BSc III. paper No. 15

Unit-I

1. Introduction of aquaculture

→ The aquaculture is a ancient art and science of collecting aquatic organisms.

→ About aquaculture no records will be available before printing.

→ Aquaculture started near about 4000 years ago

→ China was beginning of aquaculture utilizing mainly the common carp.

→ In 500 B.C. The Fan Lai worte a book about aquaculture it is "The Classic of fish culture".

→ In this book describe the structure of ponds, the method of propagation of the common carp and the growth of fry.

→ The period 500 B.C. to 500 A.C. This is a golden age of developing aquaculture.

→ In this period common carp culture had continued to develop in China.

→ In this period chinese people was migrated with knowledge to foreign areas.

→ At about this time i.e. 3000 to 3500 B.C. in India also recorded the use of reservior to hold fish.

French → In french the aquaculture is developed through migrated chinease. They develop at case culture.

India:- The practice of building water reservions and water source was not used for cultivation of fish. Indian were initially used to hold fish and later on to culture

Indonesia :- Indonesia developed a brakish water aquaculture at about 15th century. And the initatre to neighbouring areas including phillippines, malaysia, Thailand and Taiwan.

Europe :- Aquaculture in Europe started during early period. Places of early rulers as well as temples were provide the water area, later on these were used for temporary holding of fish and later on They were cultivate as fish, of common carp and trout.

→ In human nutrition there are six nutrients water, carbohydrates, lipids, proteins, minerals and vitamins.

↔ Humans derive energy from three of these nutrients. lipids, protein and carbohydrates.

→ In aquatic organism foods generally nutrient dense foods and low in calories.

→ seafoods are high protein with vitamins and minerals.

→ rich in polyunsaturated and fatty acids, but low in sodium and total fats.

→ Aquatic animals are used in various fields as wells as poultry, feed, human food, medicine as ornaments.

→ so, day by day the aquaculture is developed with new research.

1) Definition of Aquaculture

1) "Rearing aquatic animals or cultivating aquatic plant for food".

2) "The managed production of aquatic plants and animals in an enclosed outdoor environment was too restrictive for the majority of the aquaculture".

3) "Aquaculture is the production of aquatic organisms for food, aquarium, or scientific purpose, generally as a commercial value"

4) "Aquaculture also known as aquafarming is the farming of aquatic organisms such as fish, crustaceans, molluscs and aquatic plants."

5) "Aquaculture or aquafarming as also referred to as is the farming of aquatic organisms such as the fish, crustaceans, molluscs as well as plants"

6) "Aquaculture is the farming of aquatic organisms such as fish, shellfish and even plants."

7) "The term aquaculture refers to the cultivation of both aquatic plant and aquatic animal".

8) "Aquaculture is commonly defined as the active cultivation (maintenance or production) of marine and freshwater aquatic organisms (plants and animals) under water".

9) "The cultivation of aquatic animals and plants specially fish, shellfish and seaweed, in natural or controlled marine or freshwater environments. It is underwater agriculture".

10) "Aquaculture is the cultivation of aquatic organisms"

11) "Cultivation and harvesting of plants & animals in water called also aquaculture".

Importance of Aquaculture

→ Aquaculture is the fastest growing protein production sector, and the resulting direct and indirect jobs created also continue to grow in a bigger way than in agriculture providing around 55 million jobs worldwide and being the main way of living for 12 % of the world's population.

→ As the human population continue to grow, finding means to feed those people is one of the most important challenges faced around the healthy diet.

→ High protein is necessary to ensure that growing population.

→ Fish and other aquatic organisms fit the model for healthy sources of protein

ii) Concept of Extensive and Intensive

Extensive aquaculture :-

1) In this method ponds are large size, but no managed with scientific methods for increasing the yield.
2) Fish production depends on the natural food which is available in the pond.
3) The artificial food and fertilizers are not used
→ Hence the total yield is low.

Intensive aquaculture :-

1) In this method the ponds may be of small size, but the production of fishes is very high.
2) Natural food is increased by using fertilizers
3) Fish are fed on artificial food
4) The farm is managed scientifically.
5) In this method arrange seperate nursery pond for rearing a spawn, fry, and fingerlings.
6) Due to nursery pond spawn, fry and fingerling are protected from predatory animal.
7) So, the mortality of spawn, fry & fingerlings are reduced.
8) Inject a hormone to male for increase a breeding, by hypophysation.
9) And the suitable combination of fish species is used to obtain maximum yield.
← Hence the total yield is high.

Types of aquaculture :- In the study of aquaculture there are two types of aquaculture i.e. i) mono culture and ii) Poly culture.

i) Mono culture :- In this type only one species of fish is cultured in a pond. This method is easily and take a seasonal pond.

2) This type is non critical.

3) In this type single species is reared so, there habitat consume a limited food and water area.

4) So here yield is low.

5) When the Indian major carps alone were cultured the average yield is 2088 kg/ha/year

6) When exotic carps alone were cultured the average yield was 2900 kg/ha/year.

Advantage :- 1) Mortality rate is low because the predatory species is not

2) No critical condition for rearing.

Disadvantage :- 1) Total energy of pond is not utilize.

2) Total yield is low.

Polyculture :-

1) To obtaina maximum yield of fish from reservior or lake, essential to culture fast growing compatible species of different feeding habits. Fish production from traditional ~~fish~~ method gives a low yield. but if several species are stocked together in proper proportion in the same pond, so that available ecological sources are exploited the production increased several times This is known of polyculture or composite fish ~~farming~~ culture or mixed farming.

→ Polyculture fish farming depends on the manuring and fertilization of pond.

→ As well as feeding the fish with supplementary food consisting of oil cakes and rice or wheat bran.

→ In India polyculture is an old practice with species like Catla catla (surface feeder) Labeo rohita (column feeder) and Cirrhinus mrigala or Labeo calbasu (bottom feeder) are ~~stocked~~ together in the same pond.

→ Alikunhi (1957) recommended stock ratio of Catla, ~~[illegible]~~. rohu and mrigal is 3:3:4 for ~~give~~ a good yield.

→ The Hora and Pillay (1962) have recommended the following stocking proportion.

Catla	30	30
Rohu	60	50
mrigal	10	10
Calbasu	x	10

→ In the above ratio Catla is the surface feeder and feeds mainly on the zooplankton and detritus.

→ The Labeo rohita is a column feeder and its food is decayed vegetable matter, epiphytes in the mid layer of water

→ The C. mrigala and L. calbasu utilised as food of decayed vegetation benthic animals, plants and epiphytic plankton from the bottom side of pond.

→ Each having different feeding habits from others so, that all the food available in the different zones of the pond is used profitability.

→ From exotic carp the Hypothalmichthys molitrix (silver carp), Ctenopharyngodon idella (grass carp) and the Cyprinus Carpio (common carp) have selected for culture with three Indian major carp.

→ Though silver carp is surface feeding, it feeds on only phytoplankton which is unlike Catla feeds only zoo plankton.

→ The common carp is an omnivorous bottom feeder utilize food which is C. mrigala is not able to consume.

→ The grass carp utilize poisonous and excessive macrovegetation, and other unutilized material from other fishes.

→ fecal matter of grass carp served as a food for the common carp. and also accelarate the plankton.

→ During the recent years the got a result from Polyculture. from Anjana fish farm West Bengal, average production of 4000 kg/hec/year.

→ from Gujar gal fish farm Jaunpur U.P. average yield of about 3000 kg/ha/year.

→ The division of Pond Culture CIFRI at Cuttack, a record yield of more than 9000 kg/ha/year was obtained. from the ratio mentioned of following six species.

Grass carp	25
silver carp	15
Catla	15
Rohq	30
Scale carp	20
mirror carp	10

→ Prawn culture in combination with major carps has also been successful.
→ In this culture no competition for food or space.
→ The faecal matter of the fish might serve as an additional source of food for prawns.

→ In polyculture the artificial food is used i.e. Rice bran, broken rice, ground-nut oil cake, fish meal, worms and meat, ~~are~~ used

→ Thus this method of fish farming and using suitable combinations of fish species, are achieved production in country.

Advantage :- 1) Production will be got more
2) Total energy source of pond is utilize

Disadvantage :- 1) mortality rate is high because predatory fishes eat to other.
2) It is critical procedure.

iii) Integrated fish farming

a) Paddy cum fish culture:

→ In some areas ~~of~~ ~~used~~ fish cultivated in paddy fields for a period of 3-8 months in year.

→ It is source of additional supply to the farmer.

→ This is practiced in Italy, Japan, Malasia, some African country and several part of India like Kerala & West Bengal.

→ fish culture practices in paddy fields are of three categories.

→ 1) Natural method:- The simplest method is to retain the wild stock that enter the fields during floods. by erecting barriers across the drains and channels. In this method no regular stocking of fish in the fields; The fish that enter the field along with water are not allowed to escape.

→ 2) Paddy fields use as temperory pond:-

- After harvesting the paddy fields are used as temporary ponds, fish and paddy are not cultivated together, but the fields used for paddy, and later used for fish culture, fish seed of suitable species are stocked, and this serves as an off season occupation for the farmer.

→ 3) fish and Paddy cultivation:-

→ The fish are stocked in flooded fields, and there is a simultaneous culture of paddy and fish in the same water.

⟹ Various techniques are practiced for fish culture in paddy fields depending upon the climate, local conditions, species of fish available and the variety of paddy cultivated,

The cultivation of Paddy is the primary purpose of the farmer, hence fish culture is to be adapted to the schedule of paddy cultivation.

→ Species that are suitable for culture in paddy fields must be able to thrive in shallow water.

→ Fishes should be able to tolerate relatively higher temperature and turbidity.

→ Such carps are murrels and tilapia is suitable for culture in paddy fields.

→ The natural food of fish fry and fingerlings in paddy fields consists of minute crustaceans and insects. The quantity of manure applied to the paddy is increased by 50 - 100%.

→ Use of night soil, compost, stable manure, increases fish food and bring about rapid growth.

→ Fish culture is beneficial to the paddy also to some extent.

→ Fish perform tillage, destroy weed and insects that cause damage to the paddy plants, thus increasing paddy production.

⇒ In India experiments conducted on fish culture in paddy fields have shown the survival rate of Labeo, catla and mrigal, ranges from 34 - 40%, and the species show more rapid growth in paddy fields than in ponds.

→ Experiments conducted on fish culture in paddy fields (Channa stocking) have shown 7 - 13% increase in the yield of paddy, and average production of 112 kg/ha of fish.

→ Experiments conducted with Tilapia and Cyprinus carpio have also provided encouraging results.

Advantages :- No additional cost for fish production.

→ The rice production is increased by 5 - 15%, due to fish because the fish feeds on weeds causes digging activity and performs fertilization of soil.

Disadvantages :- Lack of deep water,
→ Limitation of use herbisides, pesticides, weedicides and insecticides as they are harmful to fish.

b) Fish-cum pig farming :-

→ This is integrated system of fish culture. In this method the pigs are cultured with fishes; It is developed in china, malaysia, Hungery and Germany.

→ In this method the application of pig dung in the ponds provides a nutrient base for dense bloom of phytoplankton and zooplankton. The pond is then stocked with fishes.

→ The washing of the pig sites are channelled into the pond which brings pig dungs, pig urin & remainants of pig feed into the pond. Alternatively the pig dung collected to the pond every morning after sunrise.

→ Each fully grown pig produces 500 - 600 kg dung in a year, 30 - 40 pig are sufficient to fertilize on hector water area, The pig dung containing 60 - 70 %. moisture, 1.36 - 2 % Nitrogen, 0.30 - 0.39 % phosphate when the pigs are fed with pig mash having 16 - 17 % protein.

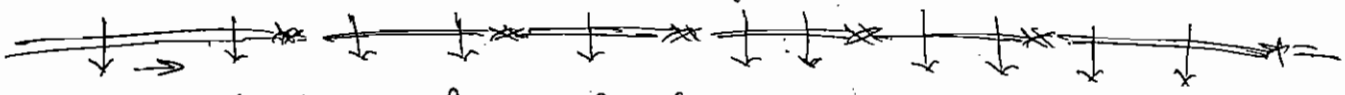
Lime is applied at 250 - 350 kg / hec depending upon the soil and water conditions for PH-7.

Advantages of fish cum pig farming :-

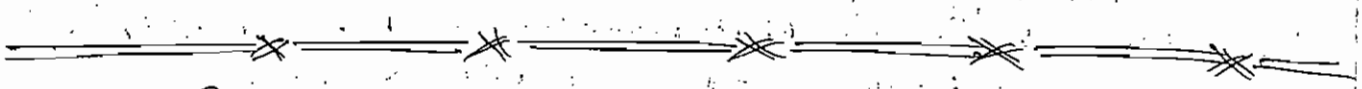
1) The fish utilize the food prefer by pigs and there excretor which is rich in nutrients to water.

2) The pig dung is acts as a substitute for pond fertilizers and supplementary fish food, so the cost of fish production decreases.

→ No additional land is required for pisgery operations.
→ The fish pond provides the water for washing the pig site and pigs.
→ It gives high profit and less investments.
→ The mud which is set deposited at the pond bottom can be used as a manure for agriculture and cattle fodder crops.



→ Culture of carps catla, rohu, mrigala, silver carp, grass carp, along with pig, provides a very high yield of 6000 - 7000 kg/ha/yr fish and 4000 - 4500 kg of pig meat.



d) Fish-cum duck farming :-

→ In this method the ducks are used for rearing along with the fishes. This is effective because the ducks feeds on small organisms like insects, tadpole, molluscans etc.
→ Ducks are "living manuring machines" as the dropping are used as food by fishes and also act as good fertilizer of the pond.
→ This is a regular practice of integrated farming in the states of W.B, Assam, Tamilnadu, A.P, Bihar, Karnataka, Orissa.

Construction of Duck Houses :-

→ The Ducks normally do not need separate houses because most of the time they remain in ponds, but for a night a low cost bamboo made shelter is necessary near the pond.
→ A floating duck house can also be constructed on the water surface using empty barrels as floats for a duck a space of 0.3 to 0.5 m2 is required.

→ Selection of Ducks :-

→ U select the improved variety from Indian duck at 200 - 300 duck for one hector.
→ provide the artificial food every day like poultry feed and rice bran in the ratio of 1:2

→ Egg laying :-

→ The ducks are start egg laying from 6 months of age and continue upto 2 years,
→ They do not lay eggs in water, so their houses should be provided with comfortable for egg laying.

→ Harvesting :-

→ Harvesting from one year and yield up to 3000-4000 kg fish, and 18000 eggs and 500 kg of duck meat.
→ The ducks are sold after three years they give less egg.

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c) Cattle cum Fish Farming :-

- Fish are cultured along with cattle.
→ Cow sheds are construcred near the pond.
→ Urine and dung is used in biogas plant and the liquid manure from the tank in added to the pond.
→ This enhances fish production considerably.

1) Scope in aquaculture

Types of job in aquaculture.

1) Aquaculture technician job.
2) Fish biologist —
3) Fish farm manager —
4) Hatchery supervisor —
5) Fish harvesting crew —
6) Fish processing —
7) Sea food processing —
8) Research lab —
9) Scientist job —
10) Aquarist job —
11) Aquaculture program director —
12) Fish sales —
13) Aquaculture veterinarian —
14) Seafood Inspector —
15) Accounting job —
16) Fisheries law & security —
17) Volunteer & seasonal
18) Net manufacture
19) Boat manufacture
20) Fish food manufacturer
21) Pharmaceutical officer trainee

Aquaculture scientist research :- The aquaculture field is constantly changing and growing with consumer demand, Therefore the need for aquaculture scientists is extremely important.

The aquaculture scientist position has several different titles based on the company and location. Aquaculture nutritionist, research scientist, water scientist, fish scientist, and marine scientist, are just sample of this range.

Unit - II

3. Culture method

i) Pen culture :- (कोंडवाडा)

→ The word 'Pen' here is also used synonymous with 'enclosure' as it is used in enclosure culture.

→ Pens are used for culture of aquatic organism like fishes.

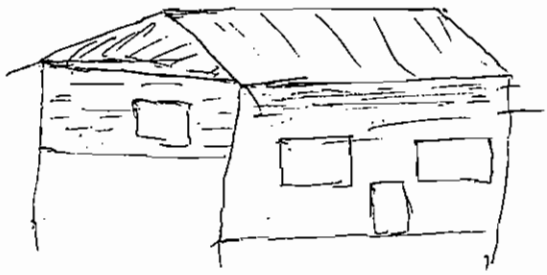
→ Pen is an artificial enclosure generally constructed within shallow water for holding and raising aquatic organism.

→ The removable part of pen is made of Bamboo mat, Plastic screen, small meshed net or gunny bags.

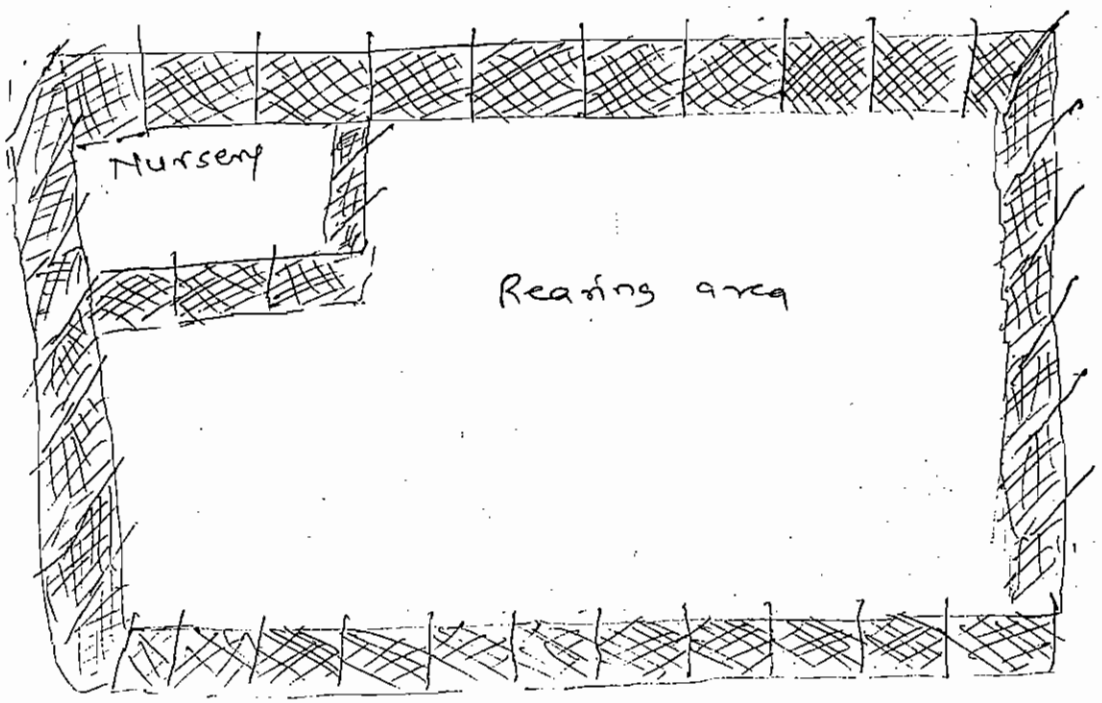
→ Partition acts like the screen which allows only exchange of water throughout but not the fishes.

→ Before stocking the Predatory fishes are removed from the pens artificial food is required.

→ Due to seperation from main reservoir, consumption of artificial food is more.



warehouse



Pen culture Practice in different countries

→ Culture of fishes in Pens is old practice in Philippines.
→ Pens were first introduced in 1965 by the Bureau of fisheries and aquatic resources.
→ They culture fishes like common carp, Tawas and Sabrus in the lake shores of Cardona and Rizal.
→ In Japan, Pen culture is a developed industry in Seto, Nakai, Yoshin and Shikoku inland sea. The Octopus and yellow tail fish is cultured in the Pen.
→ In Thailand catfishes are cultured in baskets.
→ In Indonesia common carp is cultured in Pens.
→ In Scotland Salmon are cultured in Pens.
→ In Washington and Alaska floating Pens are used for culture of Coho and Chinook Salmon.
→ In India Pens are used for stocking of fish seed before releasing in reservoirs.
→ In Combodia Pens are used for culture of Pangasius.

Design of the Pens :-

→ Design depends upon two factors.
1) Strength of the Pens.
2) Rigidity or stiffness of the Pens.
→ The following factors are also having their effect on the Pens these are.
1) wind force 2) wave action 3) water hyacinth drift or other aquatic plant drift. 4) Design of supporting structures.

Size of Pen :-

→ There are three size of Pen. i.e.
i) Small size - 1m x 2m x 1m deep used for rearing of fry
ii) Medium size - 2m x 5m x 1.5m deep
iii) Large size - 2.5m x 4.5m x 7 to 10m x 1.5 to 2m.

Stocking rate :-

→ Stocking rate of fry, fingerlings in the Pens is 1000 to 2000 respectively for medium size and 1500 to 3000 for large size.

Food and feeding :- Artificial food is trash fish, banana,

rice bran, corn and tender aquatic plants.
→ It given after 30 days of stocking

Production :-

→ In combodia culture of Pangasius in pens is quite profitable.
→ 20 tonns of Pangasius are produced from three pens, in 8 to 10 months.

Site for pens :-

→ site should have natural protection from strong wind.
→ Depth should not be more than 2 meter if it is more than 4 meter then floating pens are to be used.
→ Pens should not be put in turbid or polluted water.
→ Muddy, clay or clayloams are best soils for bottom. Such soil bottoms are desirable for easy staking of the poles.

Advantages of Pen culture :

→ Due to use of pen culture space is intensively utilized so, production is increased 4 to 10 times higher than the natural production.
→ In Pen culture fishes are safe from predators.
→ Suitability for culturing many varied species with artificial feeds.
→ It needs little maintenance.
→ Growth rate of fish is faster than in pond culture.
→ harvesting is easier than in the natural waters.

Disadvantages of Pen culture :-

→ cost of construction is more
→ They reduce natural productivity of water body in which they grow.
→ Life of pen is less than that of a pond.
→ fishes are stocked in high density so, they consume oxygen very fast. so, supply of oxygen will artificially.
→ Artificial feed is necessary due to high density of fishes.
→ Pollution of CO_2, ammonia and other excreted material due to high density.
→ Disease will be spread rapidly and mortality

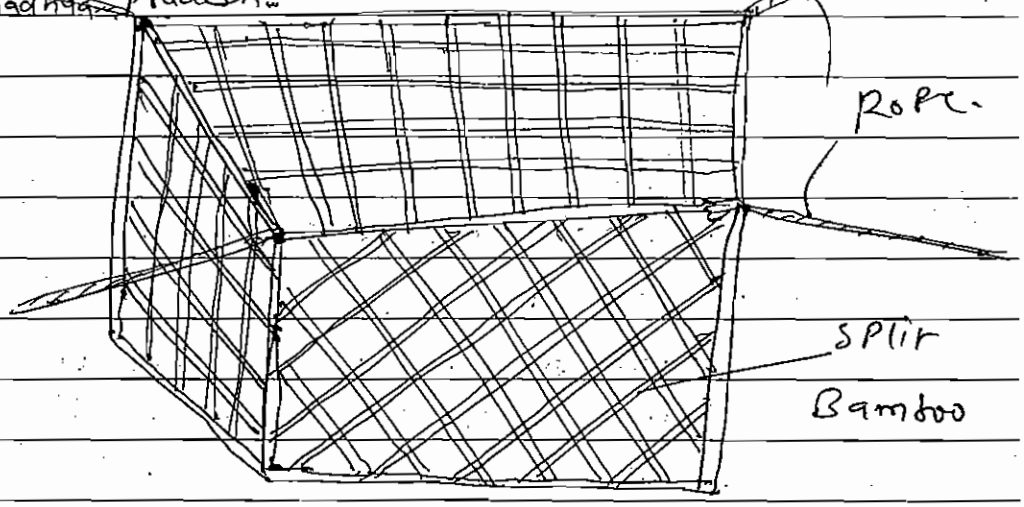
may be increase.

→ Fishes are kept in enclosed area so, may be risk of theft.

vi) Case Culture

→ Case culture is now practised in Japan, U.S.A, Indonesia, Combodia, Thialand and India.

→ In India it is practised in Bihar, Assam and Madhya Pradesh.



→ A case has a completely rigid frame on all sides.

→ Case culture is very effective method of utilizing in pond, rivers, estuaries, open ocean, as well as swampy and weedy water.

→ In this culture required a little investment.

→ These cages manufactured by wood and bamboo from 18th century in south asia.

→ But from 1950 modern case are developed by using synthetic material.

→ There is no particular design for the construction of a case, and it differs in different regions of the world.

→ In USA, Cages are made of galvanised welded wires and nylon meshes.

→ In India, split bamboo is used

→ In Japan cages are made of synthetic nets spread over bamboo poles in the form of a square.

→ The nets are made of polyster, polyethelene polyvenyl.

→ Cages of different size are used at various places.

→ A cage may be stationary fixed or free floating in pond or reservoir.

→ steel drums are usually attached as a float.

→ The upper surface of the cage is also covered with mesh to prevent the fish from jumping out.

→ Generally fish fries are cultured in small meshed cages called "nursery cage" where they grow to the size of fingerlings.

→ After this they are transferred to 'stocking cage'

→ Quantity of cultivated fishes are depend on the area of the cage as well as the species being cultured.

→ Natural food is available in cage is very limited, so regular supply of artificial food is necessary.

→ In artificial food used as banana, rice bran and aquatic plant.

→ Its feeding is required 5-6 times a day.
→ The amount of food varies according to the species of fish and their number.
→ The collection of fish or harvesting is easy and simple. The case is lifted out of water and all the fish come out with it.

⇒ The experiment of case culture conducted in Assam.

→ In this experiment the case is constructed from split bamboo and kept in weed infested water.
→ The species are used like Clarias and Anabas or Clarias, Heteropneustes and Anabas.
→ The yield was been 25000-45000 kg/ha in 200 days.

⇒ Advantages of case culture :-

→ Fish culture in cases has several advantages,
→ It is economical as compared to other methods.
→ It required less investment and installation is easy.
→ Only a small part of the pond is used, and the remaining part is available for other uses.
→ Inspection of fish for disease and their feeding is easy.

→ fish inside the cages are well protected from predators.

→ Several cages can be installed in a pond simultaneously and the production is very high.

⇒ Disadvantages of Cage Culture :—

→ The caged fish are unable to get natural food of their choice.

→ A part of the food given is lost, as it passes out of the meshes.

→ During summer months, there is oxygen deficiency in water and the caged fish die due to suffocation as they can not come to the surface to breathe in oxygenated surface water.

→ Diseases are a common problem in cage culture. The wild fish around the cage can transmit diseases to the caged fishes.

Unit - II

4. Sewage fed fish culture

Intro :- Sewage is the liquid waste discharged from domestic and industrial sources. It consists liquid waste from kitchen and bathroom.

→ It is good fertilizer for ponds having nitrogen and phosphorus as it's main constituents.

→ sewage contain bacteria and protozoa also.

i) Composition of sewage :— sewage is a liquid waste, it is a mixture of carbon, nitrogen, zinc, copper, chromium, mangamese, Nikel, phosphorus, micro-organism, along with some quantity of detergents, faecal matter and urine.

→ According to 'Saha et al (1958)' sewage of Kolkatta has the following composition.

Dissolved oxygen	—	Nil
Dissolved Carbon dioxide	—	20.96 ppm
H_2S	—	2.4 - 4.48 ppm
Alkalinity	—	170 - 490 ppm
free Ammonia	—	12.0 - 63.6 ppm
Nitrite	—	0.08 ppm
Phosphate	—	0.01 - 0.33 ppm
Suspended matter	—	160 - 420 ppm
pH	—	6.9 - 7.3

→ If sewage used to fertilize pond without previous treatment it is harmful to fish and other organism due to low oxygen content, high CO_2, ammonia, and H_2S. However, sewage if properly treated is of considerable value in raising the fertility of pond water.

ii) Sewage use in culture :-

Without treated sewage can not use for culture of fishes, so, Before use must a treat to sewage at filtering process.

→ There are three methods for the treatment of sewage, i.e.
a) Mechanical, b) Chemical c) Biological

A) Mechanical Process :-

→ The mechanical process consists of screening and filtration, so, as to remove coarse suspended matter.

→ Floating solids including fats and oils, as well as fine suspended material are removed by skimming and sedimentation.

→ Sedimentation is done by send the sewage into a tank at a high velocity.

→ When the sewage enters a large tank from a sewage channel,

→ The flow sudden stop of velocity.

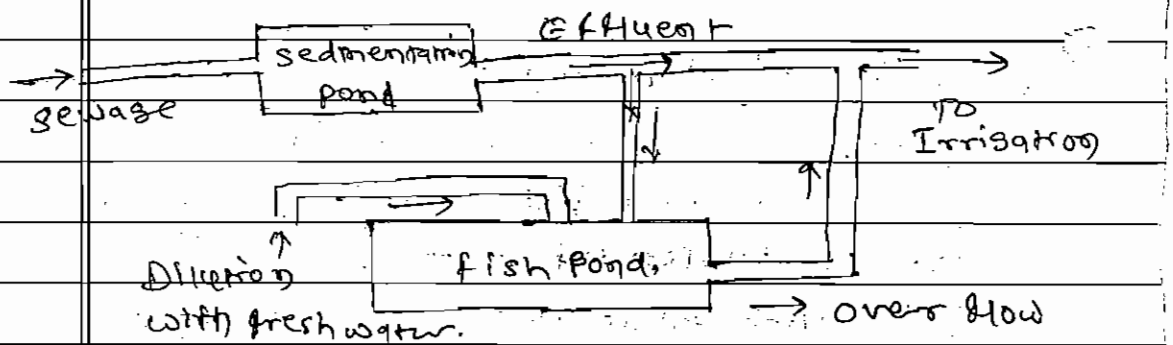
→ After some period the suspended matter will deposit at bottom side resulting in sedimentation.

B) Chemical Process :-

→ The chemical method includes coagulation, precipitation, deodorization using chlorine, ferric chloride etc. and disinfection by using chlorine and copper sulphates.

C) Biological Process :-

→ The biological treatment of sewage consists of oxidation of organic matter into CO_2, H_2O, sulphate etc. by using bacteria.



Before sewage is added to a pond, it is diluted with fresh water so as to maintain the dissolved oxygen content, and reduce CO_2, NH_3, H_2S, etc. below the danger level.

→ After sedimentation and dilution, the sewage is stored in tanks so as to allow bacterial action for oxidising organic matter.

⇒ City sewage is extensively used for fish culture in Kolkatta.

→ The sewage is diverted through a system of drains to sedimentation tanks.

→ After sedimentation and dilution at 1:4 with fresh water, it is added to fishery ponds at monthly intervals, fingerlings of rohu, catla and mrigal are stocked in the ratio of 1:2:1 giving an average yield of 1850 kg/ha of fish.

→ for effective use of sewage and industrial waste, it is necessary to construct waste stabilisation ponds which are used to retain sewage at 10–12 days, till it is made stable and fit for discharge into fishery pond.

iii) fish species suitable for sewage fed fishery:

→ sewage is not only a highly valuable organic fertilizer but the most economical
→ its utilization in fisheries has also solved one of the great problems of municipalities.
→ The problem of sewage disposition in many big cities of the world.
→ The use of sewaged water for polyculture carp culture in all over world.
→ Use of sewage in fish raising is exceptionally efficient and ecologically sound.
→ The cyprinus carpio stocking in rapidly flowing streams polluted with raw sewage is traditional method in java by case culture, and yield is fantastically high 5,00,000 kg/hectare/year.
→ The cyprinus carpio was stocked in oxidation pond at Bhopal in India 5000 fish/hec approximately.
→ Fish were netted periodically after three months. There was increase in body weight every month and fish reached 1197 gms within one year. The total average production was 11,938 kg/ha/yr.
→ Analysis of the muscle of the fish showed 22% protein, 3.2% fat and 10.4% glycogen.
→ Thus these fish had more nutritive

value than those reared in other ponds.

→ Tilapia is the very great fish for sewage fed fish. Tilapia tolerate a high turbidity and breed continuously within 16 to 28 days gap.

→ The catla, rohu or mrigala are raised in Nidhyadhari sewage spill in Calcutta (Kolkatta). The sewage is thy partially treated before use. The annual yield is 1200 kg/hectare.

→ In Tamilnadu the major carps are stocked in fort moats with sewage fed water the yield is obtained 1000-1500 kg/ha.

→ The Clarius, Heteropneustes, Channa and anbas, are air breathing fishes. These fishes raised in primary ponds of sewage with low dissolved oxygen content..

⇒ Hence use of sewage in fish culture is highly profitable as the production cost is low, because use of fertilizers and supplementary food is not required, and the fish grows at a higher rate.

Unit - II

5. Man Made Hazards and aquaculture

→ Man made a several hazards on earth under development.
→ man made a hazards for his survival requirements
e.g. forest cutting, mining,
→ After using water makes a ~~water~~ waste. The water is remove from using area. Through drainage
→ That waste water is called as sewage
→ It is classified in to three types. i.e.
i) Domestic sewage ii) Agricultural sewage & iii) Industrial effluents.

i) Domestic sewage:-

→ Domestic waste water is generated from domestic sources such as kitchen, Bathroom, toilet, laundry.
→ Domestic water is mainly composed of water is greater than 99%, & in 1% solid waste; some inorganic matter and heavy metals, grit, sand and floatable debris.
→ Domestic water containg faecal matter and urine, so, bacteria and protozoa is developed
→ These waste water flow is running in the city through drainage.
→ The drainage is covered or may be open.
→ During heavy precipitation, the street gutters collect more water, so system can hold.
→ Pollution caused by sewage water is one of the major problems in cities.
→ More cities sewage water is drained off into rivers without treatment.
→ In Maharashtra 70 Percent of the water pollution due to domestic sewage.

Grit - Hard Particles of Stone

→ Domestic sewage is the primary source of pathogens and spoiled organic substances.
→ The pathogens are excreted in faeces, so all sewage from cities and towns is likely to contain pathogens.
→ These pathogens threat direct to public health.
→ Spoiled organic matter presence a different odour.
→ Domestic sewage or water causes jundice, cholera, diarrhoea, etc.

Prevents the Pollution from Domestic sewage

→ Drainage should close where sewage is flow.
→ control the waste water through septic tank at domestic level.
→ waste water may be used in home garden.
→ Before drain flow enter in rivers it will treat through treatment plant.
→ sewage water can be store in sewage well.

⟹ In many European countries citizens are connected their homes to sanitation.
→ There is national sewerage system.
→ for example the Netherlands have 99% of the population connected to the sewarage system.
→ And it has an individual sewage disposal system; i.e. septic tank.
→ In Germany 96% homes connect to national sewarge system
→ In Belgium 86% homes are connect to national sewarage system.

Treatment of sewage

→ The sewage is treated by three methods.
a) Mechanical b) Chemical c) Biological.

ii) Agricultural sewage :—

→ Agriculture pollutes the soil and water through pesticids, fertilizers

→ From more than century air pollution has affected agriculture. Burning coal and petroleum produces poisonous sulphur oxides.

→ Fluorides result from mining, smelting and glass and ceramic manufacture.

→ Rising level of Ammonia, chlorine, ethylene, mercaptans, carbon monoxide, and nitrogen oxides are poisoning the air we breathe and systematically contaminate the global soil and water.

→ The increasing demand of food because increasing pollution. for more production; producers are use large amount of pesticides, insecticides, fungicides, herbicides and chemical fertilizers

→ That are now negative returns while systematic pollution,.

→ Infectious agent like virus & bacteria carried by water and soil, it create a disease of crop.

→ Animal diseases like Leptospirosis, salmonellosis, hog cholera, mastitis, are pollute to water and soil.

→ organic chemicals like detergent nematocides, rodenticides, growth regulators, and defoliantes are adversly affect soil & water.

→ unmanaged and unlimited use of fertilizers, pesticides, insecticides is cause of soil & water pollution.

→ When over flow from land by excess or unmanaged irrigation rain water The all content of toxic material will be flow with water and accumulate in reservoir.

→ This contaminated water is toxic to wild life, livestock and humans.

→ The Nitrogen & Phosphorus applied to agricultural land via fertilizers, composts, manures, biosolids, etc.
→ when excess N & P. can lead to contaminate water.
→ Nitrate-contaminated drinking water can cause blue baby syndrome.
→ The Phosphorus – contaminated water stock to algal dead zone.

Prevent contamination from Agricultural sewage.

→ Managed use of pesticides, Insecticides, weedisides, fungicides, fertilizers, is must.
→ Arrange the band from allover land for prevent the soil erosion & water flow.
→ Use Biopesticides & Bio fertilizers which is derived from natural materials like animals, plants, microorganisms, certain minerals.
→ The use of biological pest control agents, like predators, parasites, and pathogens to control agricultural pests.
→ The use of genetically modified organism (GMOs) in agri. It is reduce use of heavy pesticides

→ These crop can be genetically engineered to increase pest resistance.
→ The Premier example of this use of GMOs. would be Bt corn (maize), and other crops into which generic material from Bacillus thuringiensis (Bt) has been inserted so that the plants produce toxins effective against arthropod pests

→ The manure can be distribute through pump.
→ Apply managed irrigation like sprinkler, drip.

iii) Industrial Effluents :—

→ All industrial plants produce some organic and inorganic chemical wastes.

→ Those non-usable chemicals are dumped in water as a means of getting rid of them.

→ The industrial wastes include heavy metals like Hg, Cu, lead, zinc, as well as detergents, cyanides, arsenic, chlorine, petroleum, acids, alkalies, phenols, carbonates, alcohol.

→ Some industry waste material mix in sewage water i.e. fluorides from mining, smelting, and glass and ceramic manufacture.

→ Inorganic salts and minerals including boron is mix in sewage water, The boron is highly toxic.

→ Food processing industry dump their waste material in sewage water i.e. food for microorganism so. Here microorganisms are developed.

→ The Pulp and Paper industry dump their waste Pulp and Paper material in sewage water.

→ Manufacturers of organic chemicals are leave their waste organic compound in drainage that material is detergents, insecticides, herbicides, fungicides, nematocides, rodenticide,

→ The textile industry left the micro material of cotton and remaining dye. in sewage drain.

→ The sugar industry left the same molasses material.

Prevent contamination from Industrial Effluents

→ The flow of waste water from industrial area. is very hazardous. So, Prevention is must

before left those waste.

→ Organic chemical manufacture do not dump their waste in common drainage

→ They should collect their waste water in a well.

→ After collection be treat this water.

→ Govt. not allow to those chemical industry near public residency.

→ Public avoid chemical compound and use Biotech material.

→ Some industrial waste can be refilter and use again in manufacture. e.g. sugar factory.