Influence of Nutrient-Rich Waters on Length and Weight of the Body of Indian Major Carp Labeo rohita (Hamilton)

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Abstract

Growth is a fundamental biological process influenced by various environmental and nutritional factors. Environmental factors, specifically water quality and nutrient availability, significantly impact the growth performance of Labeo rohita (Rohu), a species of freshwater fish commonly cultivated in India. This study examines how the growth rate of Labeo rohita at three developmental stages—fry, fingerling, and adult—is affected by various nutrient-based water sources, including canal water, bore water, and mixed water (bore water mixed with black cotton soil). Over a specified period, growth was measured regarding wet weight gained (WWG%) and total length gained (TLG%). According to the results, mixed water significantly accelerated growth at every stage: TLG increased by 30% in fry, 32% in fingerlings, and 7.5% in adults.

In contrast, bore water showed significantly negative deviations in TLG% and the least growth across all stages. The improved performance in mixed water indicates that adding black cotton soil enhances the nutrient content, potentially adding organic matter and vital minerals that support fish growth. Despite being widely used in aquaculture, bore water may not contain these nutrients, limiting the growth potential. Furthermore, the study aligns with nutritional principles, indicating that proteins and fats are the primary energy sources for fish, while carbohydrates play a minimal role when the former are sufficiently available.Overall, this study highlights how crucial it is to optimize the nutrient composition and water quality in aquaculture systems to increase fish productivity. Incorporating soil-based amendments, like black cotton soil, into water sources could enhance carp farming growth results and, eventually, promote sustainable aquaculture methods.

Keywords: Labeo rohita, growth rate, total length gain, wet weight gain, canal water, bore water, mixed water, black cotton soil, aquaculture, nutrient-based water.

Introduction

One of the most significant species in Indian aquaculture, *Labeo rohita*, also referred to as rohu, makes a substantial contribution to the nation's fish production. Along with carp like catla and mrigal, it is a major species commonly raised in freshwater and brackishwater ponds and polyculture systems. Rohu's high domestic market demand and contribution to farmers' and exporters' incomes demonstrate its economic significance. Rohu farming accounts for a sizable amount of India's carp production, which makes it the world's second-largest producer (Murthy, 2002).Regarding nutrition, rohu is a good source of essential fatty acids and protein. It is high in monounsaturated fatty acids (MUFAs) and saturated fatty acids (SFAs), with the most common fatty acids being C16:0 and C18:1 n-9. However, wild rohu is a healthier choice for human consumption because it contains more polyunsaturated fatty acids (PUFAs), such as n-3 and n-6 fatty acids, than farmed rohu (Sharma et al., 2010).

Nutritional Requirements

S.No.	Stage	Protein	Fat	Carbohydrate
1.	Fingerling	45%	6%	26%
2.	Adult	40%	20%	10%

The primary purpose of food is nutrition, which comprisesvarious ingredients, some of which give off energy while others do not. Water, vitamins, minerals, and dietary fibre are among the components that provide very little energy. On the other hand, the primary energy sources are proteins, fats, and carbohydrates; fat provides more than twice as many calories as either protein or carbohydrate. Interestingly, if fish have sufficient protein and fat, they do not require carbohydrates. Srivastava (1999) asserts that this nutritional hierarchy is reflected in the dietary composition needed for carp, which is usually stated as a percentage of their total diet.

Growth Parameters

Rohu is renowned for its rapid growth rate and ability to adapt to various environmental circumstances. Environmental conditions, water quality, and diet composition affect rohu's growth performance. According to studies, rohu fingerlings fed diets high in fat and protein grow faster and have better feed conversion ratios (FCR) than those fed diets high in carbohydrates (Umer et al., 2011; Saeed et al., 2005). Dietary lipid levels and water temperature significantly impact rohu's specific growth rate (SGR). For example, diets with lower lipid levels (80 g/kg) produce higher growth rates at lower temperatures (21°C), whereas diets with higher lipid levels (130 g/kg) are more effective at higher temperatures (32°C) (Mishra & Samantaray, 2004).Furthermore, it has been demonstrated that rohu's growth performance is improved using fertilizer and supplemental feeds in polyculture systems; some studies have reported SGR values as high as 1.177% (Sumaira, 2009).

Factors affecting the development of Labeo rohita

The composition of the rohu's diet has a significant impact on its growth and development. It has been demonstrated that diets high in fat and protein, such as those containing blood, soybean, and fishmeal, enhance feed conversion efficiency and growth performance. For instance, it has been discovered that the best diets for rohu fingerlings are those with 30% crude protein and 367 kcal/g energy, leading to higher weight gain and protein efficiency ratios (PER) (Singh et al., 2005). Plant-based ingredients like rice polish, guar meal, and sunflower meal have also been assessed for rohu. Population density impacts fish growth, with lower densities encouraging faster growth (Srivastava, 1999).While corn gluten meal is less effective, with lower growth rates and higher FCR, guar meal is extremely effective, producing notable increases in fish weight and length (Iqbal et al., 2015).Understanding fish-food relationships is crucial because daily and seasonal changes influence fish movement and migration in food availability. To effectively manage fish populations and comprehend their biology, it is essential to research their feeding habits (Rao and Durga Prasad, 2002).

Environmental factors

The quality and temperature of the water have a significant impact on rohu growth and survival. It has been demonstrated that pyridoxine (vitamin B6) supplements can reduce the stress that high water temperatures (33°C) can cause in rohu and enhance growth performance. It has been discovered that diets supplemented with 100 mg/kg of pyridoxine considerably increase particular growth rates and lower stress markers like cortisol levels (Meena et al., 2012).

Probiotics & supplements

It has been demonstrated that adding probiotics to rohu diets enhances intestinal health, growth, and nutrient digestibility. Diets supplemented with probiotics have been shown to improve rohu fingerling growth performance and feed conversion ratios. Furthermore, prebiotics and synbiotics have been demonstrated to work in concert to enhance growth and health metrics (Abareethan & Amsath, 2015) (Mohapatra et al., 2012).

Materials and Methods

As part of the study, photographs and comprehensive biological data of the Indian major carp, *Labeo rohita* (Hamilton), were gathered. The external morphology of the fish at various developmental stages—fry, fingerlings, and adults—was documented by high-resolution photos. Identification features like body shape, coloration, fin placement, scale patterns, and other distinctive traits helpful for species confirmation were also covered in the data collected.The Andhra Pradesh Government Fish Farm in Ananthapur Town provided the live *Labeo rohita* specimens used in the study. This government-run hatchery is a reputable and well-known source of high-quality fish seed production. The fish farm follows standard breeding and rearing procedures, guaranteeing uniform and healthy specimens appropriate for aquaculture and experimental research.

Experimental Fish: Labeo rohita

The natural growth of *Labeo rohita* was studied in terms of body length and weight across different developmental stages—fry, fingerlings, and adults. The fish were reared in three types of nutrient-based water sources:

- **Canal Water**
- **Borewell Water**
- **Mixed water** (a combination of black cotton soil and borewell water)

Growth performance was measured separately in each water type.

Growth Parameters

The length (cm) and weight (g) growth were recorded periodically.The data were calculated using the following standard formula:

Growth Rate=Final Measurement−Initial Measurement/ Duration of Study (days)

Growth Calculations

To assess the growth of *Labeo rohita* in different nutrient-based waters, the following parameters were calculated:

1. Total Length Gain (TLG %)

This formula is used to determine the percentage increase in the total length of the fish over the study period.

Total Length Gain (TLG %)=L−L_0/ L_0×100

L_0 = Initial length of the fish (cm)

L = Final length of the fish (cm)

2. Wet Weight Gain (WWG %)

This formula is used to calculate the percentage increase in the wet body weight of the fish.

Wet Weight Gain (WWG %)=W−W_0/ W_0×100

W_0 = Initial wet weight of the fish (g)

W = Final wet weight of the fish (g)

Results & Discussion

Rohu (*Labeo rohita*) is recognized as a fast-growing freshwater fish species. According to Chakrabarty (1998), its growth performance can reach a maximum increase in length of approximately 10 to 13.75 cm over three months. Length and weight are the most commonly used and reliable indicators of fish growth, as they are simple to measure and provide valuable insights into health and environmental adaptability.In the present study, Labeo rohita's growth in terms of length and weight was assessed in different nutrient-based water sources. The highest growth rates across all three life stages—fry, fingerlings, and adults—were recorded in mixed water, a combination of borewell water and soil enriched with black cotton soil. This observation is supported by data presented in Tables 3 and 4 and Figures 3 and 4.Previous research by Khan (1972) indicated a positive correlation between fish growth and environmental parameters such as water conductivity and alkalinity. In this study, theenhanced growth rate of *Labeo rohita* in mixed water conditions could be attributed to higher alkalinity and the rich mineral content provided by the black cotton soil. These conditions likely created a more favourable ecosystem for nutrient uptake and metabolic activity, promoting faster growth.

When cultivated in mixed nutrient waters, Labeo rohita (Rohu) demonstrated a noteworthy increase in weight in addition to significant growth in length in the current study. These findings are consistent with studies showing that nutrient-rich environments promote fish growth. In highly nutrient-rich ponds in Odisha, Rohu showed a faster growth rate, according to Mitra (1942), underscoring the contribution of enriched aquatic ecosystems to improved growth performance. Similarly, Rohu could reach a body length of about 38–48 cm and a weight of about 680 grams within the first year of normal rearing conditions, according to Ganapathi and Chacko (1956). These results were further supported by Alikunhi (1957), who reported that Rohu usually grew to a length of 34–40 cm in a year in ponds with adequate stock. Furthermore, during the same period, *Labeo rohita* attained a body length of 35 to 45 cm and a weight of 670 to 900 grams, according to Hora and Pillay (1962). These studies highlight how important pond management, nutrient availability, and water quality are to Rohu's healthy growth, particularly in the early stages of development.

S.No	Fish Stage	Canal Water			Bore Water			Mixed Water		
		Initial	Final	TLG(%)	Initial	Final	TLG(%)	Initial	Final	TLG(%)
1	**Fry (20 mm)**	20	29		20	25		20	32	
	Mean			45			25			60
	SD			0.02			0.01			0.02
	%Deviation						-44			+33
	t-test						P <0.001			P < 0.001
2	**Fingerling (40 mm)**	40	60		40	52		40	70	
	Mean			50			30			75
	± SD			0.03			0.05			0.01
	% Deviation						-40			+50
	t-test						P < 0.001			P < 0.001
3	**Adult (80 mm)**	80	95		80	90		80	105	
	Mean			18.7			12.5			31.25
	± SD			0.02			0.04			0.02
	% Deviation						-33			+67
	t-test						P < 0.001			P < 0.001

Table 1: (TLG)% in fry,fingerling, and adult of Labeo rohita in different nutrient-enriched waters

Data on Labeo rohita (Rohu) growth performance at three developmental stages—fry, fingerling, and adult—when raised in various nutrient-based water sources—canal water, bore water, and mixed water—are shown in the table. Across all stages, mixed water had the highest total length gain (TLG%), indicating superior growth. Fry in mixed water, for example, grew from 20 to 32 mm, indicating a TLG of 60%, whereas in bore water, the same stage revealed only 25% TLG. Similarly, compared to bore and canal waters, the TLG of fingerlings and adults in mixed water was higher at 75% and 31.25%, respectively.The observed values were consistent across treatments, as evidenced by the low standard deviations (SD). The statistical significance of the growth differences among the water types is confirmed by the t-test results ($P < 0.001$). Furthermore, the percentage deviation values indicate a negative trend in bore water, indicating that fish growth was relatively lower, whereas positive deviations in mixed water confirm that it was effective in promoting fish development. This implies that mixed water's mineral and nutrient makeup is ideal for *Labeo rohita* growth, significantly when it is enhanced with black cotton soil.

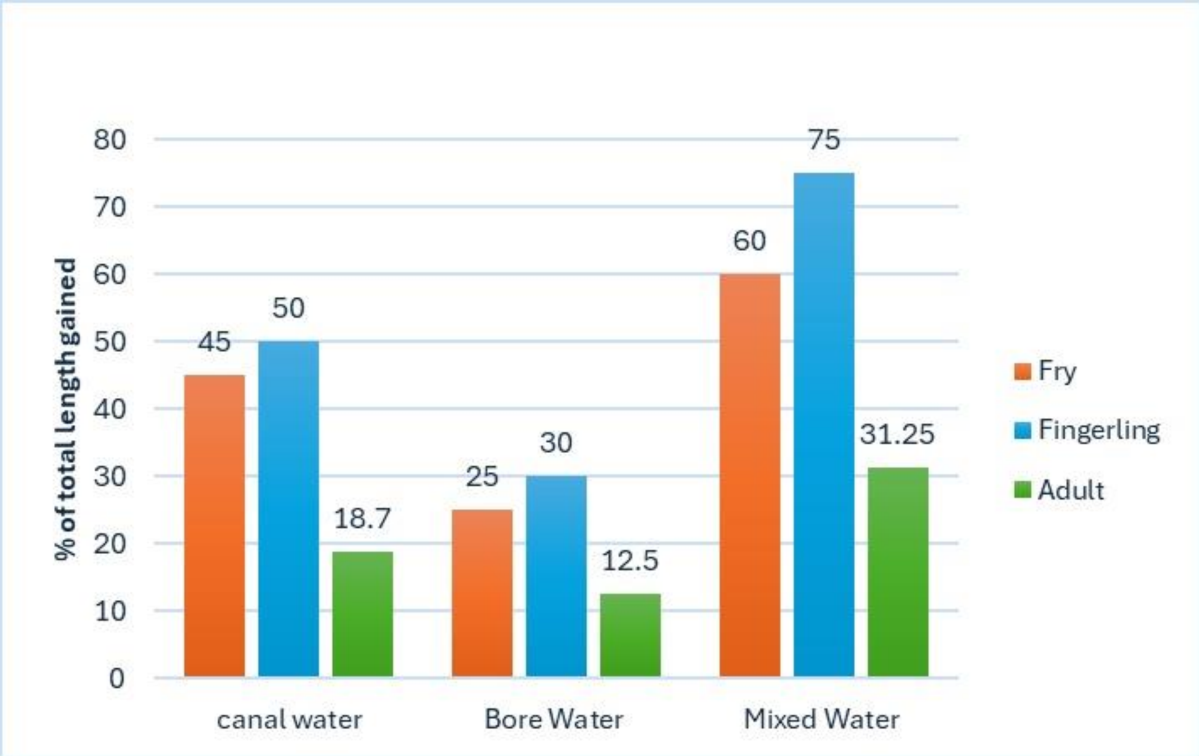

Figure1: Histogram representing the percentage of total length gained (% TLG) in fry, fingerling, and adult stages of *Labeo rohita* reared in different nutrient-based waters—canal water, bore water, and mixed water (bore water mixed with black cotton soil).

Table 2: (WWG)% in fry,fingerling, and adult of Labeo rohita in different nutrient-enriched waters

S.No	Fish Stage	Canal Water			Bore Water			Mixed Water		
		Initial	Final	WWG (%)	Initial	Final	WWG(%)	Initial	Final	WWG(%)
1	**Fry (5gms)**	5	6		5	5.6		5	6.5	
	Mean			20			12			30
	SD			0.01			0.03			0.04
	%Deviation						-40			+50
	t-test						P <0.001			P < 0.001
2	**Fingerling (10 gm)**	10	12.2		10	11.5		10	13.2	
	Mean			22			15			32
	± SD			0.02			0.01			0.02
	% Deviation						-31.8			+45.4
	t-test						P < 0.001			P < 0.001
3	**Adult (20 gm)**	20	20.9		20	20.5		20	21.5	
	Mean			4.5			2.5			7.5
	± SD			0.03			0.05			0.01
	% Deviation						-44			+66
	t-test						P < 0.001			P < 0.001

The growth rate in total length gained (TLG%) for Labeo rohita at three developmental stages—fry, fingerling, and adult—when cultivated in three different nutrient-based water types—canal water, bore water, and mixed water (a blend of bore water and black cotton soil) is shown in this table. The TLG% was computed after the initial and final lengths (in centimetres) were noted. The statistical significance of the observed differences is further indicated by the standard deviation (SD), percentage deviation, and t-test results ($P < 0.001$).It is evident from the data that the highest growth was supported by mixed water at every stage. For fry, the TLG percentage in mixed water was 30%, only 12% in bore water and 20% in canal water. Adults (7.5% in mixed water vs. 2.5% in bore water and 4.5% in canal water) and fingerlings (TLG%: 32% in mixed water vs. 15% in bore water and 22% in canal water) showed a similar pattern.
The statistical significance of these differences ($P < 0.001$) is further supported by the high positive deviation in mixed water (+50%, +45.4%, +66%) as opposed to the negative deviation in bore water (-40%, -31.8%, -44%).This implies that the black cotton soil in the mixed water may add additional nutrients or favourable conditions that promote fish growth. Because of its lower organic content or water quality parameters, bore water alone seems the least conducive to growth. The study's findings emphasize the significance of water quality in aquaculture and indicate that adding nutrient-rich soil components to water sources may greatly improve fish growth performance in culture systems.

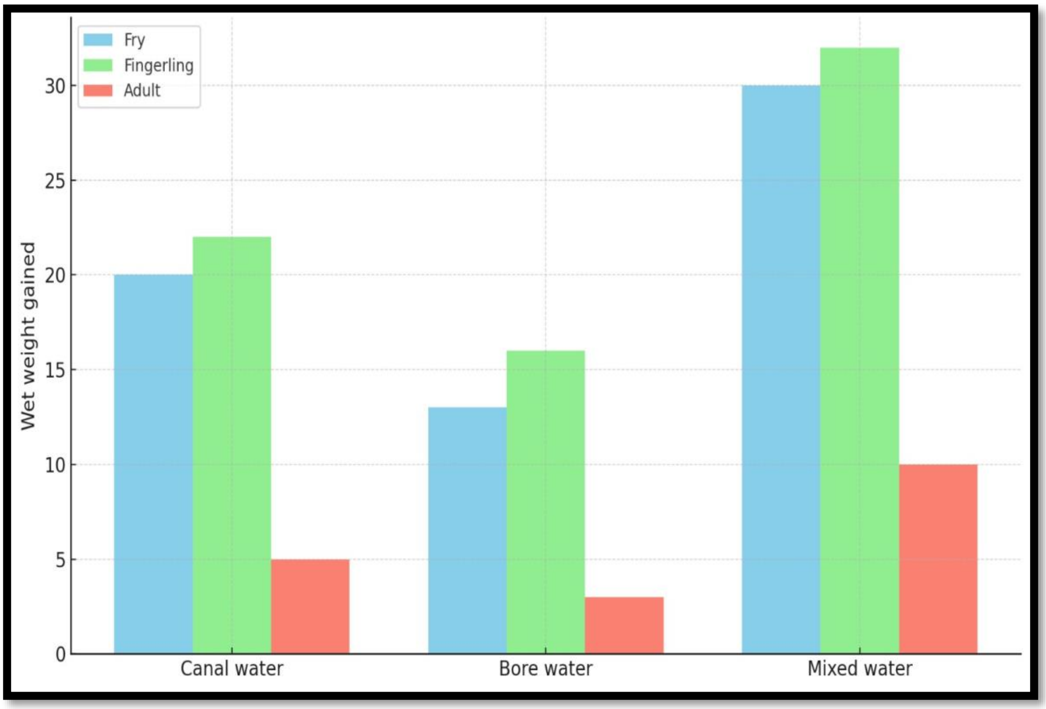

Figure2: Histograms showing the growth rate in terms of wet weight gained (% WWG) in fry, fingerling, and adult stages of *Labeo rohita* under different nutrient-based water conditions—canal water, bore water, and mixed water (bore water mixed with black cotton soil). Each value represents the mean of six individual measurements.

Conclusion
In Indian aquaculture, Labeo rohita is an essential species that provides substantial nutritional and economic advantages. A mix of genetic, environmental, and dietary factors affect its growth characteristics. Rohu can be made a sustainable and lucrative aquaculture species by optimizing these factors, which include using high-quality diets, keeping the water conditions favourable, and adding probiotics.The study concludes that Labeo rohita's growth performance at every developmental stage—fry, fingerling, and adult—is greatly influenced by the type of water used in aquaculture. The mixed water bore water supplemented with black cotton soil consistently produced the highest total length gain (TLG%) among the three tested water types, suggesting that it has favourable physicochemical properties or superior nutrient availability. Conversely, with negative deviation values at every stage, bore water alone demonstrated the poorest growth performance. The observed differences were statistically significant ($P < 0.001$), affirming the role of nutrient composition in promoting fish growth. Thus, adding organic-rich soil to improve water quality could be a useful tactic to raise aquaculture output.

References

1. Abareethan, M., & Amsath, A. (2015). Characterization and Evaluation of Probiotic Fish Feed. *International Journal of Pure and Applied Zoology*, *3*(2), 0. https://www.alliedacademies.org/articles/characterization-and-evaluation-of-probiotic-fish-feed.pdf
2. Akhtar, Pal, A., Sahu, N., Ciji, A., & Meena, D. (2012). Effects of Dietary Pyridoxine on Growth and Physiological Responses of Labeo rohita Fingerlings Reared in High Water Temperature. *Israeli Journal of Aquaculture - Bamidgeh*, *64*. https://doi.org/10.46989/001c.20617

3. Alikunhi, K.H.(1957), Fish culture in India, Farm Bulletin, *Indiancoun. Agri. Research,* New Delhi.5:24-28.
4. Chakrabarti, N. M. (1998). *Biology, culture and production of Indian major carps*. Narendra Publishing House.
5. Chacko, P.I. and Ganapati, S.V.(1956), Observations on biology and ecology of Inland water fishes of Madras with special reference to their suitability for culture. Madras fisheries station reports and yearbook.MadrasGovt.Press, 247-270.
6. Chaudhury, H. (2015). Experiments on induced spawning of Indian carp with pituitary injections.
7. Hora, S. L. (1962). Handbook of fish culture in the Indo-Pacific region. *FAO Fish Biol. Tech. Pap.*, *14*, 1-203.
8. Iqbal, K., Ashraf, M., Qureshi, N. A., Javid, A., Abbas, F., Hafeez-ur-Rehman, M., Rasool, F., Khan, N. M., & Abbas, S. (2015). Optimizing Growth Potential of Labeo rohita Fingerlings Fed on Different Plant Origin Feeds. *Pakistan Journal of Zoology*, *47*(1), 31–36. http://zsp.com.pk/pdf47/31-36%20(5)%20PJZ-1735-14%2011-12
9. Khan, R. A. (1972). Studies on the biology of some important major carps. *Unpublished Ph. D. Thesis, Aligarh Muslim University*, *Aligarh*.
10. Mishra, K., & Samantaray, K. (2004). Interacting effects of dietary lipid level and temperature on growth, body composition and fatty acid profile of rohu, Labeo rohita (Hamilton). *Aquaculture Nutrition*, *10*(6), 359–369. https://doi.org/10.1111/j.1365-2095.2004.00311.x
11. Mitra, G. N. (1942). Rate of growth in the first year of life of Labeo rohita and Catla catla in the different districts of Orissa. *Proc. Sci. Congr*, *29*(3), 159.
12. Mohapatra, S., Chakraborty, T., Prusty, A., Das, P., Paniprasad, K., & Mohanta, K. (2011). Use of different microbial probiotics in the diet of rohu, Labeo rohita fingerlings: effects on growth, nutrient digestibility and retention, digestive enzyme activities and intestinal microflora. *Aquaculture Nutrition*, *18*(1), 1–11. https://doi.org/10.1111/j.1365-2095.2011.00866.x
13. Murthy, H. S. (2002). Indian major carps. In *CABI Publishing eBooks* (pp. 262–272). https://doi.org/10.1079/9780851995199.0262
14. Rao, L. M., & Prasad, N. H. K. D. (2011). *Comparative studies on the food and feeding habits of Therapon jarbua (Forskal) in relation to aquatic pollution*. https://agris.fao.org/search/en/providers/122648/records/647480a42d3f560f80b1686b
15. Saeed, M., Salim, M., & Noreen, U. (2005). Study on the growth performance and feed conversion ratio of labeo rohita fed on soybean meal, blood meal and corn gluten 60%. *Pakistan Veterinary Journal*, *25*(3), 121–126. https://www.cabdirect.org/cabdirect/abstract/20053222885
16. Sharma, P., Kumar, V., Sinha, A. K., Ranjan, J., Kithsiri, H. M. P., & Venkateshwarlu, G. (2009). Comparative fatty acid profiles of wild and farmed tropical freshwater fish rohu (Labeo rohita). *Fish Physiology and Biochemistry*, *36*(3), 411–417. https://doi.org/10.1007/s10695-009-9309-7
17. Singh, P., Barik, P., Shukla, S. P., & Singh, S. K. (2005). *Effect of Protein Levels on Growth and Digestibility in the Indian Major Carp, Labeo Rohita (Hamilton) Using Slaughter House Waste as the Protein Source*.
18. Srivastava, C. B. L. (1999). Induced breeding of fish in India, growth and age studies. *A textbook of fishery science and Indian fisheries. PP*, *6869*(207,225).
19. Srivastava, C. B. L. (2011). Induced Breeding of Fish in India,Growth and Age Studies. In *A Text Book of Fishery Science and Indian Fisheries*. Kitab Mahal. https://www.vedamsbooks.com/books/a_text_book_of_fishery_science_and_indian_fisheries
20. Sumaira, A. (2009). *Growth performance and meat quality of labeo rohita , catla catla and cyprinus carpio under different treatments*. http://prr.hec.gov.pk/jspui/handle/123456789/134
21. Umer, K., Ali, M., Iqbal, R., Latif, A., Naeem, M., Qadir, S., Latif, M., Shaikh, R. S., & Iqbal, F. (2011). Effect of various nutrient combinations on growth and body composition of rohu (Labeo rohita). *AFRICAN JOURNAL OF BIOTECHNOLOGY*, *10*(62). https://doi.org/10.5897/ajb11.1682