irrigation and other uses (Gaya *et al.*, 2023). The lack of focused research on Nile perch growth pattern and morphology here represents a notable gap, particularly given the potential for unique adaptations to the dam's distinct conditions.

This study was therefore undertaken to address this gap by examining the growth pattern and morphological characteristics of Nile perch in Kanye Dam, Kano State. The objectives were to analyze the relationships between different morphometric measurements and the fish's total length; estimating the length-weight relationship; size frequency distribution and assessing the condition factor. These analyses will establish facts on population structure, growth patterns, and health status, offering baseline data to inform future monitoring and promote sustainable management of fisheries in the area.

MATERIALS AND METHOD

Study Area

This study was conducted at Kanye Dam, located in Kabo Local Government Area of Kano State, Nigeria (latitude 11°57'N and longitude 8°08'E). The dam lies within the Sudan savanna ecological zone characterized by two distinct seasons: a rainy season from May to October and a dry season from November to April (Yamusa and Abdulkadir, 2020; Fabeku and Okogbue, 2014). Kanye Dam was constructed in 1969 and commissioned in 1970. It also covers an estimated surface area of 11.31 km² with a total storage capacity of 24.60 million m³, an active capacity of 21.53 million m³, and a dead storage of 3.07 million m³ (Akinjogunla and Ipinmoroti, 2025; Abdullahi *et al.*, 2018). The dam receives inflows mainly from River Guzu-Guzu and River Kanyan Maja and is located approximately 50 km northwest of Kano city along the Kano-Gwarzo road (Meye and Ikomi, 2008). It serves multiple purposes, including irrigation, fisheries, domestic water supply, and flood control, and its ecological diversity and accessibility make it an ideal site for studying the morphological feature of fish species (FAO, 2014).

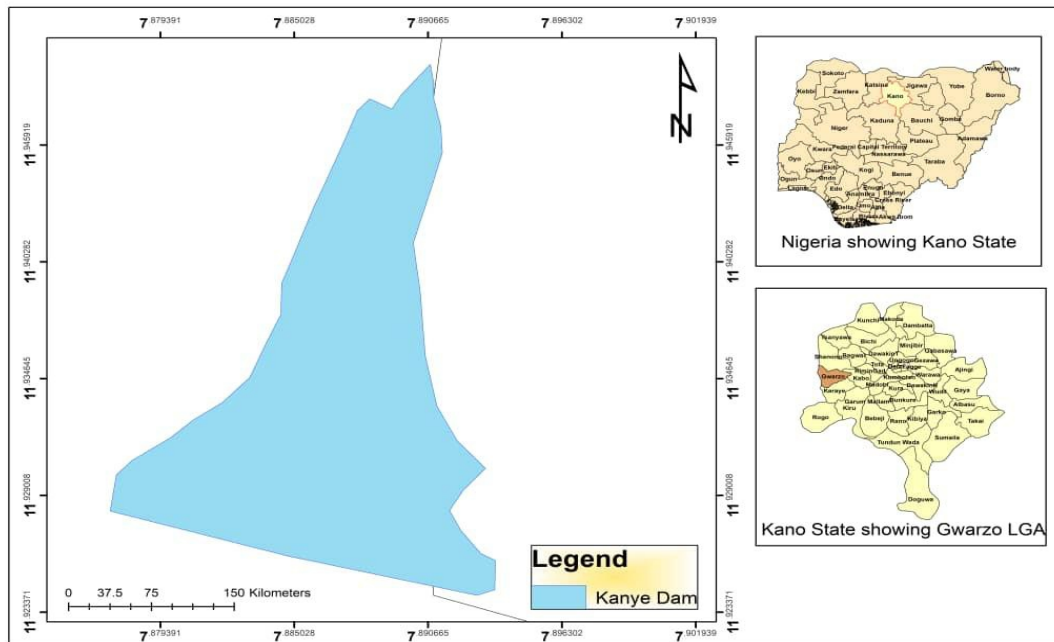


Fig. 1: Map of Kanye Dam showing the sampling site. Source: GIS Lab, Centre for Dryland Agriculture, Bayero University Kano (2024).

Table 1: Description of the various Morphometric features used for the study



Morphometric Characters	Description
Standard Length (SL)	Length from the tip of the fish snout to the base of the tail fin.
Total Length (TL)	Length from the tip of the snout to the tip of the tail fin.
Body Depth (BD)	The depth of the body at its widest point
Weight (W)	Using a calibrated scale to weigh the fish.
Body Depth at Anus (BDA)	Vertical distance between the body margins through the posterior boarder of the anal opening.
Eye Diameter (ED)	Length between the anterior and posterior walls of the bony orbit.
Eye Length (EL)	Length between upper and lower walls of the bony orbit.
Snout Length (SnL)	Length from the tip of the snout to the anterior margin of the orbit.
Head Length (HL)	Length from the tip of the snout of the posterior bony extremity of the operculum.
Head Width (HW)	Length between the margins at the widest area of the head between the opercula on either side.
Mouth Gape (MG)	Length between the angles of the mouth.
Dorsal Fin Length (DFL)	Distance from the base of dorsal fin to the tip
Caudal Fin Length (CFL)	Distance from the base to the tip of the caudal fin.
Pectoral Fin Length (PEFL)	Distance from the base to the tip of the pectoral fin.
Pelvic Fin Length (PFL)	Distance from the base to the tip of the pelvic fin.
Pre -Pelvic Distance (PPD)	Length between the tip of the snout and the insertion of the first ray of the ventral fin.
Pre-Anal Distance (PAD)	Length between the tip of the snout and the insertion of the first ray of the anal fin.
Pre-Dorsal Distance (PDD)	Length from the tip of the snout to the structural base of the first dorsal fin ray.
Pre-Pectoral Distance (PPED)	Length between the tip of the snout and the insertion of the first ray of the pectoral fin.

Fig. 2: Morphometric characters of *L. niloticus*

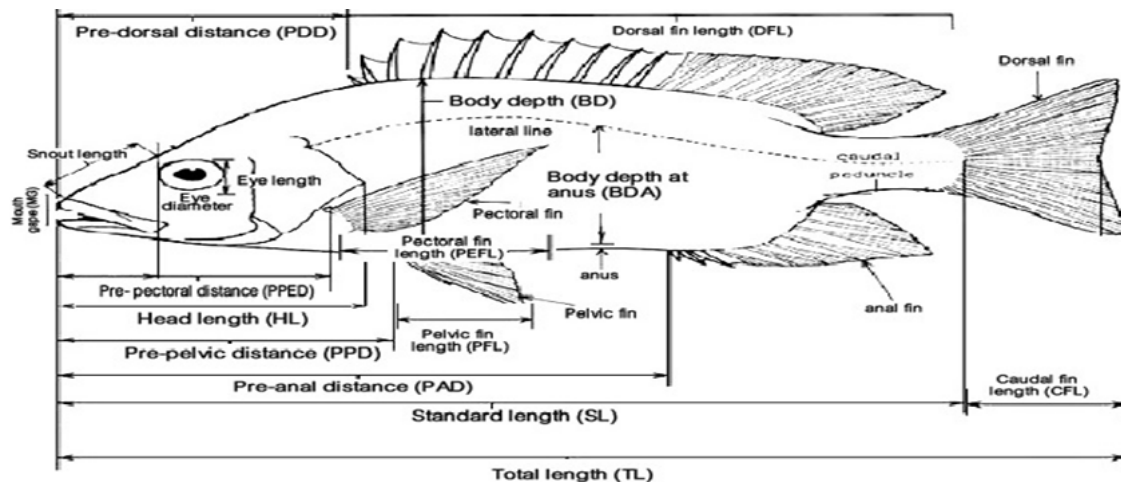


Fig. 2: Morphometric characters of *L. niloticus*

Sample Collection

A total of sixty (60) specimens of *L. niloticus* were collected from Kanye Dam, Kano State, Nigeria, over a four-month period (September to December 2023). Fish were captured using gillnets and seine nets during multiple sampling sessions. Immediately after capture, specimens were preserved in an icebox containing crushed ice and transported to the Fish Biology Laboratory, Department of Fisheries and Aquaculture, Bayero University, Kano, for detailed morphological examination and analysis.

Morphometric Measurements

External morphological features were carefully examined, and measurements were recorded in a structured dataset. Nineteen (19) morphometric parameters were measured for each specimen following

standard procedures described by Teugels (1984). Measurements included total length (TL), standard length (SL), body weight (BW), head length (HL), dorsal fin length (DFL), pectoral fin length (PEFL), pelvic fin length (PFL), mouth gape (MG), and other body dimensions (Table 1). All measurements were taken from the left side of each fish positioned laterally. Total length (TL) and standard length (SL) were measured in cm using a fish measuring board. Other linear dimensions were recorded using a digital vernier caliper. Body weight was determined using a digital weighing balance.

Data Analysis

Data were analyzed using Microsoft Excel (2016) and SPSS version 25. Results were presented in tables, scatter plots and histograms. Descriptive statistics such as mean (\pm standard deviation) were computed. The length-weight

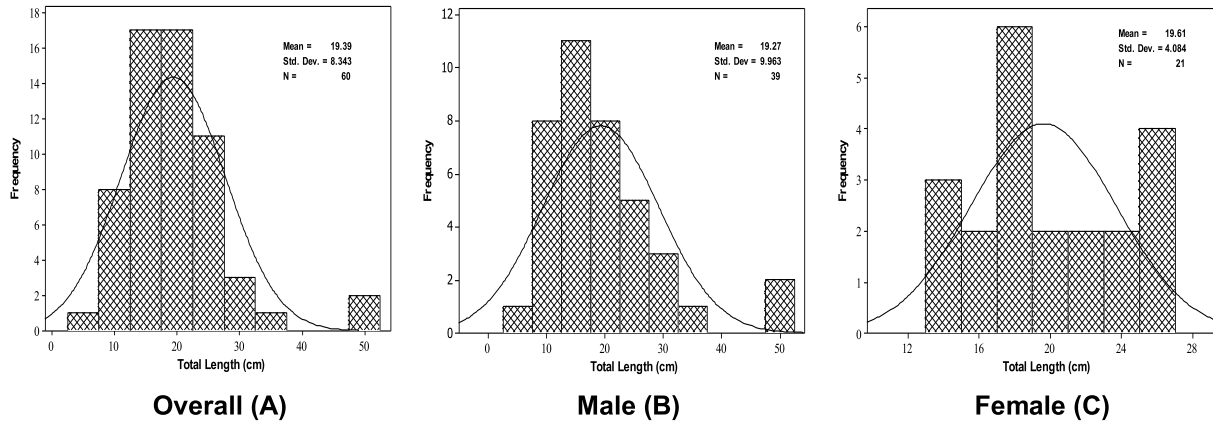


relationship (LWR) was estimated using the equation $W = aL^b$ as described by Panase and Mengumphan (2015). The condition factor (K), is calculated using $K = \frac{W \times L}{L^3}$ formula to assess the fish well-being. One-way ANOVA was used to test for significant differences of the fish condition factor across sexes. All statistical tests were conducted at a significance level of $p < 0.05$.

RESULTS

Size Frequency Distribution

A total of sixty (60) *L. niloticus* specimens were examined, comprising 39 males (65%) and 21 females (35%). The overall total length ranged from 6.70 to 51.20 cm, with a mean of 19.39 ± 8.34 cm. Male total length varied between 6.70 and 51.20 cm, with a mean of 19.27 ± 9.96 cm, while female total length ranged from 13.30 to 25.50 cm, with a mean of 19.61 ± 4.08 cm (Figure 3)



Length Weight Relationship

The total length-body weight relationship parameters of *L. niloticus* for males, females, and combined sexes are presented in Table 2. Regression analysis between total length (TL) and body weight (W) was plotted on a logarithmic scale (Figure 4). The estimated allometric coefficient (b) values were 2.676 for males, 3.199 for females, and 2.731 for combined sexes. These results indicate a negative allometric growth pattern in males and combined sexes, and a positive allometric pattern in females. The coefficient of determination (R^2) ranged from 0.956 to 0.984. The length-weight relationship equations were: $\text{Log } W = 2.676 \text{ Log } TL - 1.601$ (males), $\text{Log } W = 3.199 \text{ Log } TL - 2.259$ (females), and $\text{Log } W =$

$2.731 \text{ Log } TL - 1.665$ (combined sexes).

Condition Factor

The Condition factor (K) of *L. niloticus* in Kanye Dam is presented in Table 2. For the condition factor, the K values showed a similar fluctuating trend, ranging from 0.923 to 3.375. The table shows sex-specific differences in growth patterns and body condition. Males (n=39) exhibit negative allometric growth ($b=2.676 < 3$) with a high mean condition factor ($K=3.375$). Females (n=21) show positive allometric growth ($b=3.199 > 3$), with a significantly lower mean K (0.923). For the combined sample (n=60), negative allometric growth prevails ($b=2.731$) with a near-isometric condition ($K \approx 1.007$).

Table 2: Length-Weight Relationship and Condition Factor Parameters of *L. niloticus* from Kanye Dam

Sex	N	A	B	R ²	Growth type	LWR Equation	Mean (K)	SD
M	39	0.025	2.676	0.956	Allometric (-)	$\text{Log } W = 2.676 \text{ Log } TL - 1.601$	3.375 ^a	1.125
F	21	0.006	3.199	0.984	Allometric (+)	$\text{Log } W = 3.199 \text{ Log } TL - 2.259$	0.923 ^b	0.079
B	60	0.022	2.731	0.956	Allometric (-)	$\text{Log } W = 2.7305 \text{ Log } TL - 1.665$	1.007 ^b	0.238

Note: M, male; F, female; B, both sexes; N, number of individuals; a, intercept; b, slope; R^2 coefficient of determination, Means with the different superscript within the column are significantly different ($p < 0.01$); K = condition factor, SD = standard deviation



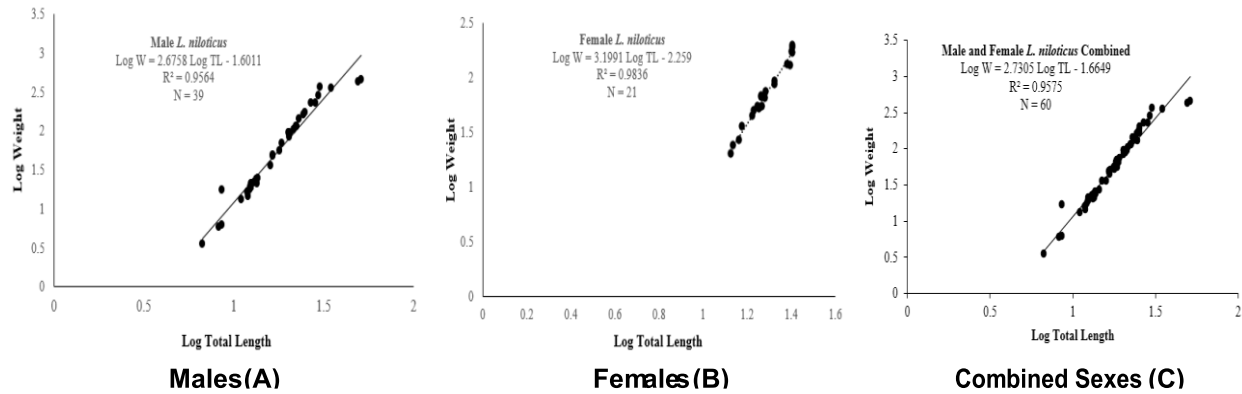


Fig. 4: Length-Weight Relationships of *L. niloticus* from Kanye Dam: (A) Males, (B) Females, and (C) Combined Sexes

Morphometric Relationships

Tables 3 present the morphometric data for male and female *L. niloticus* from Kanye Dam. Sexual dimorphism in many body features was seen even though there is no significant difference in overall length parameters. Females exhibited significantly larger head length (HL),

head width (HW), eye diameter (ED), pelvic fin length (PFL), pre-pectoral distance (PPCD), and pre-dorsal distance (PDD) ($p < 0.05$). Males showed significantly greater caudal fin length (CFL) and pre-anal distance (PAD) ($p < 0.05$).

Table 3: Descriptive Statistics of Morphometric data of Male and Female *L. niloticus* from Kanye Dam

Variable (cm)	Male (Mean ± SD)	Female (Mean ± SD)	Difference (♂ - ♀)	t-value	p-value
TL	19.27 ± 1.60	19.61 ± 0.89	-0.34	-1.058	0.295
SL	15.77 ± 1.40	15.92 ± 0.71	-0.15	-0.550	0.584
HL	3.94 ± 0.32	4.40 ± 0.21	-0.46	-6.692	0.000
DFL	7.75 ± 0.58	7.47 ± 0.53	+0.28	1.888	0.066
HW	3.65 ± 0.29	3.86 ± 0.19	-0.21	-3.373	0.001
EL	1.08 ± 0.05	1.20 ± 0.50	-0.12	-1.097	0.286
ED	0.91 ± 0.06	0.96 ± 0.02	-0.05	-4.738	0.000
MG	0.94 ± 0.55	0.94 ± 0.02	0.00	0.000	1.000
SNL	1.37 ± 0.63	1.50 ± 0.09	-0.13	-1.265	0.213
BD	4.86 ± 0.40	4.73 ± 0.23	+0.13	1.598	0.116
BDA	4.10 ± 0.30	4.01 ± 0.21	+0.09	1.356	0.181
CFL	4.06 ± 0.27	3.85 ± 0.19	+0.21	3.506	0.001
PFL	3.05 ± 0.21	3.18 ± 0.16	-0.13	-2.682	0.010
PCFL	2.82 ± 0.19	2.82 ± 0.13	0.00	0.000	1.000
PPCD	5.17 ± 0.32	5.58 ± 0.23	-0.41	-5.716	0.000
PDD	7.66 ± 1.03	7.05 ± 0.30	+0.61	3.438	0.001
PAD	11.70 ± 1.08	11.51 ± 0.51	+0.19	0.924	0.359

Key - TL : total length; SL : standard length; HL : head length; DFL : dorsal fin length; HW : head width; EL : eye length; ED : eye diameter; MG : mouth gape; SNL : snout length; BD : body depth; BDA : body depth at anus; CFL : caudal fin length; PFL : pelvic fin length; PCFL : pectoral fin length; PPCD : pre-pectoral distance; PDD : pre-dorsal distance; PAD : pre-anal distance; SD : standard deviation



Discussion

The size frequency distribution of *L. niloticus* in Kanye Dam revealed dominance of smaller individuals (6-25 cm), indicating a young population. The absence of larger size classes indicates possible high fishing pressure, environmental constraints, or small sample size. This pattern may also reflect continuous recruitment supported by favorable spawning conditions. Males exhibited a wider size range than females, likely due to differences in growth rates or habitat segregation. Similar patterns of smaller-dominated populations and sex-related size variations have been reported in Nile perch from other African reservoirs and rivers, such as Goronyo Dam in Nigeria and the Pendjari River in West Africa (Abdullahi *et al.*, 2022; Tah *et al.*, 2013).

The results of the LWR indicated negative allometric growth ($b < 3$) in males and combined sexes an indication of their higher growth in length than in weight. Thus, fish experiencing this type of growth tend to have slimmer body shape. There is positive allometric growth ($b > 3$) in females, an indication of its fast growth in weight than in length thereby giving it a robust appearance. This may indicate sexual dimorphism in growth, with females attaining larger sizes compared to males. This finding agrees with Abdullahi *et al.*, (2022) and work of Imam *et al.*, (2019) where comparable sex-specific and allometric growth trends have been observed in Nile perch populations in Nigerian reservoirs namely Goronyo Dam and Kanye reservoir respectively. This also agrees with Argungu *et al.*, (2022) who recorded negative allometric growth patterns from their calculated b-values for samples of *L. niloticus* collected from Goronyo dam.

Condition factor (K) values indicate the well-being of fish populations. A condition factor of '1' or above is considered favorable for growth and development (Jisr *et al.*, 2018). The condition factor (K) ranges from 0.923 to 3.375 and was significantly higher in males followed by combined sexes then females. This suggests that majority of the fish species studied are in good conditions. Higher K values in male suggest better nutritional status or energy balance which might be linked to lower reproductive energy expenditure. Females' lower K values likely reflect energy diversion to gonadal development during spawning. Similar findings on condition factor and its sex-related variations have been reported in Nile perch from Goronyo Dam, Nigeria, and Pendjari River, Benin by Abdullahi *et al.*, (2022) and Tah *et al.*, (2013) respectively.

CONCLUSION AND RECOMMENDATION

This study has demonstrated clear sexual dimorphism in growth patterns and condition factors of *L. niloticus* in Kanye Dam. Males exhibited negative allometric growth ($b < 3$) (slimmer bodies), while females showed positive allometric growth ($b > 3$) (robust forms), indicating differences in energy allocation and reproductive strategies. Condition factors confirm good overall health, with males in superior condition to females. The study reveals a young, small-sized *L. niloticus* population, dominated by juveniles (6-25 cm) with limited larger individuals, suggesting high fishing pressure or

continuous recruitment. These research findings are useful reference information for effective management and conservation of *L. niloticus* populations in Kanye Dam, Kano.

To sustainably manage *L. niloticus* in Kanye Dam, key measures include establishing a minimum catch size of 30-35 cm total length, quota limits to protect juveniles and large spawning females, mandating gillnet mesh sizes of at least 6-7 inches to selectively target mature individuals. Also, illegal and destructive gears must be strictly prohibited with consideration given to seasonal or area-specific restrictions to preserve reproductive capacity. Similarly, closed seasons of 2-3 months should be enforced during peak spawning periods, and protected areas be designated in critical breeding and nursery habitats to enhance juvenile recruitment and rebuild spawning stock biomass. Finally, a co-management approach should be implemented to actively engage fishers, government agencies, and other stakeholders in regulation enforcement and the provision of viable alternative livelihood programs to improve compliance and the long-term ecological and socio-economic sustainability of the fishery.

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