International Journal of Zoology Studies
www.zoologyjournals.com
ISSN: 2455-7269
Received: 07-04-2024, Accepted: 28-04-2024, Published: 22-05-2024
Volume 9, Issue 2, 2024, Page No. 9-19

Study on fresh water fish production and management in Cuttack district, Odisha

Deeksha Sinha[1], Amit Kumar Mohapatra[2]
[1] Department of Zoology, Stewart Science Collage, Cuttack, Odisha, India
[2] Department of Life Sciences, Sambalpur University, Odisha, India

Abstract
A study on freshwater fish production and management in Cuttack District, Odisha, involve various aspects related to aquaculture practices, environmental conditions, socio-economic factors, and policy implications specific to the region. This study would provide valuable insights into the current status, challenges, and opportunities for freshwater fish production and management in Cuttack District, facilitating evidence-based decision-making and targeted interventions to support the growth of the aquaculture sector in the region.

Keywords: Fishery, fertilization, breeding

Introduction
The term 'Fishery' ordinarily means culture and propagation of edible and marketable fishes. Fishery is a vast domain. In a broader sense it includes the furious exploitation of natural resources of water for human consumption and benefit. The natural resources of water include all the organisms that live in water - fishes, prawn, Shrimps, crabs, sharks and rays, etc. The science of fishery is very complex as it is multi-disciplinary and includes physical, chemical and biological microbiological, immunological and meteorological sciences interacting with the biology of fish, ecology of the resources, production management, marketing, etc. Now, talking about the concerned state Odisha within which this topic of fish culture and its management is confined a little knowledge of the location and its climate will also help to understand this topic more effectively.

Location
- It is in the north eastern part of country.
- Bounded by states like - Jharkhand, West Bengal to the north and northeast, Bay of Bengal to the east, Andhra Pradesh and Telangana in south, and Chhattisgarh in west.
- Geographically it is located at a latitude of 20 degree 03-to-20-degree 40 N and a longitude of 84 degree 580 to 860 20 F.

Climate
- It has tropical climate characterized by high temperature, high humidity, medium to high rainfall and short mild winters.
- This state has 480km long waistline with 24000 sq.km area within the continental they having ample potential for marine fishery as well as inland fishery development.

Area of Study
This study of fish culture and management is restricted near Cuttack district or places nearby this district.

Rivers
- Cuttack is flanked by Mahanadi River on the north and Katha Jodi River on the south.
- Covering a geographical area of 3932 sq.km.

Population
The total population of this district is 7,63,000. About 60-70% of the population feed on fish and their byproducts.

Fig 1: https://r.search.yahoo.com/_ylt=AwrKDqIXJztmFhkAMkjGHAx.;_ylu=c2VjA2ZwLWF0dHJpYgRzbGsDcnVybA-/RV=2/RE=1715181463/RO=11/RU=https%3a%2f%2fstore.mapsofindia.com%2fdigital-maps%2fdistrict-maps%2fmaps-of-india%2fodisha-district-map/RK=2/RS=tafQnwjap1WjNVRXaPXmnIT_f.E-

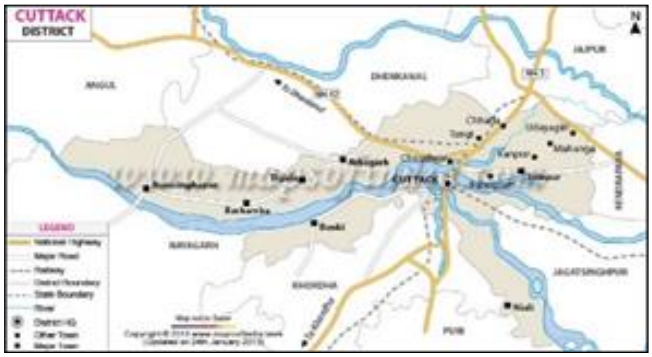

Fig 2:
https://r.search.yahoo.com/_ylt=AwrKDqL6JjtmLJgC0VbGHAx.;_ylu=c2VjA2ZwLWF0dHJpYgRzbGsDcnVybA--/RV=2/RE=1715181434/RO=11/RU=https%3a%2f%2fwww.mapsofindia.com%2fmaps%2forissa%2fdistricts%2fcuttack.htm/RK=2/RS=p49YQVXFBslhyEg6L40.RCrajjE-

Fish culture

- Fish culture or pisciculture involves commercial breeding of fish, usually for food, in fish tanks, or artificial enclosure such as fish ponds.
- It is the controlled cultivation and harvesting of aquatic animals such as - fish, mollusk and crustaceans, in natural or pseudo natural environment.
- Global demand is increasing for dietary fish protein which has resulted in widespread overfishing in wild fisheries resulting in significant decreases in fish stocks and even depletion in some regains. Fish culture allows establishment of artificial fish colonies that are provided with sufficient feeding, protection from natural predators and competitive threats, access to veterinaries service and easier harvesting when needed, while being separate from and thus do not usually impact the sustainable fields of wild fish populations. In Odisha, there are about 7.65 lakh hectare of in land water resources which includes - tanks, ponds, reservoirs, lakes, swamps, canals with total productivity of 4.40 lakhs M.T. of fish. About 2.95% population depends on fisheries for their livelihood of them 7.51 lakh depends on Inland fisheries and 3.33 lakh depend on marine fisheries. The fisheries subsector contributed about 6% to the
- GSDP share of the agriculture service. The present level of fish production in the state is about 62% of the overall fisheries potential.

Why Culture fishes?

- Fishes are advantageous for culture because -
- Fish do not spend much energy of temperature regulation as they are Poikilothermic in nature.
- Fishes can convert food into body tissues more efficiently than any other farm animal.
- There is always a certainty of getting a rich haul from culturable waters than from natural resources.
- Fish is a prolific breeder; it has a high fecundity.
- Fish production can be organized according to the market demand in respect of quality, quantity, size, colour preservation and processing.
- Low tropic feeders (herbivores) can be raised at comparatively lower costs than those which are higher in the food chain.

Objective of Fish Culture

- Raising specific species of fish in enclosures or special tanks.
- The fish raised on farms are primarily for food, though the objective of this aspect of aquaculture includes more than increasing the seafood supply.
- There are employment and economic advantages as well as possible of sustaining species that might be over fishing it not for the controlled environments of fish farms.

Scholary Analysis

- Katz *et al* (1972) studied the different special of fish and observed the presence of manganese concentration in gills and gut. He concluded that main root of manganese uptake is gills and gut accumulated more amount of manganese.
- Frag. *et al* (1995) studied the toxic effect of heavy m*et al*s may influence the growth rate, reproduction and morality. It reduces fish metabolic rate and growth.
- Richard *et al* (1998) said that long term exposure of fish (20 days and more) to water born cadmium at sub lethal concentration showed decrease growth rate in juvenile and adult stage.
- S. Hayat, M. Javed and S. Razzq (2007) conducted the experiment by keeping group of (30 fish), the fingerlings of major carps (Catla, rohu and marigal) in control condition and other group of 30 fish in sublethal counteraction of manganese for catla, rohu and mrigal respectively for 30 days. Fish were dispensed with equal quantity of feeds daily. After 30 days the growth performance was studies and they concluded the catla, lubeo rohita and origal showed negative weight increment of fishes during the stressed condition. The fork and total length increment were also negative in rohu and mrigal but positive result shown in catla.*From above experiment we conclude that the heavy m*et al* put negative impact on the growth rate of fish.
- Raut, M. Javed and M. Ubaidullah (2009) studied the heavy m*et al* concentration in gills, kidney, liver, muscles and scales of three fish species. They take the sample of fish organ that is gill, kidney, liver, skin, muscles separately. They concluded that amount all the body organ liver of all the three species showed higher concentrations of cadmium. Catla showed higher ability to accumulate cadmium then that of rohu and mrigal. Gills accumulate less concentration of cadmium. The highest concentration of chromium was observed in liver and lower concentration was found in gills.
- Nurun, N. Begum, Subhash.C.Chak and 3 other scientists in 1994 conducted a growth study over a period of 90 days. The silk worm pupa (Bombyx mori) and calm meat were given to the Indian major carps. (Labew Mohita) fingerlings as a source of dietary protein under laboratory condition. It showed that diet containing 50% of the protein as fish meal has higher growth rate with value of 1.64, 1.92, 1.48 for specific growth rate, blood conversion ratio and protein efficiency ratio respectively, whereas lower growth was observed with none of its protein as fish meal. From this we can conclude that silkworm pupa and calm meat is used as a dietary protein for better nutrition and development.

- Nandeesha, S. S. Desilva, D. Krishnamurty and K. Dathri (1994) conducted experiment on the Govt. fish farm of the Karnataka State, India. The mixed feed of bran and groundnut meal cake mixture is used for the trails. In trail 1, tour was tested. Here two feeds are used alternatively, each for a predetermined number of days. The control diets are rice bran (A) and ground nut meal cake (B) in a particular ratio is given continually in first trails. The mixed feeding schedule tested were 1B, 1A/2B, And 1A/3B. After the experiment the growth response was studied. Diet A show poor growth in all treatment. Growth in the mixture feeding were generally higher than diet A. Nitrogen retention was higher in fish with those of mixed schedules. *From this we can conclude that mixed feeds are useful for fish growth.
- De Salvia (1997) studied the feed management strategies in the semi-intensive fish farming. Tacon in 1993 studied the production of fish. He found out that 60% of total production was realized within semi-intensive or extensive dam. In extensive farming, no eternal nutrient input while in semi-intensive farming system external fertilizer supplementary diet nutrient input is given, and in intensive farming external diet input is given. De. Salvia in 1984 studied the effect of supplementary food changes the dietary feeding habit of cultured species along with natural food. *From this we can conclude that fish gain extra weight and energy from supplementary food.
- Lal (1999) conducted an experiment using 10 dams. 5 were treated with bamboo poles as substrate and 5 were without substrate. Dam is fertilized with inorganic manure and left for 15 days for periphytonic growth. Then the fish are stocked into both the dams. Observation is done for 4 months. After this the fish are harvested and total length and weight are measured. They found that survivorship of rohu was higher in treatment 1, than treatment 2. The net weight gain per-fish was 222.53g in treatment 1 and in treatment 2 it is 143.22g. The net production of fish in 1st treatment is 1.7 times higher than that for 2nd. *From this we can conclude that bamboo substrate allows the periphyton which is a major food source.
- Das *et al* (2004) studied that effect of certain on production and water quality changes in intensive crap culture. The experiment was carried out in 4 earthen dam and 6 species are stocked into the dam. Two dam T1 and T2 were provide with one aspirator aerator in each, which two other dam C1 and C2 without any aerator. The hydrological parameter was analyzed in monthly basis. The observation was taken for 1 year. The survival rate and body weight of each species and the biomass production of each species were recorded at the time of final harvest. The water temperature varied between 20 to 320c during the culture period. Total harness also showed progressive reduction with culture period in aerated dam. Do of all dams reduce in all dams. Do is tower in control dams compared to treatment dams. All the 6 species recorded higher increment and survivability in treatment dam compared to those of control dam. The biomass production of the treated dam is higher than control dam. *From this we can conclude that better aeration in the cultured dam leads to higher survivability of fish and good production rate.
- Ahmed *et al* (2005) studied the growth performance of major camps in semi-intensive fish culture system and Rice Polishing (12% crude protein) is used as supplementary feed, in the dam for the growth of major craps. One dam is taken as control and other for experiment. 30 rohu, 15 mrigal and 25 catla were stocked in both the dam. The treated dam was supplemented with rice polishing. After the study we found out that fish production of treated dam is 1477 times greater than the control dam. The fish showed better growth in treated dam. *From this we can conclude that fish gain better nutrient from the supplementary food (rice polishing).

Culture Farms Under Study

I had selected 4 sites for the study of fish culture and their management, located near Cuttack districts which are as follows

Site A: Bhanu fish center, Cuttack
Site B: Niali block, Cuttack
Site C: Brundaban Nayak fishery, Choudwar, Cuttack.
Site D: R P biofloc fish farming. Choudwar, Cuttack

Materials Required for Fish Culture

- Water Pumps
- Net / Seine Net
- Fish tanks / Ponds
- Fish graders
- Water purifier
- Oxygenation of water- Aeration devices.
- To know the water quality - Thermometer, BOD meter, etc.
- Miscellaneous Assets like - Generator set, Electrical installation
- Cleaning Equipment like high pressure washer, Fishing net washer.
- Landing Net
- Filtering material
- Suction House
- Fertilized eggs / Seedling

Fish Culture in Cuttack District, Odisha

Cuttack district is one of the 30 districts of Odisha. It is located on the costal part of the state and its administrative headquarter are located in the city of the Cuttack. It is bounded by Anugul, Dhenkanal, Nayagarh, Khorda district in the west, while its southern and eastern boundaries are - Puri, Jagatsinghpur, Kendrapara and Jajpur districts. Fish culture in Cuttack district mainly depends upon the species of fish being cultured. And the species being cultured in the farms depends upon the market demand. Maximum population of this area feed on fish as food and the fishes which are in great demand are :

- Labeo rohita locally called as 'Roii/Rohu'.
- Catla catla locally called 'Bhakura'.
- Crihinus mrigala locally called 'Mrigal'.
- Clarias batrachus locally called as 'Magur'

The culture process of Indian Major carps like the catla, Labeo and Mrigala are followed mainly by 3 practices: -

- Tends to be semi-intensive
- Almost always use poly culture

- May be integrated with other forms of farming (Integrated system)
- Are carried away in ponds and pens but rarely in cages and raceways.

Poly culture

Poly culture has thought to have been originated in China. It is the farming of two or more compatible species with different feeding habits in the same pond to maximize utilization of niche of a pond. It maximizes the synergetic fish-fish and fish- environment relationship.

- The basic species combination of the fish culture born in mearhy farms in Cuttack district were: -
- Catla, rohu, mrigal, silver carp, grass carp and common carp.
- Stocking density of 5000 Nos./ha (120-250 kg/ha) the yield was nearly 9MT/ha/ yr.
- Rohu is the dominant species of poly culture which is stocked at 80% of the stocking density.
- The pond area of the exceeds 1ha and the ponds are stocked at 6–12-month-old juveniles @5000/ha.
- For this pond should be prepared before the introduction of the fish.
- Production In Cuttack averages about 8000 kg/ha with the range of 5300-14620 kg/ha.

Pond Preparation

If fish culture is done using pond, either already existing or made artificially then following steps are taken: -

Before the introduction of fry or fingerlings the steps taken are

A. Renovation of the pond

Generally due to rain the flood the edges or dykes of ponds may get damaged due to which a lot of silt or mud may accumulate at the pond bottom.

- In this case, the entire water of the pond is removed through the help of a pump.
- Humus of pond should be allowed to dry.
- Dykes have to be repaired and plants to be planted on it so that its roots would prevent soil erosion.
- The pond is then filled with water.

B. Clearance of Weeds

One of the crucial problems encountered by the pisci culturists of Odisha, is the excess growth of aquatic vegetation and its control.

- Weeds can remove either manually if the area is small.
- If the area is big, then chemical and biological methods can be used.

Chemical Control

Simazine is used at a dose of 0.5 to 1.0 ppm. Ammonia at the rate of 15-20 ppm.

Diuron at the rate of 0.1 - 0.3 ppm

Biological Control

Weeds can be controlled by introducing selected varieties of herbivores fish.

Eg. -Tilapia mosambica Gourami

C. Eradication of Predatory Fishes

The predatory fish directly prey on culturable fish. Therefore, their eradication is very important.

- Dewatering and drying the ponds can be done.
- However, if dewatering cannot be done fishes can be killed by application of fish poison.
- Chemical poisons are generally not used as they will leave harmful effect in the pond.
- Most widely used fish poison of plant origin is Mahua oil cake. Initially, Mahua oil cake acts as piscioide and later on acts as manure.
- The recommended dose of Mahua oil cake is 2500 kg/ha.

D. Addition of lime

The step used for fertilizing the pond is by the use of lime. The common form of lime used is limestone.

The uses of lime are as follows: -

- It corrects the acidity of soil and water.
- Acts as strong pH buffer.
- It kills bacteria as well as fish parasite and may render the fishes less liable to disease.
- Lime counters the poisonous effect of magnesium, potassium and sodium.
- Liming is essential for successful pond manuring. A pond containing lime is more fertile than a pond without it.

Dosage - The dose of lime depends on characteristics of soil and water. Generally, a close of 1000 to 1500 kg/ha for a acidic soil and water.

E. Addition of Fertilizers

Generally, there are two types of fertilizers: - Organic and Inorganic.

Generally organic manure is used like: - Mohua oil Cake.

Cow dung. Green manuring Compost

- In Odisha, green manuring is practiced by growing a leguminous plant (Sesbania species) on the pond bottom for 10-15 days.

Dosage - 1680 green manure per hectare is recommended at an interval of 3 months.

After the pond made fit for fish culture, then according to the demand of market the selected various of fishes are cultured.

Generally, in Cuttack, Odisha or places near Cuttack there is a huge demand for mainly -

Laheu Mohita (Rohu)

Culta

Crihinus mrigal (Magur)

Trapia mosambica

Seed Selection

Seed Selection plays a very important role on the quality of fish that we can get during harvesting.

- Generally good quality of seed is costly.
- Desired seeds of selected fish species are taken and good quality of seed always gives good results.

Fig 3: Seed selection for farming.

Supplementary feeding

The main 4 points that should he kept in mind during supplementary feeding are:

- Regular feeding schedule must be followed on daily basis during warm months before harvest.
- The feed a quantity must be calculated by the farmers based on actual sample weight data collected at the end of each month.
- Fish should be fed at the same time and at the same place in the pond.
- Farmer must carefully observe the feeding behavior and determines the extent to which the fish are consuming the feed given.

Usually, high protein intent food is given, high quality pellets specifically designed for your selected species of fish is given.

Commonly given feed for Indian carps –

Rice/ wheat bran

Oil cakes of groundnut, coconut, mustard, etc. Powdered algae Fish meal, wanting 26.7% protein and 32.5% of carbohydrate.

Fish culture

- Fish culture or pisciculture involves commercial breeding of fish, usually for food, in fish tanks, or artificial enclosure such as fish ponds.
- It is the controlled cultivation and harvesting of aquatic animals such as - fish, mollusk and crustaceans, in natural or pseudo natural environment.
- Global demand is increasing for dietary fish protein which has resulted in widespread overfishing in wild fisheries resulting in significant decreases in fish stocks and even depletion in some regains. Fish culture allows establishment of artificial fish colonies that are provided with sufficient feeding, protection from natural predators and competitive threats, access to veterinaries service and easier harvesting when needed, while being separate from and thus do not usually impact the sustainable fields of wild fish populations. In Odisha, there are about 7.65 lakh hectare of in land water resources which includes - tanks, ponds, reservoirs, lakes, swamps, canals with total productivity of 4.40 lakhs M.T. of fish. About 2.95% population depends on fisheries for their livelihood of them 7.51 lakh depends on Inland fisheries and 3.33 lakh depend on marine fisheries. The fisheries subsector contributed about 6% to the
- GSDP share of the agriculture service. The present level of fish production in the state is about 62% of the overall fisheries potential.
- Harvesting fish is one of the most important activities of fish farming. It is the most important part of getting fish out of production facilities in good condition.
- Based on the demand of the market, fish can be harvested from a pond.
- Harvesting is done using a net.
- Ponds are undrinkable, so the fishes are harvested by using a seine net.
- In case of drainable ponds with proper harvesting sumps are similar device, harvesting is done by draining.

Methods for culturing of Indian major carps

Many cultural species of fin fishes (particularly the major corps) under farm culture conditions do not get the required environment impetus for spontaneous maturation. This has led to the development and standardization of a technique called induced breeding or hypophyation.

- In this process through the injection of pituitary extracts, the natural gonadotropin surge is stimulated, disregarding the environment impetus.
- Thus, it has not only made the major carps and other fin fishes to breed in conjoined water under farm conditions but it also has the added advantage of regulating the tune of spawning.

1. Breeding techniques used by fisherman during culture

a. Dosage of pituitary Extract

Fur successful induced breeding it is essential that proper dosage of pituitary gland is assessed.

- The dosage of pituitary injection to be given is calculated in relation to the weight of the breeders to be injected.
- Administration of preliminary low dose in female breeders followed by a effective higher dose after 6 hours has proved more successful than a single knock out dose.
- Male spawners are for more tolerate in farm environment then the female spawners.
- For this reason, make spawners require less dose of pituitary for the induction of spawning by hypophysation.
- The female breeders of IMC are given a preliminary dose at the mate of 2-3 mg of pituitary gland / kg body weight. After 6 hours they are again given a second higher dose of 5-8 mf / kg body weight. During this time, the male receives only one dose at the mate of 2-3 mg/kg body weight.
- A third dose of injection is generally not recommended. However, if the condition of the female breeder is found suitable and also the weather condition then the 3rd injection is given. It is given 12 hours of ten the 2nd injection at the rate 4-7mg per kg body weight.
- In case 3rd injection is not given then the breeders are released into the stocking pond.

b. Injection Method

Different methods of injection are in practice, like

- Intra - Muscular
- Intra - Peritoneal
- Intra - Cranial

Fig 4: Muscular injection for breeding.

In fish breading workers, intra muscular injections are in practice.

- Intra muscular injections are administered in the region of caudal peduncle, or near shoulder region.
- In case, more than one injection is given it is better to give the 2nd injection on the other side.
- The size of the needle for the syringe depends upon the size of the breeders to be injected.
- Generally, B.D.H needle No-22 is used for 1-3kg carp's breeders, needle No-19 for larger (above 3kg) and No. 24 for smaller below 1kg ones.

Injection Technique

For introduction of injection into the breeders generally 2 people are required.

- The brood fishes are taken out of hapa, where they were sex wise segregates, and weighed.
- Then they are brought one by one to the small field table for injection.
- One person holds the head of the fishing gently while other holds the tail with one hand and gives injection into the caudal peduncle area.
- The needle is pierced at an angle of 45; under the scale.
- The entire process takes near the water body where they are introduced after the final injection.

Injection Time

Generally, injections can be given at any time of the day or night as spawning can occur at any time.

Since low temperature is helpful for spawning, injection may be given on a wol day or in the evening or night when the temperature is fairly low.

c. Spawning

- In case, where a single high dose in administered, spawning generally takes place about 6-9 hours after the injection.
- In case of two injections, spawning occurs within 3-6 hours of the second injection.
- A few hours after the final injection is given, sex play between the female and male is noticed.
- Spawning is normally influenced by low temperature, rain water, slightly dizzying and cool weather.
- The average fecundity rate of IMC has been estimated to be about 2 lakh eggs / kg of body weight.

d. Fertilized Egg

As the female liberates eggs in the stream, the male oozes its milt and the eggs thus get fertilized.

- The fertilized egg become crystalline, transparent and non- adhesive with a redshirting in catla, pale reddish in rohu, and light pale brownish in mrigal.
- The sizes of fully swollen eggs of Indian major carps vary within 2.5mm to 6.5mm in diameter.

e. Collection of Eggs and Transfer to Hatcheries

- Eggs should be collected from when the embryo starts the twisting movement because by that time the eggs get properly water harded and can with stand sufficient strains.
- Eggs care collected by the hapa from means of cup or beaker and poured into a bucket with a small amount of water.
- The breeders are then collected and the weight of the breeders after spawning is noted.
  The difference in weight before and after spawning gives an idea.

Advantages of Induced reeding in Indian major carps:

Induced Breeding has manifold advantages:

1. Pure and disease-free spawn of a desired variety of fish under cultivation can be obtained through induced breeding.
2. It ensures availability of the fish seed at any time for fish culture.
3. The same fish can be breed twice in one year.
4. The technique of induced breeding is very simple and can be easily handled by a layman without much training.
5. The cost incurred for production of a spawn from induced breeding is comparatively lower than that obtained from natural sources of the quantity of the eggs laid.
6. The breeders are then transferred back into the pond.

Factors conducive for successful spawning

1. Availability of fully matured and ripe male and female breeders.
2. Collection of pituitary glands from fully gravid fishes.
3. Proper assessment of dosage of pituitary hormone.
4. Conductive physio-chemical factors of environment for spawning are -

- Optimum dissolved O2 ranges generally between 6-7ppm.
- Optimum PH ranging between 6.0-8.0
- Optimum temperature ranges between 28-30C
- Electromagnetic properties of water within a limited range.

5. Current of water

The resultant effect of the above sated physio-chemical factors provide stimulation for sex play and spawning.

Reasons for-failure of An Induced Breeding Experiment: -

- Poor condition of the brood fishes, including their health and nutrition and stages of gonadal development.
- Sudden rise in temperature.
- Incorrect assessment of the pituitary hormone dose
- Non-fertilization of eggs or death of embryo occurs because of the eggs not being fully viable.

Biofloc fish culture

Meaning of Biofloc farming

Biofloc Technology (BFT) is considered as new 'blue revolution' since nutrients can be continuously recycled and reused in the culture system, benefited by the minimum or zero-water exchange. Biofloc is an environment friendly aquaculture technique based on in-situ microorganisms' production. Biofloc is the suspended growth in ponds/ tanks which is the aggregate of Living and dead particulate organic matter, phytoplankton, bacteria and grazers of the bacteria. It is the utilization of microbial processes within the ponds/tank itself to provide food resources for cultured organisms, while at the same time acts as a water treatment remedy. Thus, this treatment is also known as active suspension ponds or heterotrophic ponds or even green soup ponds.

Working process of biofloc farming

- Firstly, we have to select the place where will carry out the culture process. It may be ponds/tanks.
- Aeration - it's time to work on aeration system after site selection. All biofloc system requires constant motion for maintaining high o2 and turn into anaerobic zones which release large amount of ammonia and methane.
- Pre-seeding beneficial microbes:

To accelerate the development of biofloc farming and stabilize the pond faster it is advisable to pre-seed the culture water. This can be achieved by adding a number of commercial or homemade recipes to the culture water.

Species Selection and Stoking Density

The species which will be most benefited by BFS. The species which best grown in this type of culture method should be selected.

Balancing carbon source Input

To prevent ammonia peaks at the start of the culture cycle, Carbohydrates are supplies through various sources. These 'C' in carbohydrates enables heterotrophic bacteria to multiple and synthesis ammonia, thus maintaining water quality.

Biofloc Growth

With plenty of accretion and carbohydrate source the biofloc numbers starts to multiply readily. Depending upon the number of factors like - Temperature of water
Sunlight Nutrients
No. of biofloc seeded before the start of process.

Biofloc Development

In this point, the water samples should be regularly taken to check the pond water and determine the activity of biofloc types and their densities.

Harvest and clean up

If all steps have been followed, a farmer can accept successful growth rate of fishes and survive. Thus increasing profit ability.

Composition and nutritional value of biofloc

Biofloc is heterogenous aggregate of suspended particles and variety of microorganisms assisted with extracellular polymeric substance. It is composed of microorganisms such as bacteria, algae, fungi, in vertebrates and detritus. etc. It is a protein rich live feed formed as a result of conversion of unused feed and excreta into a natural food in a culture system on exposure to sunlight and vigorous aeration. Each floc is held together in a loose matrix of mucus that is secreted by bacteria and bound by filamentous microorganism or electro Static attraction.

Large flocs can be seen with the naked eyes, but most of them are microscopic. Floc soze range from 50-200 micron. A good nutritive value is found in biofloc. The dry weight of protein ranges from 25-50%, fat ranges 0.5-15%. It is a good source of vitamins and minerals, particularly phosphorus. It has an effect similar to probiotics. The dead biofloc is proposed as an ingredient to replace the fishmeal or soya bean in feed.

Advantages of Biofloc Farming

- Flo friendly culture system.
- It reduces the environmental impact.
- Limited or zero waste exchange system.
- Reduces water pollution and mitigate the risk of introduction and spread of pathogens.
- It reduces the utilization of protein rich feed cost of standard feed.
- It reduces the pressure on capture fisheries. i.e use of cheaper food fish and trash for fish feed formulation.

Fishes suitable for biofloc

Major cultivable fish species in biofloc farming are:

A basic factor in designing a biofloc system is the species to be cultured. Biofloc system works best with species that are able to derive some nutritional benefits from the direct consumptions of floc. Biofloc system is most suitable for species that can together high solids concentration in water and are generally tolerate of poor water quality.

Examples of fish suitable for biofloc farming are:

- Air breathing fish like singhi (*Heteropneustes fossils*), Magur (*Clarias batrachus*), Padba (*Umpok padba*), Anabas /koi (*Anabas testudineus*), Pangasuis (*Pangasianodan hypothalamus*)

Non-breathing fishes are - Common carp (Cyprinus carpio) Rohu (Labeo rohita), Tilapia (oreochromis nilotius) Milkfish (chanos chanos)

- Shellfishes like - Vannamei (*Litopenacus Vannamei*)

Tiger Shrimp (*Penarus menodon*)Fish species cultured near Cuttack, Odisha:

There are mainly 4 types species fish which are of high demand in the markets of Cuttack and are grown at almost every farm. They are:-

1. *Catla Catla*
2. *Labeo rohita*
3. *Chrinnus mrigal*
4. *Tilapia*

1. *Catla Catla* (Catla)

Systematic Classification

Kingdom -Animalia
Phylum -Chordate
Class- Actriopterygii
Order- Cypriniformes
Family- Cyprinidae

Genus - Catla
Species- Catla

General Character
It is commonly called as Bhakura in Cuttack, Odisha.
- Catla is a fish with large and broad head, protruding lower law and upturned mouth.
- Grayish scales on its dorsal side and within on his belly.
- It is surface and midwater feeder.
- Feed on zooplankton and phytoplankton.
- They attain sexual maturity at an average age of 2 years and average weight of 2kg.

Culture Process: It is grown in poly culture with Labeu Rohita and mrigal carp.
Market demand: They are generally preferred of 1-2 kg weight.
Transport: Transported on ice. They are consumed fresh.
Market Price: Cost of 1kg catla in Cuttack market is 280/-

2. *Labeo Rohita*
Systematic Classification
Kingdom - Animalia
Phylum - Chordate
Class - Actinopterygii
Order - Cypriniformes
Family - Cyprinidae
Genus - Labeo
Speuis - Rohita

General Characters
- It is called as rohu, ruhi in Cuttack.
- It is large, silver colored fish of cyprinid shape.
- Omnivore with specific food preferences at different life stages.
- Early stage its cat zooplankton, as it grows it eats mere phytoplankton.
- It is herbivorous, column feeders.
- It has gill rakers, which is modified thin hair like as it feeds on sieving the water.
- Rohu reaches sexual maturity between 2-5 years of age.
- Generally, spawn during monsoon season.
- It is a fast-growing species and attains 35-45cm total length. And 700-800g in one year under normal culture condition.
- In poly culture, the growth rate is higher than mrigal but lower than catla.
- Optimum temp of Spawning is 22-31c.
- Rohu is a principal species reared in carp poly culture system along with other two major carps.
- The higher consumer preference and market demand for rohu during recent years has led to high culture preference.
- Market Price: The market price for rohu in Cuttack is 140/- per kg.

3. *Cirrhinus Mrigala*
Systematic Classification
Kingdom- Animalia
Phylum-Chordata
Class - Actinopterygii
Order - Cypriniformers
Genus - Cirrhinus
Species-Mrigala

General Characters
- It is known as white carps, locally known by mrigala in Cuttack.
- It is a ray - jinred fish in the carp family.
- Mrigal is the benthopelagic and potamodromous plankton feeder.
- Spawning occurs in marginal are of water bodies at a depth of 50-100cm.
- At the age of 2, they attend 60 cm and weight as much as 2kg.
- It is a popular food fish and an important aqua cultured fresh water species.
- There species of fishes exhibited rapid growth rate during the first 2 years of their age, later growth was moderate.
- Fry and fingerlings tend to move to deeper water.
- Adults are bottom dwellers.
- It is stenophagous and an illiophage fish in its feeding habit.

Food Habit
The principle food components of fish mrigal are detritus and decayed vegetation, at the same phytoplankton and zoo planktons comprise the rest.

Temperature
Mrigal is eurythermal and can tolerate upto minimum 140c.

Culture Process
Mainly they are cultured through induced preceding in poly culture.

Market demand
Mrigal has a good market demand in Cuttack or are as near Cuttack, but not as much as Rohu and catla.

Market Price: The market price for marigala in Cuttack is 1200/3kg.

4. *Walking catfish* (Magur)
Systematic Classification:
Kingdom - Animalia
Phylum - Chordata
Class -Actinopterygii
Order - siluriyarmes
Family - clamiidue
Genus - clarias
Species - C. Batrachus

General characters
The walking catfish has an elongated body shape and reaches almost 0.5 m in length 1.2kg in weight. Often covered with small white spots laterally. Body is mainly coloured into gray or grayish brown.

Feeding
These are the omnivorous feeders, it does not discriminate much in its choice of food. By shifting through the muddy bottom with its long barbeus, the adult feeds on a mixture of mollusws, insects, plants, eggs, and smaller fish. The larval feeds exclusively on plankton.

Breeding
- The walking catfish mate seasonally in the summer during the months between June and august.
- Walking catfish are sexually matured at the age of one.
- The male guards the nest from predators immediately after spawning.

Culture Process
They are generally cultured through Biofloc farming method.

Market Price
In Cuttack, the market price for usually known 'Magur' is 600/kg

TILAPIA
Systematic classification
Kingdom – animalia
Phylum - Chordata
Class -Actinopterygii
Order - Cichliforms
Family - Cichlidae
Genus - Tilapia

General character
- They are shaped like sunfish or crappie and are easily identified by interrupted lateral line characteristics.
- Laterally compressed by deep bodies and have long dorsal fins.
- Spines are also found in pelvic and anal fins.
- They can live upto 10 years and can reach ten pounds in weight.
- Usually there are wide vertical bars of dark colouration found along the sides of fry, fingerlings and sometimes adult.

Feeding
Tilapia feeds initially on plankton, compensating the consumption of balanced feed and this is why the pond is fertilized before sowing the fry.

Breeding
Most farming chooses to keep only male tilapia in the grow out stage. Male tilapia has proved to be more profitable as they grow bigger and are more time and energy efficient.
Female tilapia tends to waste energy and time due to breeding.

Culture Process
Biofloc farming is suitable for this fish species.

Market Price
In Cuttack, the market price of tilapia is -200/-per kg.

Discussion
- We conducted a recharge work which was based on our topic study of Fish culture and Management, near Cuttack district, Odisha.
- I had done research on this topic almost 2 months from May-June at the season of summer, generally I selected 5 sites or from where culture of fishes was done.
- Generally, what I observed was that the Indian major carps were generally cultured through the process of induced breeding while other fish species like Tialpia, Magur were cultured through the most recent tried which is famous here called the biotic farming.

The fish species which are high demand in Cuttack market and those which are cultured in almost all the farms are :
Labeo rohita (Rohu /Roii)
Catla catla (Catla)
Cirrhinus mrigala (M.
Clarias batrachus (Magur)
Tilapia

Management of fish culture
1. Proper management consist of monitoring, your fish farm weather it is a pond, tank, hatcheries. Etc, keeping good records and planning ahead for the operation of the farm.
2. The extend of monitoring and record keep required depends on several factors such as :
   - The level of education and skill of fish farmer.
   - Interest of farmer in good management and profit.
   - Size and organization of fish farm.
3. As a commercial farmer it is very important to monitor the fish stock very closely.
4. At least once a day, farmer should visit the farm and check
   - The water supply entering the pond is adequate.
   - Ponds likes are in a good condition.
   - Quality of water
5. The best time to visit the farm is easily morning or late afternoon.
6. More complete checks should me made once a week and periodically:-
   - Canals/Tanks/Ponds for major maintenance or repair.
   - Compost piles to refer them as necessary.
7. If the farmer is fertilizing and the lining the pond regularly then addition case should be taken to check the
   - The water quality for temperature, dissolved O2, PH, and total alkalinity.
   - Measure Plankton and check on its general composition.
8. After complete draining, of the ponds/Tank before referring it with water, check its dykes, leaks and damages. Fully control bottom mud, aquatic vegetation and animal pests.
9. Growth and health of the fish should be regularly checked.
10. A proper reward should be kept by the farmers:-
    - The amount of money spent on fish farming.
    - Total number of fish harvested.
    - The amount gained (net profit) or lost (net loss) through fish culture process.
11. Different stages of fish are kept in different types of ponds.
    - Breathing ponds
    - Hatching pits
    - Nursery ponds
    - Rearing ponds
    - Stocking ponds
    - Harvesting ponds.

The state of Odisha has a lot of potential resources for fisheries, but they are still underutilized. If the resources can

be utilized as its full capacity, the state can make more profit from the fisheries sector. The extension services in the state are not proper due to which technology doesn't reach most of the fish farmers. If it can reach them, they will adopt the new and advanced technologies, so that the production can be increased. Vertical expansion and species and system diversification can also be adopted by young and advanced farmers to double up their production.Breeding and culture technologies of diversified groups of freshwater species which have already been standardized like Indian major craps, minor crabs, barbs, catfish, pabda, freshwater prawn, climbing perch, and murals can be taken up to increase production by folds. Strategies like intercropping minor craps in conventional major craps culture, monoculture of catfish and prawns or their poly culture with major craps and mono sex tilapia can be effective as well. Adoption of multi- stocking and multi harvesting, implementation of waste water aqua culture system, utilization of shallow/rain fed ponds for producing stunted fingerings, adoption of integrated, intensive and semi-intensive farming system can be applied for increasing fish production and productivity. Most of the fish farms are still being operated with traditional fish farming techniques. Therefore, most fish farms must be brought under scientific farming. There are lots of schemes like- Rashtriya Krishi vikas yojana. (RKVY) for giving financial support to the fish farmer, but they are not aware of it. Making the fish famous aware of these schemes can make fish culture become full-fledge entrepreneurship. Integrated farming like the culture of the fish with paddy, piggery, poultry, horticulture, apiculture. etc. should be encouraged to enhance the production. Sewage fed pond culture can be established by which waste water can be reused and produce more from fewer resources.

Result of *catla catla*

In the present study of the catla catla from May to July 2022, The result of the experiment carried out on Indian major craps i.e catla catla treated with pituitary gland extract has been presented in the given table.

Aggressiveness of the brooders was noticed after 4-6hrs of the second dose (0.6- 0.8 ml/kg body weight) of pituitary extract to female and single dose (0.2-0.4ml/kg body weight) of pituitary extract to male.

In the present study 40 females and 80 males which were healthy and diseases free were selected for the experiment.

Overall effect of Pituitary extract and Ovaprim

Table 1: A comparative analysis between pituitary extract and ovaprim uses for fish culture.

Pituitar Extract		**Ovaprim**	
Parameters	**Results**	**Parameters**	**Results**
1. 86 No. of female treated	20	1. 86 No. of female treated	20
2. Total weight of female	84	2. Total weight of female	86.5
3. Total No. of eggs obtained	6480000	3. Total No. of eggs obtained	9810000
4. Total No. of fertilized eggs	5320000	4. Total No. of fertilized eggs	9192000
5. Total No. of hatchlings	9440000	5. Total No. of hatchlings	8360000
6. Average No. of eggs/kg	141493	6. Average No. of eggs/kg	111435.8
7. Average No. of fertilized egg/kg	63781.4	7. Average No. of fertilized egg/kg	107041.8
8. Average No. of hatchling/kg	45151.6	8. Average No. of hatchling/kg	97252.6
9. Overall fertilization %	76.74	9. Overall fertilization %	93.9
10. Overall hatchling %	67.97	10. Overall hatchling %	90.982

Spawing response

In the month June, average number of eggs obtained 980000, average number of fertilized eggs were 680000, average number of hatchlings were 400000.Average no. of eggs/kg was 81666, average no. of fertilized eggs/kg was 56666,average no. of hatchling/kg was 3333.

Fertilization % = (Egg in a sample/ Average no of egg in a sample) × 100 = 69.38%

Hatching Rate % = (Total no. of spawn/ Total no. of fertilized) × 100 = 58.82%

While in the month of July, maximum response was found such that the average no. of eggs obtained 1700000, average no. of fertilized eggs was 1450000, average no. of hatchling were 1135000, average no. of eggs/ kg was 67441, average no. of hatchling/ kg was 52790.

Fertilization rate (%) = 85.29% Hatchling rate (%) = 78.82%

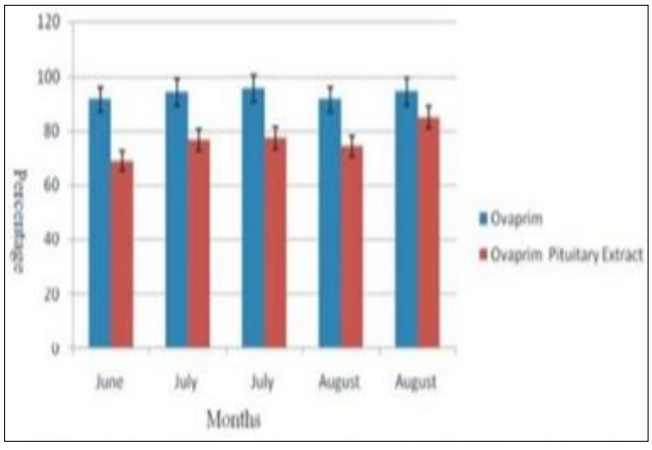

Fig 4: Fertilization rate (%) in Catla catla due to compared Overprim with Pituitary Extract.

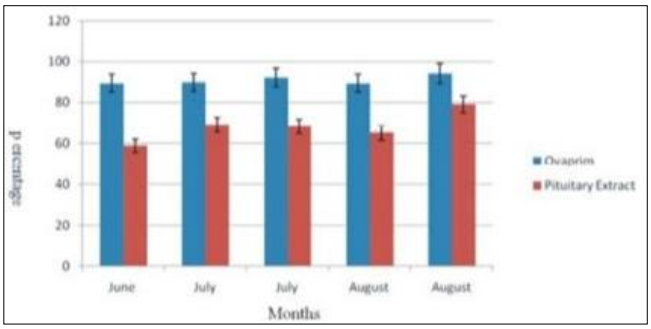

Fig 5: Hatchling rate (%) in Catla catla due to compared Overprim with Pituitary Extract

Conclusion

With the increase in demand of food fish, the decline in capture fisheries production and the exhaustion of mangrove areas available for fish pond expansion, aquaculture is heading towards intensification and the utilization of waste waters for cage and pen fish farming. This shift from low density to high density culture is consequently leading to an unprecedented rise in the demand for feeds more than that of fertilizers. However, taking about the fisheries status of Odisha, Odisha has established itself as a major fish producing state in the country. More emphasis is required to reach its full potential. To further increase the fish production, the various underutilized water bodies, need to be explored and utilized sustainable. Understanding the socioeconomic problem of farmers, promotion and adoption of a robust and modern aquaculture system, upgraded infrastructure facilities and improved management policies are required for sustainable development of aquaculture in the state.

References

1. Training manual of freshwater aquaculture as a livelihood option, Central Institute of Freshwater Aquaculture, Bhubaneswar, India, Jeyasankar, P. Pillai, 1-137.
2. Sundaray BR, JK Mohapatra BC. Ferose Khan S. Ananthroja K, Kamble SP, 2016.
3. Principles of aquaculture, online - e-learning module on Agricultural Education.
4. Index of list of tittles, fisheries Research Board of Canada and Associated Publication, Updated annually in the Canadian Journal of fisheries and Aquatic Sciences through, 1994.
5. WAVES (Canada Department of Fisheries and Oceans) includes all DFO Publications except for journal articles.
6. Fisheries: Annotated bibliography, FAO publications and documents 1045 - 1969, Bibliography with indexes to all FAO publication on fisheries.
7. FAO fisheries Department list of publication ad document 1948-1976, 1977-1990, listing by publication series, no indexes.
8. Fisheries, Annotated Bibliography, FAO publications and documents 1045-1969, Bibliography with indexes to all FAO publication on fisheries.
9. Bibliography of the early life history of fishes (Hoyt) 1988 (Print copy available in QL 689.25 H69 1988) provides 13,717 references on the early life of fishes.
10. Effects of logging, other forest industries and forest management practices on fish: an initial bibliography (MC Donald) 1988 (Canadian Technical Report of fisheries and Aquatic Sciences # 1622) SH 223 A349 #1622)
11. The effects of temperature on invertebrates and fish. A selected bibliography (Kennody and Mihursky) includes approximately 3,500 references. Most date before 1993 with selective coverage of more recent literatures.
12. Fish passage at road crossings an annotated bibliography 1980 includes 44 annotated references.
13. Managing for enhancement of Riparian and wet land areas of the western united status. An annotated bibliography 2000 (Print copy available in Docs A, 13:88 - RMRS - 54) (USFS General Technical Report RMRS - 4TR - 54) includes approximately 2000 references on riparian and wet land management.
14. Aquaculture: Farming Aquatic Animals and Plants" by John S. Lucas and Paul C. Southgate - This comprehensive textbook covers various aspects of aquaculture, including freshwater fish culture techniques.
15. "Freshwater Aquaculture" by Craig S. Tucker and Louis R. D'Abramo - This book provides insights into freshwater aquaculture practices, including fish culture methods and management strategies.
16. "Principles of Warmwater Aquaculture" by Robert R. Stickney - While focusing on warmwater species, this book discusses principles applicable to freshwater fish culture, including water quality management, nutrition, and breeding.
17. "Freshwater Fish Culture in China: Principles and Practice" edited by Jiashou Liu, Yingguo Li, and Zuoyan Zhu - This book offers insights into freshwater fish culture practices in China, including breeding techniques, pond management, and species selection.
18. "Handbook of Fish Biology and Fisheries, Volume 1: Fish Biology" edited by Paul J.B. Hart and John D. Reynolds - This handbook provides a comprehensive overview of fish biology, including topics relevant to freshwater fish culture such as physiology, behavior, and genetics.
19. Fisheries and Aquaculture Economics" by D. Justin Kirkpatrick and Jerry Leonard - This book explores the economic aspects of fisheries and aquaculture, providing insights into the economics of freshwater fish culture operations.
20. Katz M, LeGore RS, Weitkamp D, Cummins JM, Anderson D, May DR. Effects on freshwater fish. Journal (Water Pollution Control Federation), 1972, 1226-1250.
21. Sola F, Isaia J, Masoni A. Effects of copper on gill structure and transport function in the rainbow trout, Oncorhynchus mykiss. Journal of applied toxicology,1995:15(5):391-398.
22. Hayat S, Javed M, Razzaq S. Growth performance of m*et al* stressed major carps *viz*. Catla catla, Labeo rohita and Cirrhina mrigala reared under semi-intensive culture system, 2007.