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Length – Weight Relationship of Rohu (*Labeo rohita*) Advanced Fingerlings under Sodic Soil Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted at the Instructional Fish Farm, College of Fisheries, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, Uttar Pradesh, in earthen ponds (8m×8m×1m). The experiment for 90 days, using *Labeo rohita* advanced fingerlings (avg. wt. 30.0 ± 0.5g) under sodic soil conditions. Five treatments were taken in triplicate, with 50 fingerlings per pond. T1 served as the control with traditional feed only (MOC+RB in 1:1 ratio, 5% of total fish body weight). T2 and T3 were fertilized with cattle dung (20 and t ha^{-1} yr^{-1}) respectively. T4 and T5 received poultry droppings (10 and 7.5 t ha^{-1} yr^{-1}) respectively. Results showed negative allometric growth (b<3), indicating fish becoming slimmer with length increase. Final weight gain was highest in T4 (110.9±0.9 gm) and T2 (108.7±0.88 gm), and lowest in T1 (70.7±0.49 gm).

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Keywords: Cattle dung; poultry dropping; Labeo rohita.

1. INTRODUCTION

Aquaculture is the fastest-growing food production industry in the world. It is extending, intensifying, and expanding in almost every region of the earth. The increasing worldwide population is driving the demand for aquatic food items. The bulk of the principal fishing fields have achieved their maximum fishing capacity, and the production of the capture fisheries has stagnant, indicating that the worldwide demand for aquatic food will be satisfied through aquaculture. Aquaculture is considered as a potential solution to the global supply-demand imbalance for aquatic food [1]. Fish is the principal source of protein for over 950 million people globally, and they are an important element of the diets of many more. Fish offer approximately 16% of the animal protein consumed by people worldwide and are a good source of minerals [2].

Carps dominate freshwater aquaculture, with three basic species. Rohu *(Labeo rohita* Hamilton 1822: Cypriniformes, Cyprinidae) is well-known for its flavor and popularity among the general population. Rohu is also regarded as a viable aquaculture species in India, Bangladesh, Myanmar (Burma), and Pakistan. Farmed Rohu are omnivores that require a high protein diet (30-35%). Aquaculture's key constraints include feed prices, disease outbreaks, and seed quality, all of which assure the long-term viability of fish production. This species' high fertility (2million eggs/kg), external fertilization, and domestication make it excellent for intensive breeding [3].

Labeo rohita is the eleventh most popular species in aquaculture. This species, which is categorized as Indo-Gangetic, is native to the riverine regions of northern and central India. For mono and composite fish farming systems (polyculture) in India, *L. rohita* is considered a suitable species due to its fast development, distinct eating niche and behavior, fertility, and market demand. The body is bilaterally symmetrical and slightly extended. It has a more arched dorsal shape than ventral, and it is coated in cycloid scales. The back is blue, while the flanks and belly are silver. Rohu's favorite food as an infant was zooplankton. Rohu feeds largely on phytoplankton and periphyton during its juvenile and adult stages of life [4].

The length-weight relationship (LWR) is important method in fish biology research to determine the fish's growth form, maturity, reproductive state, and overall well-being. LWR is a valuable method for estimating biomass and assessing stock. LWR can also be used to examine intra-species variation based on the body shape of fish specimens obtained from various environments or geographical regions [5]. Fish species growth rates vary depending on their genetic makeup, food availability, and current environmental conditions.

Labeo is a highly significant fish species, widely consumed across the country for its excellent nutritional value and easy availability. However, its population has recently been affected. Notably, the ray-finned fish, *Schizothorax richardsonii*, is also found in the river, preferring the cold, mountainous waters and feeding mainly on aquatic plants and detritus [6]. This species commands high market value due to its taste and nutritional quality. The overall fish production in the river has decreased, raising serious concerns about the well-being of the fish species inhabiting these waters.

2. METHODS

2.1 Experimental Site

The present study was conducted at Instructional Fish Farm College of Fisheries, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya Uttar Pradesh. The experimental set up earthen pond (8m×8m×1m). Experimental fish *Labeo rohita* advanced fingerlings (avg.wt. 30.2± 0.5 g) were also brought from Instructional Fish Farm of College of Fisheries.

2.2 Experimental Details

The experiment was conducted for 90 days period in the earthen pond. Each group were having three (triplicate) earthen pond, each tank stocked with 50 *Labeo rohita* advanced fingerlings (avg. wt. 30.0 ± 0.5g) under sodic soil condition. Total six treatments were taken in triplicate the details of treatments and control T1 was taken as control where no cattle dung and poultry dropping was added in control (T1) only traditional feed MOC+RB in 1:1 was given @ 5% of total fish body weight present in the pond. T2 was fertilized with (20 t ha^{-1} yr^{-1}) cattle dung and traditional feed was given. T3 was fertilized with cattle dung (15t ha^{-1} yr^{-1}), T4 was added with poultry dropping (10 t ha^{-1} yr^{-1}), T5 was added with poultry dropping (7.5 t ha^{-1} yr^{-1}). Single Super Phosphate (SSP) was applied 25kg/ha and urea was added @ 20 kg/ha per month. After 15 days of pond preparation fishes were stocked in ponds water quality parameters were measured and fish were fed with control feed for one week. For acclimatization fish were stocked into the pond for 30 minutes.

Condition factor: The Condition factor (K) generally, used for determining the physiological state of a fish, including reproductive capacity. The heavier the fish for a length, the higher its condition factor (K). It is calculated by using the formula by (Fulton 1904):

where K is the condition factor, W is the body weight of fish in grams, and L is the total length in centimeter [7].

$$K = W \times 100/L^{2}$$

Where, W = weight (g), L = length (cm) and 100 is a factor to bring the value of K near unity [8].

At times, it may be necessary and useful to determine the weight of a fish directly from its length [9].

3. RESULTS AND DISCUSSION

3.1 Length-weight Relationship

Table 1. Length-Weight relationship (LWR) different treatments

Treatment	a	b	Rsqr
T1	0.079824	2.301808	0.890889
T2	0.020759	2.816166	0.941575
T3	0.032692	2.66518	0.923328
T4	0.021111	2.823435	0.944928
T5	0.033908	2.657976	0.909125

T1= Traditional Feed +soil base, T2 =Traditional feed+ cattle dung @20T /ha, T3= Traditional feed+ cattle dung @15T /ha, T4= Traditional feed+ poultry dropping @ 10 T/ha, T5 Traditional feed+ poultry dropping @ 7.5 T /ha

“The total length (TL) was estimated as a distance from tip of snout up to the end of caudal fin with the help of measuring scale, while fish weight was recorded with the help of a digital balance (corrected up to 0 mg) after eliminating water and mucus from the fish body. For any biological organism the Length-Weight relationship is generally non-linear and expressed in the form of parabolic equation W= a L^b where weight (W) is proportional to a certain power (b) of the length (L) and 'a' is the intercept. Values of the exponent 'b' provide information on fish growth. When 'b'=3, increase in weight is isometric. When the value of 'b' is other than 3, weight increase is allometric (positive if 'b' >3, negative if 'b' <3)” [10]. “Relationship between these two variables were adjusted by transforming them into linear regression” [11].

During the present study, 'b' values ranged from 2.30-2.82 with corresponding 'r' values as 0.89-0.94 at the selected sites. Individuals showed negative *L. rohita* negative as it less than 3 allometric growth at the selected sites. During the present study the values of b<3 clearly indicate that fishes are becoming slimmer with increase in length i.e the weight of fish is lower than cube of its length. The final weight gain observed was significantly higher and was maximum T4 (110.9±0.9 gm) followed by T2 (108.7±0.88 gm). The weight gain was minimum in T1(70.7±0.49 gm). The introduction of poultry dropping boosted the protein content of the diet, which has been shown to improve fish growth performance [12]. “Many other workers have reported similar findings in cold water cyprinids where fish is becoming slimmer with increase in weight” [13]. The values of correlation coefficient depicted a strong positive correlation between length and weight indicating an increase in length with corresponding increase in weight. The similar findings have been reported by Singh et al*.,* [14] reported that the relationship between length and weight in L. rohita, with regression coefficients ranging from 0.242 to 3.234 across treatments. The findings indicated negative allometric growth. Gupta et al., [15] reported that “the value of ‘b’ was noted less than ‘3’ in the case of *S. richardsonii* thriving in the same habitat, thus showing a negative allometric growth”. Similar results were also revealed by Pandey et al., [16] for *L. rohita* (0.917-1.04), *C. catla* (0.903-1.07) and *C. mrigala* (0.976-1.031) “from a sodic soil pond in Uttar Pradesh. Mir et al. [17] reported the condition factor of male rohu to vary between 1.20 to 1.51while it was 1.26 to 1.40 in case of female rohu from six different rivers of Ganga basin. The length-weight relationship of fish is influenced by multiple environmental factors, as well as the fish’s body shape, outline, and contour”. Nikolsky [18] noted that “growth patterns exhibit distinct characteristics across different age groups. In the current study, it was observed that different treatment the growth rate varied among different length groups”.

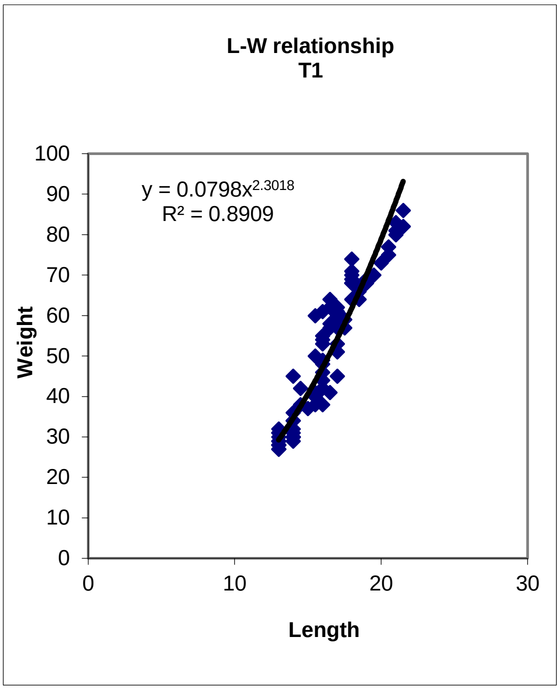

Fig. 1. T1 Control

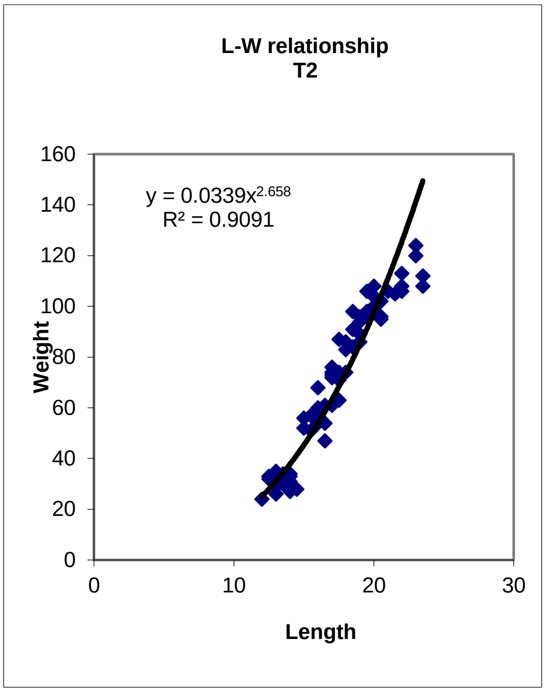

Fig. 2. T2 @ 20t Cattle dung

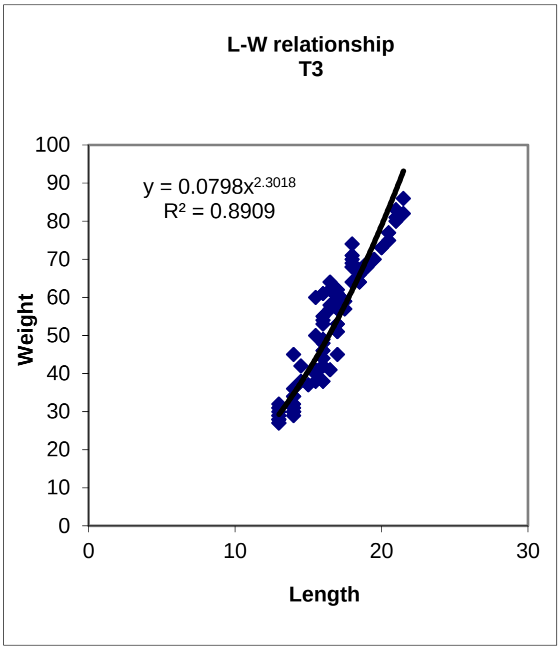

Fig. 3. @15t Cattle dung

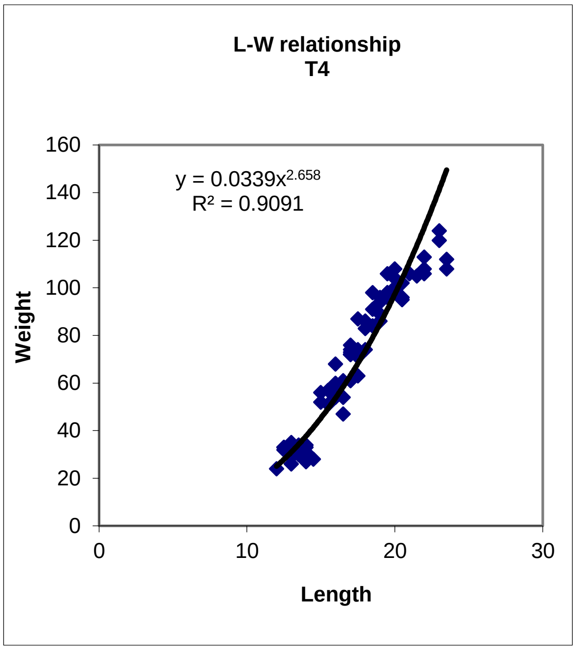

Fig. 4. @ 10t Poultry dropping

All treatments in the study exhibited negative allometric growth, with 'b' values ranging from 2.30 to 2.82 and 'r' values between 0.89 and 0.94, indicating that fish became slimmer as they increased in length. The highest weight gain was observed in T4 (110.9±0.9 gm) due to the use of poultry droppings, which enhanced dietary protein content. In contrast, the control group (T1) showed the lowest weight gain (70.7±0.49 gm). Similar findings were reported by Ujjania, [19] and others, showing negative allometric growth in Labeo rohita and cold water cyprinids. The study concluded that poultry droppings significantly improve fish growth performance, despite the negative allometric growth pattern [20,21].

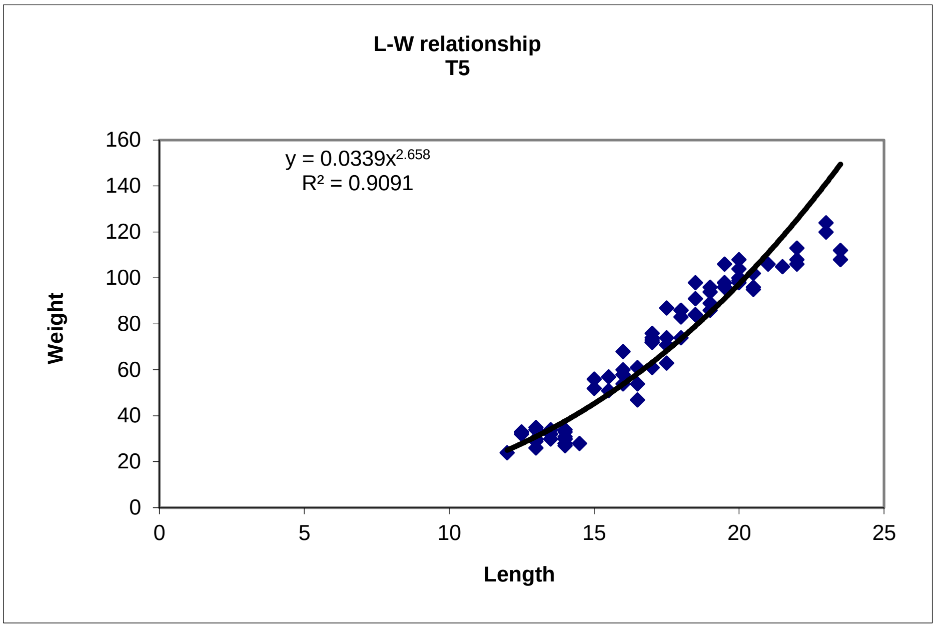

Fig. 5. @ 7.5t Poultry dropping

4. CONCLUSION

Further research is necessary to enhance growth and optimize feeding strategies under sodic soil conditions. The application of poultry droppings at a rate of 10 t ha^{-1} yr^{-1} resulted in the highest fish growth across all treatments. All treatments exhibited a negative allometric growth pattern, indicating that the fish became more slender as their length increased. This finding emphasizes the importance of developing optimized feeding strategies to improve growth performance in *Labeo rohita* under sodic soil conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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