



An assessment of production by Induced Breeding Techniques of Carps in Nuapada and Kalahandi Districts of Odisha

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ABSTRACT

India is the third largest producer of fishes across the globe. Fish provides protein, vitamins, minerals and omega-3 fatty acids. The induced breeding technique was conducted in three farms, one in Nuapada district and two farms in Kalahandi district during the period of June-September 2022 and January-March 2023. Five varieties of carp species were selected for induced breeding i.e, the Indian Major Carp (*Labeo rohita*, *Catla catla*, *Cirrhinus cirrhosis*) and Minor Carps (*Cyprinus carpio* & *Ctenopharyngodon idella*). Mature, healthy & ripped brood stocks are being selected for this process. Ovaprim hormone was injected in the selected carp species. 0.2-0.7 ml of hormone was injected in each species according to the body weight. Determination of ovulation, fertilization and hatching rate was also observed. It was observed that ovulation takes place within 6-7 hrs after injection. Hatching takes place after 18-20 hours in Indian Major Carps and 42-46 hours in Common Carps & Grass Carps. The spawn production rate of selected carp species was checked. This study determined several environmental factors which affects in induced breeding in carps such as temperature (22°C-27°C), rainfall, pH (7.1-8.0), water parameter, etc. It is concluded that by using the induced breeding technique the fish production was increased along with mortality rate.

Keywords: Ovaprim, ovulation, spawning, hatching, seed production, fingerlings.

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INTRODUCTION

Fishing in the initial half of the 20th century was mostly an artisanal inshore catch fishery utilizing sailboats and catamarans and Bengal carp culture i.e. catla, rohu, and mrigal [1]. After China, India is the third largest producer of Fish in 2021-22. Fish is rich in protein, vitamins, and minerals like calcium, phosphorous, zinc, iodine, magnesium, and potassium [2]. It also provides omega-3 fatty acids. It is very essential for heart patients, helps in lowering high blood pressure, and also healthy for brain [2]. Carp culture is very common in India. Carps are numerous members of the Cyprinidae family that live in oily freshwater ecosystems. They are commonly found in Asian and European continent, while peoples from other parts of the world also consume carps. The Indian Major Carps such as rohu, catla, and mrigal are known as Gangetic carps. In North India they are the natural habitants of river Ganga, Yamuna, Gomati, and Brahmaputra [3]. Common Carp (*Cyprinus carpio*) is native to Central Asia and is widely distributed all over the world. Because of its capacity to endure a variety of settings, common carp has become one of the most important foreign species to spread over the world [4]. The common carp is one of the world's most economically significant and frequently produced freshwater fish, accounting for 11% of total freshwater aquaculture reproduction [5]. Grass carp (*Ctenopharyngodon idella*) is native to China-continent. Due to the grass carp's feeding habits, the releasing of grass carp at the above stocking rate standard is widely practiced with favorable outcomes in fish (eel and carp) culture ponds with weed problems, or castle moats, park ponds, and factory reservoirs that are not for fish culture [6].

With the rise of intense carp aquaculture in the past few decades in India, farmers' need for seed is growing year after year [7]. As per the increasing population in the world, it is very difficult to get sufficient number of fish which are naturally occurring [8-10]. To overcome this problem induced breeding technique is done to breed the fishes [2]. Induced breeding is a technique whereby ripe fish breeders are stimulated by

Pituitary Extract or any other synthetic hormone [2]. Cultivable carp seed production is mostly dependent on induced breeding, and its success is heavily reliant on the availability of well-maintained broodstock [11-12]. Induced breeding by hypophysation created a high proportion of eggs that hatch, boosted development and survival, and increased the adaptability of the larvae to environmental changes [13]. The main issue with carp culture is a lack of quality fish seed. Initially, fish seeds were gathered from river banks using cloth happas, but this method was dangerous since, as with carp seed gathering, some predatory fish seeds were also mistakenly collected [14]. Chaudhary and Alihunhi [15] performed the first successful spawning of Indian big carps using induced breeding using pituitary extracts. This approach was thereafter applied across India.

The freshwater fish fauna of India is highly diverse in nature and consist of 1027 species [16]. Odisha contribute about 13.92% to the freshwater fish fauna of India [17]. Dr. Hiralal Chaudhri, a Bengali fisheries scientist discovered induced breeding technique in the year 1957 and is known the “Father of induced breeding of the carp” as well as the “Father of Blue Revolution” in India. Induced breeding in Odisha have been studied and described in many studies like [2, 7, 18, 19]. However no details investigation has been taken up so far on the induced breeding technique of Nuapada and Kalahandi district of Odisha. In the present study a systematic check list of fishes of the district is prepared based on the research study and available literatures.

MATERIAL AND METHODS

Study Area

Odisha state is the one of the coastal states in India extending from 17° 49' N to 22° 34' N latitude and 81° 27' E to 87° 11' E longitude the Eastern part of India. This study was conducted in two districts namely Kalahandi and Nuapada. This district covers area of 7920 sq km lies in between 19.175489° to 20.454517° North latitude and 82.617767° to 83.794874° East longitude (Govt. of Odisha, 2023). The climate of Kalahandi district is extremely dry except in monsoon. The district consists of plain land, hills & mountains and is famous for its rich in culture and for gemstone. Nuapada district occupies total area of 3,852 sq km and is located between 21° 0' N to 21°06' N latitude and 82° 19' E to 82°60' E longitude. Mahanadi river basin passes through it and Jonk River is the key river in this district. Khariar Tehsil in Nuapada district have Vertisol type soil i.e; Black soil is found with rich in potassium and nitrogen [20].

Tropical Dry Deciduous Forests are present in this area. In Kalahandi District Northern Tropical Dry Deciduous Forests are present in this area. Red soil is dominant in this district which covers 45% of the total area and is poor in nitrogen, phosphate, potassium and organic matters. The study areas located in Kalahandi and Nuapada districts are i) a Government farm named as “Fish Seed Hatchery Project” AT/PO-Habaspur, Junagarh. ii) at a Private farm “Nilamadhab Fish Seed Farm, AT/PO- Arada, Khariar. iii) Prafulla Intrigated Fish & Seeds Farm, Bhairipali, Block- Jaipatna [20].

Table 1. The following Carp Species were studied in the in present work

Sl.No	Scientific Name	Class	Order	Family	IUCN Status
1	<i>Labeo rohita</i>	Actinopterygii	Cypriniformes	Cyprinidae	LC
2	<i>Labeo catla</i>	Actinopterygii	Cypriniformes	Cyprinidae	LC
3	<i>Cirrhinus cirrhosus</i>	Actinopterygii	Cypriniformes	Cyprinidae	VU
4	<i>Cyprinus carpio</i>	Actinopterygii	Cypriniformes	Cyprinidae	VU
5	<i>Ctenopharyngodon idella</i>	Actinopterygii	Cypriniformes	Cyprinidae	LC

External secondary sexual characteristics were used to select mature male and female carp (Jhingran and Pullin 1984). Ovaprim hormone was used in common carps and Indian major carps (figure 4). Ovaprim contains an analog of salmon gonadotropin releasing hormone (sGnRHa) and dopamine inhibitor which helps to promote and facilitate reproduction of carps [21]. A good stock of breeders is important for successful induced breeding. The breeders should be fully ripped, healthy and medium in size (figure 7). Ovulation takes place after 6-7 hours on injection given to the carp. In carps, one female and two males are placed in a br hatchery pool (figure 8) or breeding hapa (figure 9) for spawning. Hatching occurs after 18-20 hours in Indian Major Carps and 42-46 hours in Common & Grass Carp [22]. Inside the breeding pool the female and male brood get excited and female start laying eggs as well as male fish release milt.

The egg then mixed with milt and get fertilized [22]. After fertilization the eggs are being collected from the hatchery (figure 6). The fertilized egg appears transparent whereas the unfertilized egg is opaque and whitish. [23] Normally 45-55 lakhs spawn is produced per day of breeding. The production increases in rainy days because of favorable conditions which involves releasing of more eggs to the water column. Then the spawn is collected from the outer hapa and transferred to the pond nursery. They spawn feed on zooplanktons for the growth and development and become fry [2].

Determination of Ovulation, Fertilization and Hatching Rate

The following formula was used to compute the ovulation rate, fertilization rate, and hatching rate:

$$\text{Ovulation rate (\%)} = (\text{No. of fish ovulated} / \text{Total no. of fish injected}) \times 100$$

$$\text{Fertilization rate (\%)} = (\text{No. of fertilized eggs} / \text{Total no. of eggs}) \times 100$$

$$\text{Hatching rate (\%)} = (\text{No. of eggs hatched} / \text{Total no. of fertilized eggs}) \times 100$$

The frequent natural disasters caused by flooding in most of our rivers during the monsoon months have a significant impact on spawn collecting from rivers. Embankments built across several rivers to avoid flooding have unfortunately ruined many carp breeding sites [2]. It is observed that by natural breeding fish are not produced as much as needed to human. By artificial breeding maximum amount of fishes are being produced [24].

RESULTS

The brood of carps are selected according to their age and weight (Table 2).

Table 2. Age and Weight of selected brood fish

Species	Sex	Minimum Age(years)	Minimum Weight(kg)
<i>Labeo rohita</i>	Male	2 years	2 kg
	Female	1.5 years	1.5 kg
<i>Catla catla</i>	Male	2 years	2.5 kg
	Female	2 years	2 kg
<i>Cirrhinus cirrhosus</i>	Male	2 years	2 kg
	Female	1.5 years	2 kg
<i>Cyprinus carpio</i>	Male	2.5 years	2.5 kg
	Female	2 years	1.5 kg
<i>Ctenopharyngodon idella</i>	Male	2 years	2.25 kg
	Female	2 years	1.5 kg

Synthetic hormone induced in carps

In the present study Ovaprim was injected to the carp species (rohu, catla, mrigal, common carp, amur carp & grass carp) near the pectoral fin base [25]. According to the body weight and age the amount of hormone is injected to the male and female brood (Table 3). **Table 3.** Doses of synthetic hormone for male and female breeders

Carp Species	Name of the Hormone	PG dose of Male (ml/kg body weight)	PG dose of Female (ml/kg body weight)	Ovulation Time (hr)	Hatching Time (hr)
<i>L.rohita</i>	Ovaprim	0.2	0.4	6	20
<i>C.catla</i>	Ovaprim	0.2	0.5	6	18
<i>C.cirrhosus</i>	Ovaprim	0.2	0.25	7	19.5
<i>C.carpio</i>	Ovaprim	0.2	0.6	7	42
<i>C.idella</i>	Ovaprim	0.2	0.6	6.5	46

Impact of Environmental Factors Effecting Induced Breeding in Carps

The importance of the breeding in carps has been reported by various researchers around the globe [27-30]. It was observed that environmental factors like temperature, light, pH, water current and rain, rainy season, dissolved oxygen plays vital role in induced breeding [2]. The fishes breed in optimal temperature between 22°C-27°C [31]. Carps breed in a broad range of pH conditions. A pH of alkaline is required for successful breeding. For the survival and growth of carps 7.1-8.0 pH is suitable [32]. Light has a significant role in fish reproduction (Paul et al., 2014). Fish mature and spawn earlier as a result of improved photoperiodic circumstances. It is observed that the larger the monsoon, the higher the rain, the greater the water circulation, the stronger the stimulation, the greater the maturation, and the bigger the gonadal activity [30].

The majority of fish successfully spawn on cloudy and damp days, especially after a heavy rain. This factor is crucial since the weather is still cool and cloudy, which attracts fish. Fish have a highly developed

rheotactic response to water movement. Even when huge carps are given synthetic hormones, rain becomes a need for spawning.

Table 4. Spawn production percentage of carp species observed in Bayasagar Fish & Seed Project, Kalahandi district.

Name of the carps	June 2022	July 2022	August 2022	September 2022
<i>L.rohita</i>	73.42%	96.06%	90.17%	79.52%
<i>C.catla</i>	76.35%	97%	82%	65%
<i>C.cirrhosus</i>	82%	93.58%	80.19%	68.55%
<i>C.idella</i>	73.72%	84.22%	78%	55%
<i>C.carpio</i>	94%	92.65%	73.21%	62.3%

Table 5. Spawn production of the selected carp species observed in Nilamadhab Fish Seed Farm, Nuapada district.

Name of the carp	June 2022	July 2022	August 2022	September 2022	January 2023	February 2023	March 2023
<i>L. rohita</i>	84.3%	93.52%	94%	74%	-	-	-
<i>C. catla</i>	88%	95.02%	86%	79%	-	-	-
<i>C. mraa</i>	85.84%	94.52%	86.48%	69.05%	-	-	-
<i>C. cirrhosus</i>	85%	88.32%	74%	68.11%	-	-	-
<i>C. carpio</i>	83.07%	91%	90.25%	76.4%	85%	74.58%	64.21%

Table 6. Spawn production of selected carp species observed in Prafulla Intrigated Fish & Seed Farm, Kalahandi district.

Name of the carps	June 2022	July 2022	August 2022	September 2022	January 2023	February 2023	March 2023
<i>L. rohita</i>	88.6%	90.25%	94%	74%	-	-	-
<i>C. catla</i>	90.32%	93.65%	82.74%	64%	-	-	-
<i>C. cirrhosus</i>	84%	91.2%	86.95%	72%	-	-	-
<i>C. idella</i>	74%	81.25%	88%	52%	-	-	-
<i>C. carpio</i>	84%	96.2%	90.52%	70.31%	86.19%	83.44%	62%

Spawn Production Rate

Spawn production percentage of Indian Major Carps, Common Carp & Grass Carp was analyzed during the month of June-September 2022 & January-March 2023 in the present study area shown in table (4, 5 & 6).

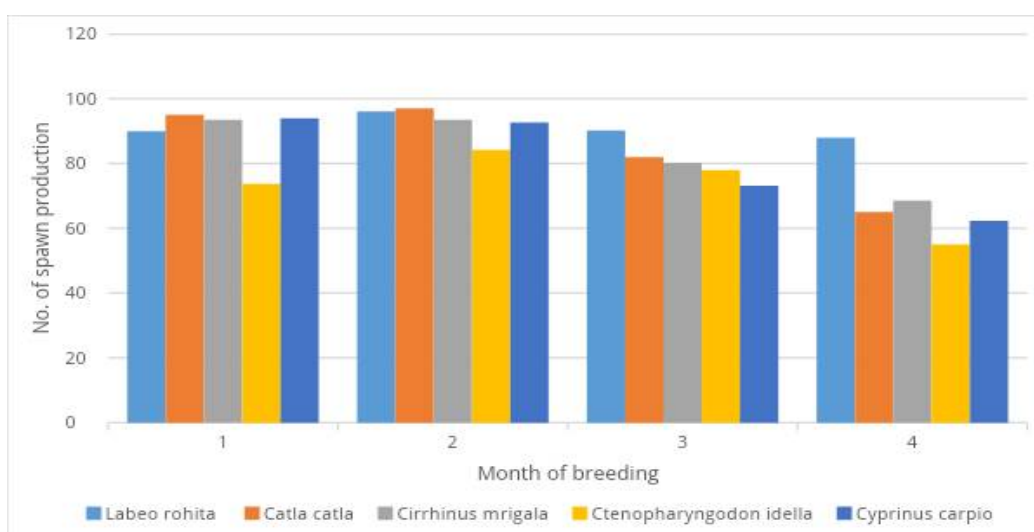


Figure 1: Spawn production rate in Baya sagar Seed and Fish Project, Kalahandi during June- September 2022.

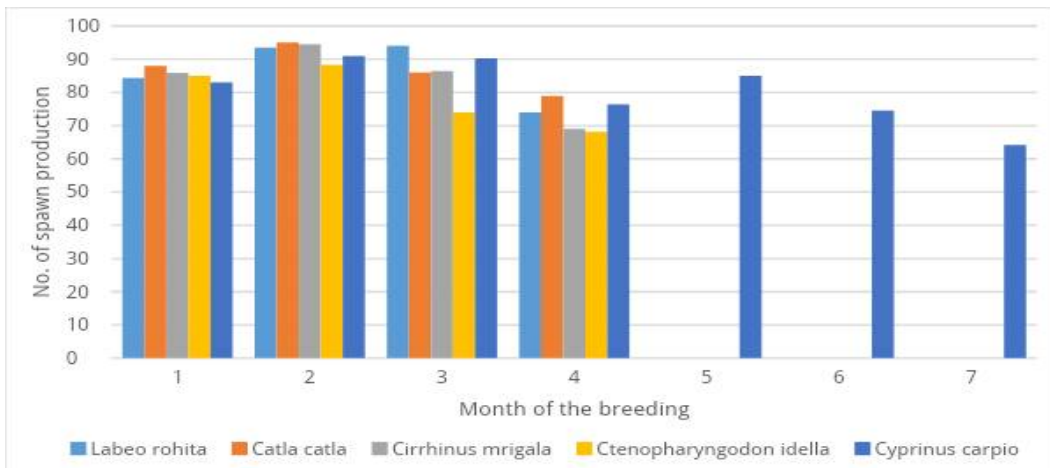


Figure 2: Spawn production rate in Nilamadhab Fish & Seed Farm, Nuapada during June-September 2022 and January-March 2023.

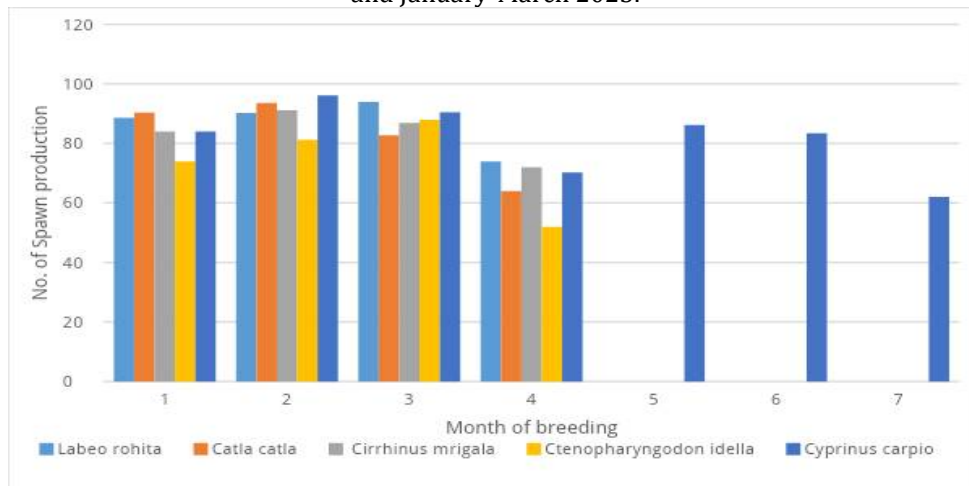


Figure 3: Spawn production rate in Prafulla Intrigated Fish & Seed Farm, Kalahandi during June-September 2022 and January-March 2023

DISCUSSION

Catla grows fast among other major carps and the common carp attain maturity within 12-18 months. The fry takes 2 months to become fingerlings in all these carps. In the inbreeding technique favorable amount of PG hormone is required to all the studied carp species. Numerous environmental variables such as temperature, light, water current, pH, dissolved oxygen and rainy season are responsible for successful breeding and in rainy season the female fish lays maximum number of eggs [2].

Within the ideal standard levels, water quality characteristics were regarded growth stimulating elements. The primary priority for raising excellent broods was brood pond management in terms of fertilization and feeding. It is well understood that a full brood stock diet is required to optimize spawning quality and consistency. A good quality seed production necessitates the feeding of brood stock, which has a substantial impact on fertility and survival. The results of the current study were very similar to those of the preceding authors mentioned in the above statements. According to [33]. Hatching occurs between 46 and 48 hours after fertilization, depending on the ambient temperature [22].



Figure 4: Injection of Ovaprim to Common Carp



Figure 5: Fingerlings in Hapa



Figure 6: Eggs collected from Hatchery



Figure 7: Collection of the Brood Stock



Figure 8: Hatchery Pool



Figure 9: Breeding Hapas

CONCLUSION

Farmers would be able to attain the potential level of performance of the technique if certain parameters were met, including as the availability of brood stock and adequate climatic circumstances. There are many factors have been identified as factor influencing spawning, egg quality and reproductive performance of fish. All of the factors are play a vital role in the spawning, egg composition, gonadal development, egg quality and reproductive performance of fish directly and indirectly. All the factors mentioned above should be in a limit range for successful reproduction. With India's fast industrialization, a great number of industries are being constructed, and as a result, vast volumes of manufacturing waste are being dumped

into rivers around the nation These industry effluents damage the water and harm riverine fisheries. Finally, the frequent natural catastrophes caused by flooding in most of our rivers during the monsoon season have a significant impact on spawn collecting from rivers. Numerous natural carp spawning habitats have been destroyed by embankments built across numerous rivers to avoid flooding. So artificial breeding helps in producing large number of fish species without any cause. The mortality rate is low in case of Induced Breeding Technique and egg production increase.

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