# ASSESSMENT OF CONDITION INDEX AND FEED CONVERSION RATIO IN Carassius *auratus*

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**Abstract**

The present study evaluates the Condition Index (CI) and Feed Conversion Ratio (FCR) of *Carassius auratus*, commonly coined as Gold Fish under controlled conditions in two aquariums A and B. Growth parameters such as length (L), weight (W) and CI were recorded over eight months (March 2024 - October 2024) to assess the health and growth performance of the species using the Python script for data analysis, designed for a Streamlit app. Along with these, change in feed consumption and change in weight were also provided as inputs to know the FCR values. The study of goldfish (*Carrassius auratus*) in aquarium A and aquarium B reveals interesting insights into their growth parameters, particularly Condition Index (CI). The CI, which is an indicator of the fish's overall health and well-being, varies between the two aquariums. In Aquarium A, the CI starts at a relatively higher value of 42.08 and gradually decreases over time, suggesting a decline in condition as the fish grow. Similarly, Aquarium B shows a decline in CI, but the initial value is slightly higher, indicating better early-stage growth conditions. A lower FCR in Aquarium B suggests better feed efficiency, meaning the fish in this aquarium utilized their feed more effectively for growth (increase in biomass) compared to those in Aquarium A.

**Keywords:** *Carassius auratus*, Condition Index, Feed Conversion Ratio, Ornamental Fish Culture, Growth Performance

## 1. Introduction

Ornamental fish culture has gained significance due to its economic potential and growing market demand. Among ornamental species, *Carassius auratus* (goldfish) is widely cultivated for commercial and domestic purposes. The Condition Index (CI) is a crucial parameter for assessing the health status of fish, while the Feed Conversion Ratio (FCR) serves as an indicator of feed efficiency. Biologists have developed a wide range of morphological, biochemical, and physiological metrics to assess the health, and particularly the energetic status of individual animals. These metrics originated to quantify aspects of human health but have also proven useful to address questions in life history, ecology, and resource management of game and commercial animals. In this research, we review the application of condition indices (CI) for conservation studies and focus on measures that quantify fat reserves, known to be critical for energetically challenging activities such as migration, reproduction and survival during periods of scarcity. Standard methods score fat content or rely on a ratio of body mass rationalized by some measure of size, usually a linear dimension such as wing length or total body length. Higher numerical values of these indices are interpreted to mean an animal has greater energy reserves. Such CIs can provide predictive information about habitat quality and reproductive output, which in turn can help managers with conservation assessments and policies. We review the issues about the methods and metrics of measurement and describe the linkage of CIs to measures of body shape. Debates in the literature about the best statistical methods to use in computing and comparing CIs remain unresolved. Next, we comment on the diversity of methods used to measure body composition and the diversity of physiological models that compute body composition and CIs. The underlying physiological regulatory systems that govern the allocation of energy and nutrients among compartments and processes within the body are poorly understood, especially for field situations and await basic data from additional laboratory studies and advanced measurement systems including telemetry. For now, standard physiological CIs can provide supporting evidence and mechanistic linkages for population studies that have traditionally been the focus of conservation biology. Fish researchers can provide guidance for the field application of conditions indices with validation studies and development of new instruments.

This study aims to analyse these indices considering *C. auratus* as candidate species to understand their growth patterns and optimize feeding protocols for ornamental fish sector in fresh water environment, although saline water has considerable impact on estuarine fauna and flora (Mitra, 2000; Banerjee *et al*., 2013; Mitra, 2013; Sengupta *et al*., 2013; Mitra and Zaman, 2014; Mitra and Zaman, 2016; Mitra, 2019).

## 2. Methodology

Individual weights were taken at every 7 days interval throughout the trial periods of 8 months. Fulton's condition equation was used to find out the condition factor (Chow and Sandifer, 1991) as follows:

$$K = \frac{W}{L^3} \times 100$$

Where K is the condition factor, W is the average weight (g), and L is the average total length (cm).

It is to be noted that the value of K was generated as the output of a Fish Health & Wellness Tracker, which is a data-driven application developed using Python on analysing the Average Body Weight (ABW) and Average Body Length (ABL) of the selected fish species.

In addition to total production, feed conversion ratio (FCR) as production parameters was estimated after the period of experiment by drag netting and finally dewatering the aquaria as

FCR= Total feed intake/Total biomass gain

### 2.1. Fish Health and Wellness Tracker

The Fish Health & Wellness Tracker is a data-driven application developed using Python and Streamlit, designed to assess the health and efficiency of fish farming systems. The tool focuses on calculating two critical aquaculture performance indices: Condition Index (CI) and Feed Conversion Ratio (FCR), the outputs of which are displayed in Figs. 1 and 2.

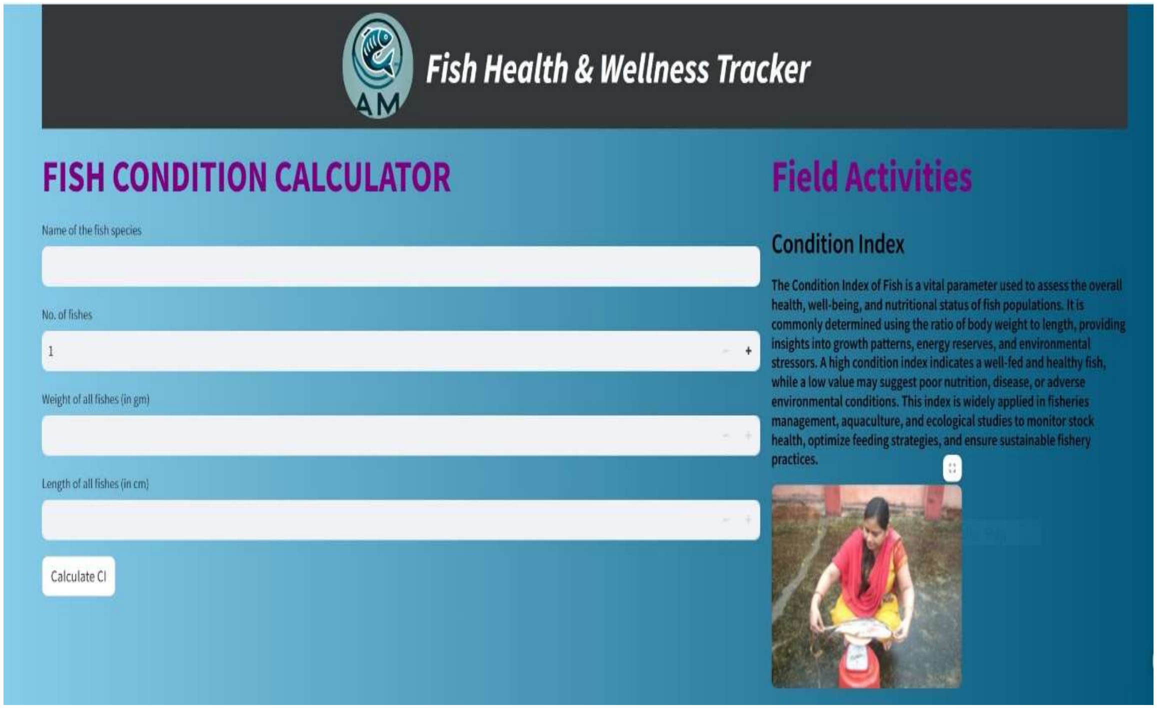


**Fig. 1. Fish Condition Calculator– Data Analysis with Streamlit**

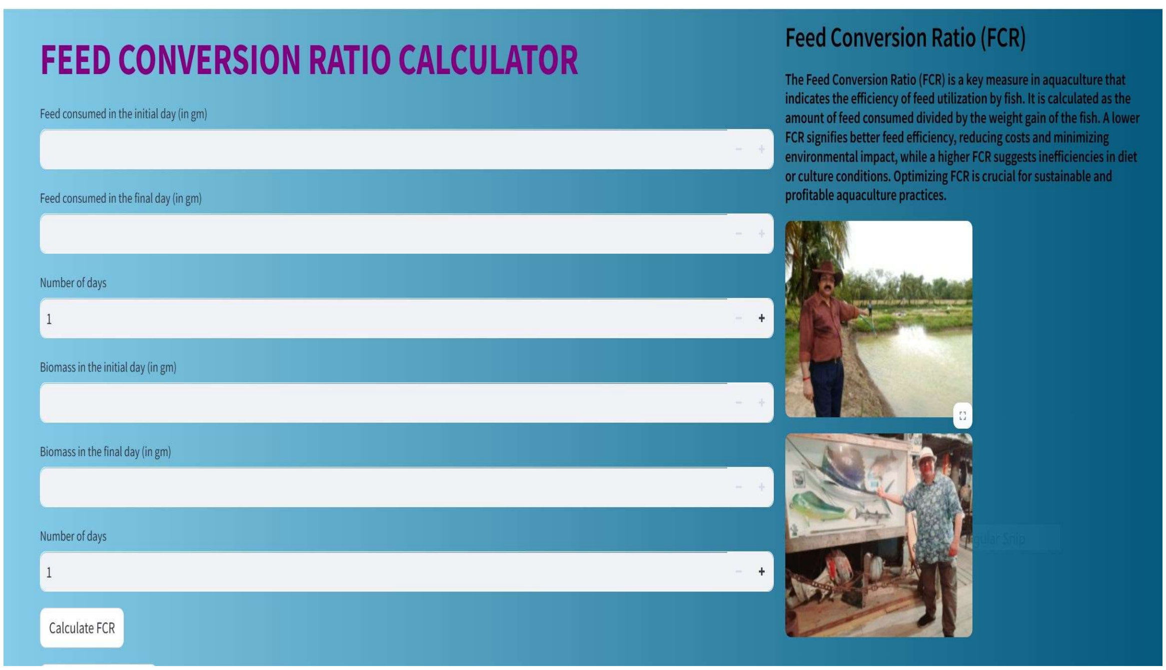


**Fig. 2. FCR Calculator – Data Analysis with Streamlit**

### 2.2. Streamlit Framework

The application is built using Streamlit, allowing users to input fish data and calculate key aquaculture parameters via a simple web-based interface.

**2.3. Session State Management**

Various session state variables (st.session_state) store user inputs and calculation result to maintain continuity during interactions. In Streamlit, st.session_state is a way to store and retain user inputs, computed values, or any other variables throughout an interactive session. This means that when a user interacts with the app—such as entering data, adjusting sliders, or triggering calculations—the values are saved in st.session_state. This allows for continuity so that the app remembers previous inputs and results even when users navigate different parts of the interface or trigger re-runs of the script. Essentially, it helps maintain a seamless user experience by preserving data across interactions instead of resetting everything on each refresh.

**2.4. Condition Index (CI) Calculation**

CI is computed as a function of average weight and average length, using the formula:

$$CI = \left(\frac{\text{Average Weight}}{\text{Average Length}^3}\right) \times 100$$

**2.5. Feed Conversion Ratio (FCR) Calculation**

The FCR metric assesses feed efficiency in fish, calculated as:

$$FCR = \frac{\text{Change in Feed Consumption}}{\text{Change in Biomass}}$$

where feed consumption and biomass changes are derived from user input.

**2.6. Data Storage & Retrieval**

Computed values on length, weight, CI, and FCR are saved in an Excel file as (**fish_health_wellness_checker_<session_id>.xlsx**), allowing users to track fish health data over time.

**2.7. User Interface & Input Handling**

The UI includes multiple text inputs, number inputs, and buttons, ensuring an interactive user experience.

**2.8. Data Visualization**

The app dynamically displays results, including CI and FCR calculations, helping users quickly interpret data.

**2.9.File Management & Deletion** Users can delete specific entries from the Excel file, ensuring data updates as needed.

### 2.10. Email Notification System

The app includes an email contact form that sends messages using SMTP, allowing communication with stakeholders (Fig. 3).

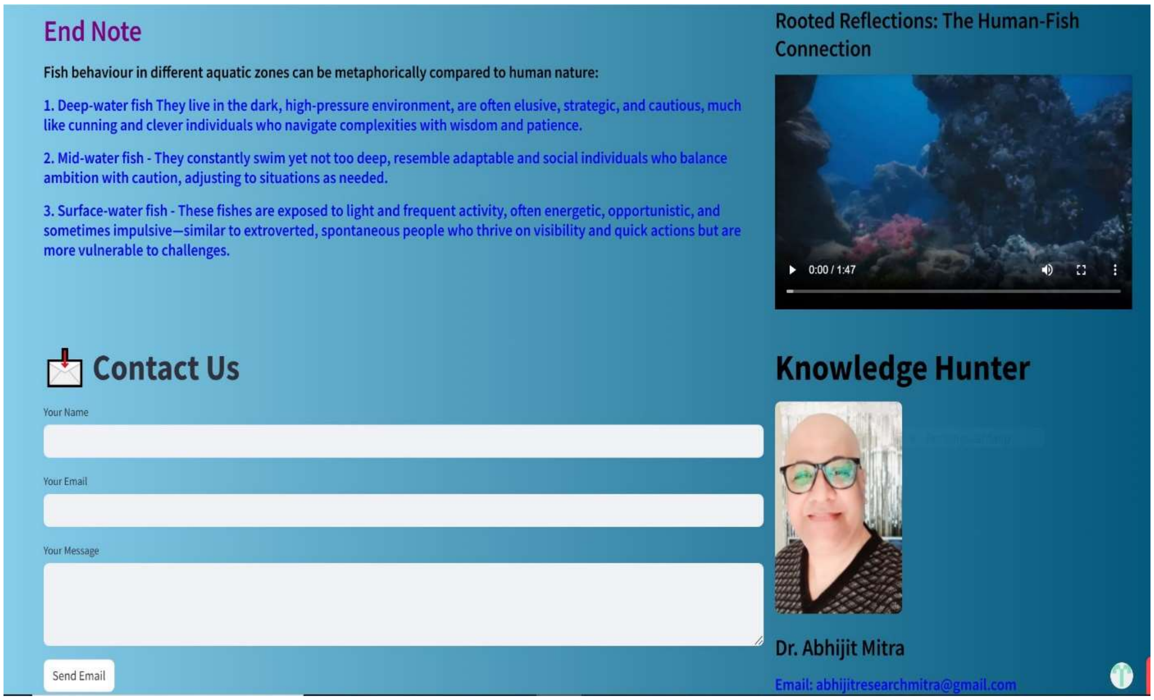


**Fig. 3. Fish Health Dashboard – Analysis & Communication *via* Streamlit**

## 3. Results and Discussion

Considering the importance of culturing ornamental fishes, their export value, and several ecosystem services, several works have been conducted by Green, 2003; Fossa, 2020; Dey, 2016; Olivier, 2001; Biondo, 2017; Moorhead and Zeng, 2010; Lubbock and Polunin, 1975; Bell et al., 2009; Townsend, 2011; Calado et al., 2017; Olivotto et al., 2011; Sayers, 2008; Chan et al., 2019; Pouil et al., 2019; Andrews, 1990; Surtida, 2020; Penning et al., 2009; Raghavan et al., 2013; Teletchea, 2016; Whittingtonand Chong et al., 2007; Ploeg, 2007; Saxby et al., 2010; Chidambaran, 2009; Wood, 2001; Leal et al., 2015; Cheong, 1996; Bartley, 2000; Ekaratne, 2000; Watson, 2000; Jordan, 2001; Olivier, 2003; Huntington, 2002; Gopakumar, 2004; Shuman et al., 2005; Kurup and Ravindran, 2005; UNEP-WCMC, 2008; Howard, 2012; Tissera, 2012; Pasaribu-Guzina, 2013; Hmtnb, 2014; Livengood, 2015; Bruckner, 2000; Chapman, 1997; Adamas et al., 2001; Smith et al., 2008; Reynoso et al., 2012; Floyd, 1984; Dufour, 1997; Wikesekara and Yakupitiyage, 2001; Ochiavillo et al., 2004; Mutia and Suna, 2007; Duco and Vallejo, 2013; Manduppa et al., 2014; and Sinansari and Priono, 2018. The present work is an attempt to monitor the growth parameters of fish using the Python script for data analysis, designed for a Streamlit app, which is perhaps the first attempt in the sector of ornamental fishery.

The tracker enables users to:

- Input raw data on fish weight, length, and feed consumption.
- Compute **CI** and **FCR** using built-in functions.

- Store, retrieve, and delete records dynamically.
- Save results in **Excel format** for further analysis.
- Use interactive visualizations and structured reports for aquaculture monitoring.

This scientifically structured approach ensures accurate monitoring of fish health and productivity, facilitating informed decision-making in sustainable aquaculture management.

The study of goldfish (*Carrassius auratus*) in aquarium A and aquarium B reveals interesting insights into their growth parameters, particularly Condition Index (CI). The CI, which is an indicator of the fish's overall health and well-being, varies between the two aquariums. In Aquarium A, the CI starts at a relatively higher value of 42.08 and gradually decreases over time, suggesting a decline in condition as the fish grow. Similarly, Aquarium B shows a decline in CI, but the initial value is slightly higher, indicating better early-stage growth conditions. Additionally, differences in weight and length between the two aquariums suggest variations in feeding efficiency and environmental factors. Despite these discrepancies, both aquariums exhibit a downward trend in CI, which may indicate a need for dietary adjustments or improved water quality management. The study underscores the importance of continuous monitoring of fish health metrics to ensure sustainable growth and optimal rearing conditions.

The FCR for aquarium A is 1.44, calculated from an initial feed input of 10 grams and a final feed input of 12.07 grams, with a total biomass increase of 1.429 grams. The FCR for aquarium B is 1.1634, derived from an initial feed input of 11.05 grams and a final feed input of 12.26 grams, with a total biomass increase of 1.04 grams. A lower FCR in aquarium B suggests better feed efficiency, meaning the fish in this aquarium utilized their feed more effectively for growth compared to those in Aquarium A.

## 4. Conclusion

The study evaluates the Condition Index (CI) and Feed Conversion Ratio (FCR) of *Carassius auratus* under controlled conditions in two aquariums, A and B, over eight months (March 2024 - October 2024). Key growth parameters, including length (L), weight (W), and CI, were recorded using a Python-based Streamlit application for data analysis. Additionally, feed consumption and weight change were monitored to determine FCR values. The results indicate a gradual decline in CI in both aquariums, with Aquarium A starting at 42.08 and decreasing over time. In contrast, Aquarium B initially exhibited a slightly higher CI, reflecting better early-stage growth conditions. Notably, the lower FCR in Aquarium B suggests superior feed efficiency, indicating that the fish in this setup utilized their feed more effectively for biomass gain compared to those in Aquarium A. These findings provide valuable insights into the health and growth performance of goldfish under controlled conditions.

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