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Evaluating The Suitability of *Cirrhinus Mrigala* in a Sintex Tank Culture System: A Promising Experimental Study

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Abstract

This pioneering study conducted by the Department of Aquaculture aimed to assess the suitability of Cirrhinus Mrigala, a freshwater species, for cultivation in a Sintex tank. The objective was to determine the growth potential and productivity of Cirrhinus Mrigala in this specific tank culture system. Over a period of 60 days, the final weights of the fish specimens were recorded as follows: 2.0g, 4.30g, 6.96g, 9.98g, 11.21g, and 14.17g, respectively. The total fish yield achieved during this period was 437.58 grams, utilizing a natural feeding regime. This study provides valuable insights as the first investigation in this domain, revealing promising indications for the implementation of Sintex tank culture for Cirrhinus Mrigala cultivation.

Keywords: *Cirrhinus mrigala, Sintex tank, Aquaculture, Feeding*

1. Introduction

India is globally recognized as the third-largest producer of aquaculture, trailing only behind China (FAO, 2014). The fishing industry in India is a significant contributor to the country's economy, employing over seven million people and generating substantial annual revenue (Gadage RS, 2005). Fisheries and aquaculture play a fundamental role in providing food, nutrition, livelihood, and economic stability for millions of people. Given its affordability and high-quality protein content, fish consumption can contribute to combating hunger and malnutrition in the nation. India's fishing industry has undergone significant development over the years, emerging as a crucial socio-economic sector. The country contributes around 16% of the world's inland fish production and 5% of marine fish production, with a total fish yield of 162.48 lakh tonnes in 2021-2022 (Handbook on Fisheries Statistics, 2022).

Among the various fish species cultivated in India, major carps hold a prominent position due to their rapid growth and high consumer acceptability (V.P. Saini et al., 2014). These carps account for approximately 87% of the country's total freshwater aquaculture production (Ayyappan S and Jena JK, 2003). Consequently, India possesses immense potential for the development of fish-based enterprises, with a focus on fish production, marketing, and consumption. The three primary carps in Indian freshwater aquaculture are Catla (Catla catla), Rohu (Labeo rohita), and Mrigal (*Cirrhinus mrigala*). These carp species are preferred by farmers due to their fast growth rates and high consumer demand. Additionally, certain exotic carp species, such as Ctenopharyngodon idella, Hypopthalmichthys molitrix, and Cyprinus carpio, have successfully adapted to Indian water conditions (Basant Bais, 2018).

Cirrhinus mrigala, also known as the Mrigal, is a fish species found in rivers and lakes in northern India. They have a streamlined body with a round abdomen and a deeply forked caudal fin. The mouth is wide and transverse, with a depressed snout and a complete top lip. Mrigal has two barbels and golden-colored eyes. It grows to an average length of around 40 cm and is well-suited for aquaculture

in South India. Breeding occurs during the monsoon season, and forced breeding techniques are commonly used in its cultivation. There are several inter-generic hybrid fries available for culture. The fingerlings and adults primarily feed on animal protein. Maturity is reached by the age of two, although induced breed fish may reach maturity at one year old. Natural breeding usually occurs during the monsoon season, and fingerlings are available for sale from July to November. Mrigal can be found in rivers, tanks, and water bodies in regions such as Burma, the major river systems of India, the Deccan, Punjab, Sindh (Pakistan), Cutch, and Bengal (Basant Bais, 2018).

The fishing sector is a significant driver of India's foreign exchange profits and contributes substantially to the national economy. Fish production in India has surged from 56.56 lakh tons in 2000-01 to 162.48 lakh tonnes in 2021-22. Andhra Pradesh, West Bengal, Karnataka, Odisha, and Gujarat are the top five fish-producing states (Handbook on Fisheries Statistics, 2022). Major carps, including *Cirrhinus mrigala*, are important freshwater fish species cultivated in Asia, particularly in the Indian subcontinent. They are also commonly raised in semi-intensive composite culture systems in Pakistan. The aim of fish culture today is to maximize production under intensive culture conditions with the use of artificial nutrients (Silva *et al.*, 2022).

Fish farming, conducted in tanks, ponds, and pools, has gained popularity as more people seek a sustainable and healthy source of food for their families (Bharti, Pandey, and Vennila, 2016; Boyd *et al.*, 2020). Tank culture offers advantages such as reduced feeding and harvesting time, as well as the ability to treat diseases more effectively due to smaller tank volumes. Intensive tank culture can maximize yields even on small parcels of land. However, the aquaculture industry faces challenges such as disease outbreaks, environmental degradation, and labor shortages, which must be overcome to ensure sustainable fish production (Yue and Shen, 2022).

Circular tanks are an attractive choice for fish farming due to their ease of maintenance, ability to maintain uniform water quality, and the option to optimize fish health and condition through control of rotational velocities. Additionally, circular tanks allow for efficient removal of settleable solids through the center drain.

2. Materials And Methods

Tanks for Culturing:

Initially, a Sintex tank was chosen for the experiment. The tank is a round plastic container with a bottom outlet. A pipe was used to bring in water from the outside source (Fig.B and Fig.C).

Fig.A. Study area: Adikavi Nannaya university, Rajamahendravaram (17˚03'59"N81˚52'23"E)
Fig.B. Water Inlet;
Fig.C. Water Outlet;
Fig.D. Fermentation Process

Fermentation:

To initiate the fermentation process, we used 2 kg of rice bran, 1 kg of jaggery, and 100 grams of yeast powder. These were mixed with 10 liters of water for a 48-hour period (Fig.D).

Selection of Fish Species

Cirrhinus mrigala was selected for the Sintex tank culture based on its economic importance.

Stocking of Fish

Fingerlings of *Cirrhinus mrigala* were obtained from Balabhadrapuram. The fingerlings were transported in polythene bags infused with oxygen. Each fish was weighed and measured before being stocked. A total of 40 fingerlings were stocked in a 1000-liter tank.

Feeding

After stocking, the fishes were fed with natural feed rice bran. The feed amount was 2% of their body weight in the morning at 9:00 AM and in the afternoon at 3:00 PM. After 40 days, the feed amount was increased to 3% of their body weight.

Sintex Tank Management

To properly maintain the Sintex tank, 200 liters of water were added to the 1000-liter tank. The tank was covered with a green fabric to protect it from direct sunlight. Water exchange was done every ten days. Water quality parameters were monitored daily. Feeding was conducted daily at 9:00 AM and 3:00 PM.

Culture Period

The fingerlings were cultured in the Sintex tank for a period of 60 days, from February 2022 to April 2022.

Water Quality Parameters

Important water quality parameters such as temperature, pH, total alkalinity, dissolved oxygen (DO), hardness, ammonia, nitrite, and nitrate were regularly measured and analyzed following the standard procedures recommended by APHA (2000).

3. Results and Discussion

Growth and production performance of *Cirrhinus mrigala* in tank culture

The growth performance of *Cirrhinus mrigala* in a sintex tank in terms of final length and weight, weight gain percentage, specific growth rate (SGR%), daily growth rate (DGR), survival rate, and total production are shown in the table below.

Length Gain

The mean initial length of *Cirrhinus mrigala* for the 60-day culture period was 5.6 cm, 6.2 cm, 7.0 cm, 8.4 cm, 9.6 cm, and 10.2 cm, respectively.

Weight Gain

The percentage of weight gain in natural feeding sintex tanks was 2%, 4.30%, 6.96%, 9.98%, 11.21%, and 14.17%, respectively.

Specific Growth Rates (SGR)

The mean percentage specific growth rates (SGR) over a 60-day period, with 10-day regular intervals, were 0.049%/day/fish, 0.487%/day/fish, 2.551%/day/fish, 4.156%/day/fish, 4.018%/day/fish, and 3.447%/day/fish, 3.263%/day/fish respectively.

Daily Growth Rates (DGR)

The mean daily growth rate of *Cirrhinus mrigala* in natural feeding sintex tanks was 0.01 g/day, 0.115 g/day, 0.165 g/day, 0.199 g/day, 0.184 g/day, and 0.202 g/day, respectively.

Mortality

Out of the 40 fishes placed in the sintex tank, 10 fishes died in the first week. After that, there were no more deaths recorded.

Survival Per Cent

The survival rate was 75%, with most of the deaths occurring in the first ten days of the experiment period.

Yield/Total Production

The total weight gained (yield) of *Cirrhinus mrigala* in the 60-day sintex tank culture with natural feeding was 437.58 g.

Water Quality Parameters

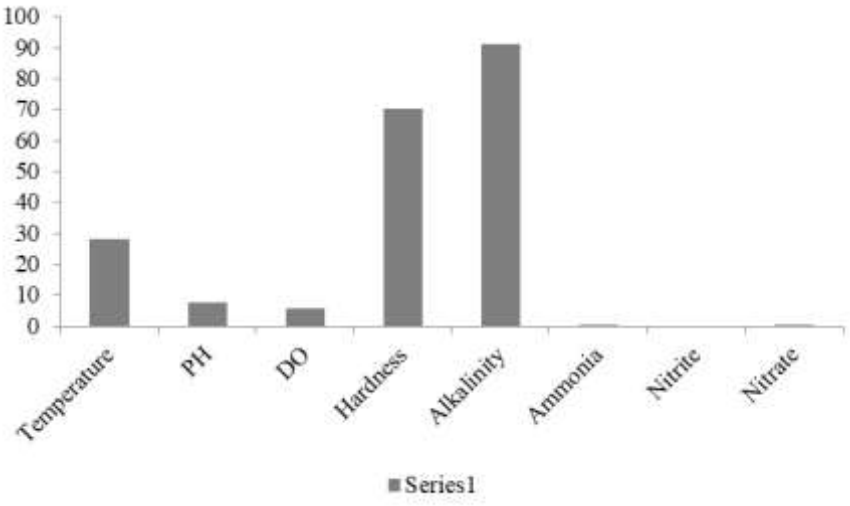
Physical parameters such as temperature and pH, as well as chemical parameters such as dissolved oxygen (DO), alkalinity, hardness, ammonia, nitrite, and nitrate, were measured at daily intervals throughout the study period. The mean values (±SD) of water quality parameters for different treatments are shown in the table below.

The main objective of the present study was to assess the suitability of *Cirrhinus mrigala* for tank culture in terms of growth performance with natural feed and the maintenance of water quality parameters.

Water quality parameter:

Every 10 days average pH ranged from 7.5-7.91

Every 10 days average D.O (mg L -1) was ranged from 5.0-6.0 respectively



Graph.1. Water quality parameters of *Cirrhinus Mrigala* tank

Growth performance:

In the present study, during 60 days' time *Cirrhinus Mrigala* attained the weight of 14. 17gm. from initial weight of 2gm show in (Shown in Fig.G and Fig.H)

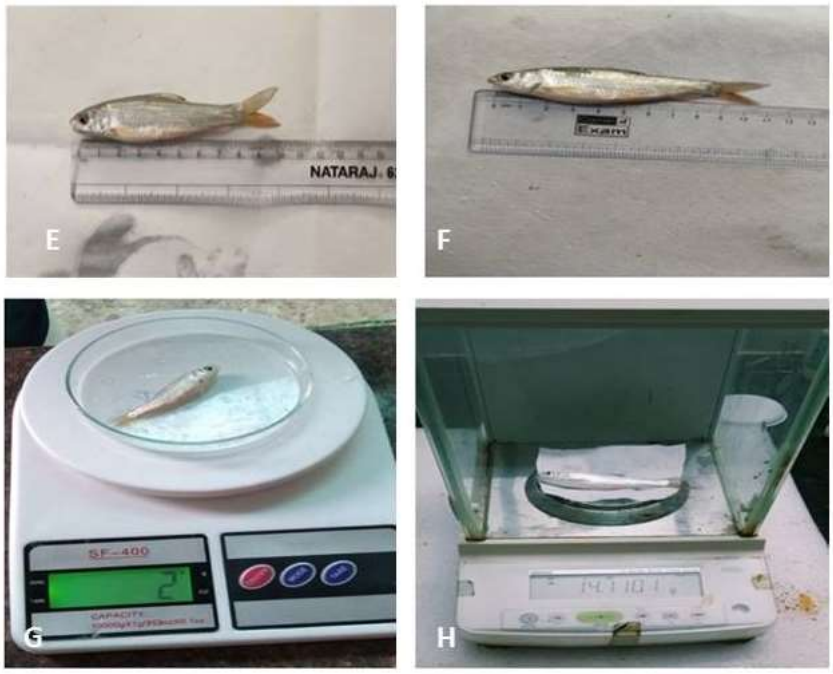
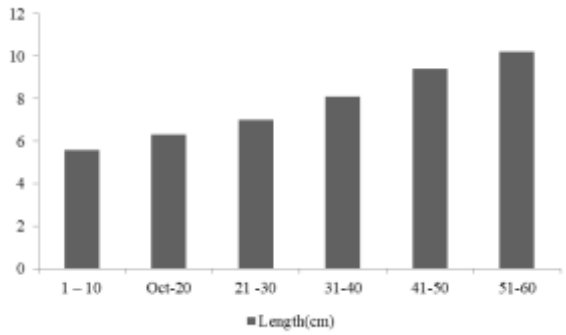
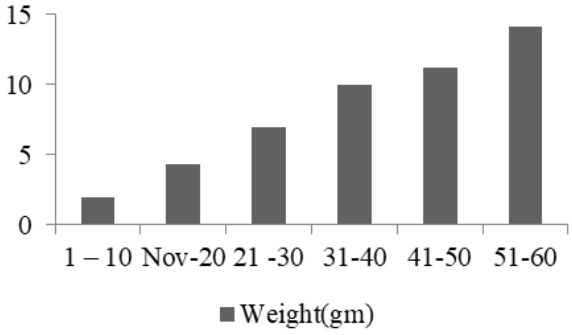


Fig.E.Initial length; **Fig.F**.Final length;

Fig.G.Initial weight; **Fig.H.**Final weight



Graph.2. The above chart indicates the body length of *Cirrhinus mrigala*



Graph.3. The above chart indicates the body weight of *Cirrhinus Mrigala.*

Table.1. Growth Study of 40 *Cirrhinus mrigala* Fingerlings Fed Naturally from February 2022 to April 2022

Days	Initial length(cm)	Final length (cm)	Initial weight (gm)	Final weight (gm)	SGR (%)	DGR	Mortality	Survival (%)
1 – 10	5.6	5.6	2	2.001	0.004	0.01	09	77.5
11 -20	5.6	6.3	2.001	4.30	2.551	0.115	00	77.5
21 -30	6.3	7.0	4.30	6.96	4.156	0.165	01	75
31-40	7.0	8.1	6.96	9.98	4.014	0.199	00	75
41-50	8.1	9.4	9.98	11.21	3.447	0.184	00	75
51-60	9.4	10.2	11.21	14.17	3.263	0.202	00	75

Weight gain percentage (WG%), specific growth rate (SGR%), and daily growth rate (DGR) are listed as columns 5, 6, and 7 respectively.

Calculations:

1. For 10 days:

   1 piece = 2g

   Total = 30 x 2 = 60 x 3% body weight / 100 = 1.8g x 10 = 18g

2. For 20 days:

   1 piece = 0.30g

   Total = 4.30 x 30 = 129 x 3% body weight / 100 =

   3.87 x 10 = 38.7g

3. For 30 days:

   1 piece = 6.96g

   Total = 6.96 x 30 = 208 x 3% body weight / 100 =

   6.264 x 10 = 62.64g

4. For 40 days:

   1 piece = 9.98g

   Total = 9.98 x 30 = 299.4 x 3% body weight / 100 =

   8.982 x 10 = 89.82g

5. For 50 days:

   1 piece = 11.21g

   Total = 11.21 x 30 = 336.3 x 3% body weight / 100 =

   10.089 x 10 = 100.89g

6. For 60 days:

1 piece = 14.17g

Total = 14.17 x 30 = 425.1 x 3% body weight / 100 =

12.753 x 10 = 127.53g

Total feed for 60 days = 437.58g

Total body weight = 425.1g

- FCR (Feed Conversion Ratio) = Total consumed by fish / Weight gain by fish

FCR = 437.58 / 425.1

FCR = 1.029 g

Daily weight gain = Final weight - Initial weight / Days

= (14.17 - 2) / 60

= 0.202 g

Length gain = Final length - Initial length

= 10.2 - 5.6

= 4.6 cm

SGR = (LnWt. - LnWi) x 100 / Δt

= (Ln14.17 - Ln2) x 100/60

= (2.651-0.693) * 100/60

= 3.263 %

Table. 2. Physico chemical parameters in sintex tanks at Adikavi Nany University.

Day	Temperature	P^H	DO	Hardness	Alkalinity	Ammonia	Nitrite	Nitrate
1	26.1^0C	7.6	6.0	30	60	0	0	0
2	27.1^0C	7.6	6.0	30	70	0	0	0
3	27.2^0C	7.7	5.6	40	60	0	0	0
4	27.1^0C	7.8	5.7	40	70	0	0	0
5	28.3^0C	7.8	6.0	60	60	0	0	0
6	28.4^0C	7.9	5.6	60	100	0	0	0
7	26.6^0C	8.0	5.6	60	80	0	0	0
8	26.3^0C	8.1	5.4	70	80	0	0	0
9	27^0C	8.1	5.2	80	80	0	0	0
10	28.2^0C	8.2	5.0	80	120	0	0	0
11	27.1^0C	7.6	6.0	40	120	0	0	0
12	27.4^0C	7.8	6.0	40	100	0	0	0
13	25^0C	7.9	5.9	50	80	0	0	0
14	27.6^0C	7.8	5.8	70	60	0	0	0
15	29^0C	7.7	6.0	40	100	0	0	0
16	29.3^0C	7.9	5.9	60	80	0	0	0
17	28.20C	8.0	5.5	50	80	0	0	0
18	27.60C	8.1	5.4	50	80	0	0	0
19	25.50C	8.1	5.2	60	90	0	0	0
20	30.10C	8.2	5.0	80	100	0	0	0
21	27.30C	7.9	5.8	60	60	0	0	0
22	24.60C	8.1	6.0	60	80	0	0	0
23	290C	7.5	5.6	40	120	0	0	0
24	26.60C	8.1	6.0	60	100	0	0	0
25	29.10C	7.5	5.6	40	80	0	0	0
26	290C	7.6	5.8	40	80	0	0	0
27	28.40C	7.9	5.7	50	60	0	0	0
28	27.80C	8.0	5.9	60	80	0	0	0

29	280C	7.5	5.8	60	100	0	0	0
30	28.40C	7.4	5.7	80	80	0	0	0
31	280C	7.7	6.0	50	60	0	0	0
32	27.50C	7.9	6.1	50	80	0	0	0
33	27.10C	8.0	5.8	60	80	0	0	0
34	240C	8.1	6.2	80	100	0	0	0
35	29.30C	7.9	5.8	50	80	0	0	0
36	27.80C	7.7	5.8	60	100	0	0	0
37	26.50C	7.6	6.0	50	80	0	0	0
38	28.0C	7.6	5.9	60	80	0.03	0	0.20
39	280C	7.5	5.8	60	100	0.09	0	0.26
40	29.10C	7.5	5.7	50	120	0.10	0	0.96
41	28.10C	7.6	5.8	60	120	0	0	0
42	27.10C	7.8	5.9	50	120	0	0	0
43	25.40C	7.9	6.0	60	100	0	0	0
44	26.20C	8.0	6.1	80	80	0	0	0
45	27.90C	7.8	6.0	80	100	0	0	0
46	28.30C	7.8	5.8	100	80	0	0	0
47	28.60C	7.7	5.8	120	100	0	0	0
48	30.20C	7.6	5.7	140	120	0.02	0	0.25
49	32.10C	7.5	5.6	180	130	0.06	0	0.86
50	30.20C	7.5	5.7	160	110	0.12	0	1.01
51	27.90C	7.8	6.2	40	100	0	0	0
52	28.20C	7.9	6.0	50	80	0	0	0
53	29.60C	7.9	6.0	60	80	0	0	0
54	30.10C	7.8	5.8	80	100	0	0	0
55	30.30C	7.7	5.6	100	120	0	0	0
56	31.00C	7.7	5.5	120	100	0	0	0
57	32.10C	7.8	5.4	100	120	0.04	0	0.92
58	31.60C	7.9	5.5	120	100	0.12	0	1.56
59	32.10C	7.6	5.4	140	120	0.18	0	2.92
Total	**1691.9**	**467.7**	**340**	**4210**	**5470**	**1.01**	**0**	**13.26**
Total/10	**28.19**	**7.795**	**5.66**	**70.16**	**91.16**	**0.016**	**0**	**0.221**

The results of the present study are supported by previous researchers who conducted experiments on growth and survival tests with different supplementary diets for various fish species (Abbas et al., 2010; Rahman & Rahman, 1999). Table. 2 shows the water qualities measured in the sintex tank during the fingerling raising. The temperature, pH, dissolved oxygen, and total alkalinity were found to be within the ideal range for the growth of these carp species (Jana & De, 1988, 1993; Jena et al., 1998).

4. Conclusion

Based on the findings, *Cirrhinus mrigala* was found to be a suitable fish species for sintex tank culture at the Adikavi Nannaya University. However, since sintex tank culture is not well-known among local businesspeople and fishermen, it is necessary to conduct root-level extension programs to increase awareness and acceptance of these cultural practices. Given the wide regional distribution of *Cirrhinus mrigala* in India and its consumer acceptance, it is crucial to prioritize the modification and advancement of techniques for its culture. Considering the eco-socio-economic context of the smallscale farmers, tank culture of *Cirrhinus mrigala* seems to be the most viable option for sustainable fish production. Especially for a densely populated country like India, sintex tank culture is essential.

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