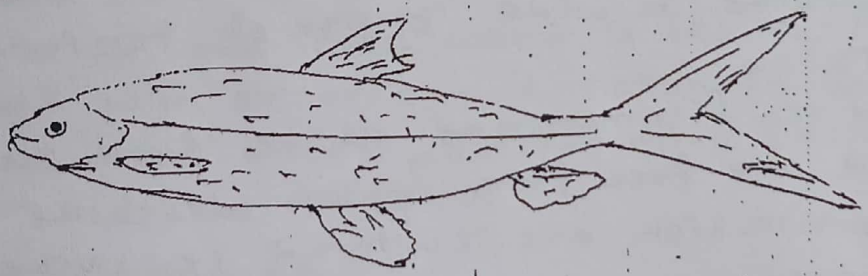
3. Culture of milk fish - Chanos chanos

→ The milk fish (chanos chanos) is the sole living species in the family chanidae. The species has many common names. The Hawaiian name for the fish is 'awa' and in Tahitian it is 'awa'. It is called 'bangus' in the Philippines. It is also called as 'bandeng or bolu' in Indonesia.

↔ Chanos chanos occurs in the Indian ocean and across the Pacific ocean. from South africa to Hawaii and the Marquesas from California to the Galapagos. north to Japan, south to Australia.

→ Milkfishes commonly live in tropical offshore marine waters around islands and long continental shelves, at depths of 1 to 30 meter. They also freauently enter esteries and rivers.



Chanos chanos

Anatomy :- The milkfish can grow to 1.80 m (5 feet 11 inch) but are most often no more than 1 m (39 inch) in length. They can reach a weight of about 14 kg and an age of 15 years.

→ They have an elongated and almost compressed body with a generally symmetrical and streamlined appearance, one dorsal fin, falcate pectoral fins and a sizable forked caudal fin. mouth is small and toothless. Body colour is olive green, with silvery flanks and dark bordered fins. They have 13-17 dorsal soft rays, 8-10 anal soft rays and 31 caudal fin rays.

Biology :- These fishes generally feed on autotrophs, algae and small invertebrates. They tend to school around coasts and islands with coral reefs.

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(12) → The young fry live at sea for two to three weeks
Then migrate during the juvenile stage to mangrove
swamps, estuaries, and sometimes lakes, and return
to sea to mature sexually and reproduce. Fema
spawn at night up to 5 million eggs in saline
shallow water.
→ The milkfish is an important seafood in southeast
Asia and some Pacific Islands
→ Because milkfish is notorious for being much bonier
than other food fish.

History :- milkfish aquaculture first occured and
800 years ago in the Philippines and spread in
Indonesia, Taiwan and into the Pacific.
→ In the late 1970's farmers first successfully spaw
breeding fish.
→ Milkfish (Chanos chanos) is one of the most ideal
finfishes for farming in coastal areas. They are fast
growing, tolerates a wide range of temperature, oxyg
and salinity.
→ They feed on filamentous algae from the bottom o
the pond and are free from major diseases and
parasites, milkfish are cultured in large in countri
like Indonesia.

Seed collection :-
→ Since milkfish does not mature and breed in
confined waters and culture ponds, development of a
hatchery technology has been difficult. However
induced breeding has been successfully carried out i
this species, but the final survival rate has been less
and hatchery operations hence are not economical. In
this respect the most suitable method is collection
of seeds from natural sources. In India, the seeds
of milkfish measuring 2-3 cm in length occur
along the coast of Orissa, Andhra Pradesh, Tamil
nadu, Kerala and Karnataka.

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→ The seeds are collected from low-lying areas using scoop nets, dip nets and hand nets. In estuaries and lagoons, drag nets or seine nets may be use while in mud flat areas. Soon after collected the seeds are conditioned by keeping in a limited volume of clear water for a definite period without food. seeds are transported in containers with diluted sea water of 10-15 ppt salinity and at a rate of about 100 brq/L.

Nursary Rearing :-

→ The area of nursery ponds ranges from 500 to 5000 m^2 The fry are attain 5-7 cm in length. At the nursary site the fry are acclimatized to the salinity of the pond water. preparation of pond for stocking with fry has to be started about one or two months in advance. The ponds are drained and dried for about 10 to 15 days and later filled and raked. Lime is added @ 1000 kg/ha and fresh water is let in. Pond water is fertilized with organic and inorganic fertilizers. once the algal bloom develops more saline water is added to a height of 10 cm.

Pond management

farming in earthen ponds

→ The ponds where milkfish fingerlings are reared are called "production ponds" or "rearing ponds". The production pond ranged from 0.5 ha to 3 ha in area and are rectangular in shape. with water depth ranging from 0.3 to 0.7 m. The best bottom for these ponds is a soft jelly like, colloidal and biologically active mud containing about 4% humus and large amounts of clay. The silt, sand and clay should be in the proportion of 64%, 32% and 4%.

→ In Taiwan, a system of canals is provided on the outer boundary of the ponds to give protection to fish against extreme conditions of temperature.

→ About two months prior to stocking, the pond management begins for the growth of blue-green algae in pond

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(4) bottom. Before this the Pond Preparation for fertile presence of draining of water, drying, tilling, levelling and ranking, manuring of the ponds is always carried out. Usually green manure is used, such as leaves and twiss of mangroove plants, rice straw, copra rice bran, oilcakes, pig manure, chicken manure etc.

→ The rate of fertilization usually varies from 500 to 2,000 kg/ha. Beside organic manure, inorganic fertilizers containing nitrates, phosphates and potassium such as superphosphates, triple superphosphate urea etc may also be applied at required rates.

→ Water is then let into the pond and the depth is increased to about 30 cm gradually.

Eradication of Predators and Pests :—

→ certain predatory fishes, crabs, water snakes are the common threat to milkfish culture ponds and pen structures.

→ These can be prevented from entering the farming area through use of fine meshed screens.

→ Apart from these larvae of certain insects also pose threat to fingerlings of milkfish. Application of 0.5 ppm Baluscide, lime, urea etc. in the initial preparation of the ponds helps to reduce their growth.

Harvesting :—

→ Milkfish has a higher growth rate in its first year in brakishwater, during when it grows to a marketable size of 30-35 cm long and 300-500 gm weight. The periodicity of harvesting depends upon the number of batches stocked.

→ During harvesting the pond is drained using pumps, while in the case of pens, the lowest tidal period the best time for harvest.

→ The survival rates ranges from 80 to 95 %, amounting to a production ranging from 500 to 1000 kg/ha in ponds and 250 to 500 kg/ha. pens.

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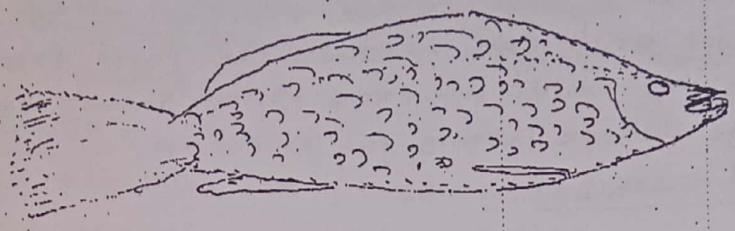
4. Culture of sea bass



→ seabass has been commercially cultivated in brackish-water and freshwater ponds and marine cages in many southeast Asian countries.

Culture techniques :-

→ culture of seabass should be approached in two phases i.e. the nursery phase and the grow-out phase.

Nursery Pond :-

→ The main purpose of the nursery is to culture the fry from hatchery (1-2.5 cm in size) to juvenile size (8-10 cm)

→ Nursery Pond size ranges from 500 to 2000 m^2 with water depth of 50-80 cm.

→ The pond has separate inlet and outlet gates to facilitate water exchange.

→ Pond bottom should be flat and sloping towards the harvesting or drainage gate.

→ Inlet and outlet gates are provided with a fine screen (1mm mesh size) to prevent predators and competitors from entering and fry from escaping the pond.

Nursery Pond Preparation :-

→ To enhance production the following improved pond preparation techniques are done.

→ The nursery pond must be drained and dried until the bottom soil cracks to release toxic gases.

→ oxidized mineralized nutrients. eradicate some pests and predators.

→ In cases where the pond cannot be completely drained, apply the derris root at the rate of 20 kg/ha to eradicate unwanted species.

→ Derris root is prepared by cutting them into small pieces, crushing and soaking in water overnight, the solution applied only for pond.

→ If derris root is not available a mixture of 50 kg/ha of ammonium sulphate with lime at a ratio of 1:50 will be sufficient to remove unwanted species.

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→ The mixture is applied to the portions of pond with water.
→ The use of any chemicals or inorganic pesticides is not recommended because the residual effect remains for many years and can reduce the pond production
→ If pond soil is acidic the pond bottom should be neutralized with lime before letting the water in.

Nursery Pond management :-

→ Fry must be acclimatized to the salinity and temperature prevailing in the pond on stocking to prevent loss.
→ Acclimatization is done by transfer the fry to a tank then gradually add nursery pond water.
→ This can be completed within one day or more depending on the salinity difference.
→ Seabass fry are stocked in nursery pond at the rate of 20-50 fry/m^2
→ Stocking is usually early morning (6 to 9 Am) or early evening (5 to 10 pm) when the temp is cooler.
→ Water replenishment is needed to prevent deterioration of pond water quality due to the decomposition of uneaten feed or excess growth of natural food.
→ Normally 30% of pond water is changed daily.

Feeding Nursery Pond :-

→ Supplementary foods are chopped and grounded trash fish.
→ Newly hatched Artemia nauplii at the rate of 1 kg dry cyst/ha.
→ The first five days feeding should be 5 to 6 times a day
→ After five day frequency is reduced to twice daily.

⇒ Nursing in net cages :-

→ Nursing in seabass fry in cages is an approach to the nursery phase.
→ The method has been successful for good health and growth of fishes.
→ It is likewise easy to maintain and require very little capital investment.

Nursing case design and Investment :-

→ The most convenient case design is a rectangular case made of synthetic netting attached to wooden frames.
→ The size of cages vary from 3 cubic meter (3x1x1 m) to 10 cubic meter (5x2x1 m)
→ The mesh size of net used for nursery cages is 1.0 mm.
→ Cages may be installed in the river, coastal area or in a pond.

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Nursery case management :-

→ Seabass fry (1-2.5 cm in size are stocked in the nursery case at the rate of 80-100 per cubic meter.
→ stocking and feeding activity are the same as in nursery pond culture practice.

Stocking :

→ The stocking phase involves the rearing of the seabass from juvenile to marketable size.
→ Marketable size requirement of seabass vary country to country e.g. Malaysia, Thailand, Hongkong, and singapore, the acceptable marketable size of seabass among these countries and region is between 700-1200 gm while in the Philippines, marketable size is between 300-400 gm.
→ The culture period in rearing phase also vary from 3-4 month to 8-12 months.

→ Pond culture :-

→ The pond culture of seabass have been practiced for over 20 years in southeast Asia and Australia.
→ It's tremendous market potential and high profitability.
→ There are two culture systems employed in pond culture of seabass, i.e. monoculture and polyculture.

Monoculture :-

→ Monoculture is that type of culture where a single species.
→ This system has a disadvantage.
→ It is entirely dependent on supplementary feeding.

Polyculture :-

→ The seabass is cultured with forage fish.
→ The choice of forage fish will depend on its ability to reproduce continuously in quantity sufficient to sustain the growth of seabass throughout the culture period.
→ The forage fish must be seen a species that could make use of natural food produced in the pond and does not compete with the main species in terms of feeding habit such as Oreochromis mossambicus, Oreochromis niloticus etc.

★ Criteria in the selection of site for seabass culture :-

Water supply :-

→ The site should have enough good water quality supply all year round.
→ water quality included all physico-chemical and microbiological characteristics of water being used for culture of seabass.

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→ The following are the parameter normally considered as suitable water supply.

Parameter	Range
pH	7.5 - 8.5
Dissolved oxygen	4-9 ppm
salinity	10 - 30 ppt
Temperature	26 - 32°c
NH_3	less than 1 ppm
H_2S	less than 0.3 ppm
Turbidity	less than 10 ppm.

Tidal fluctuation :-

→ Area best suited for seabass should have moderate tide fluctuation range between 2 - 3 meters. with this tidal characteristic even for ponds as deep as 1.5 meters, complete drainage during low tide can be done. In addition the pond can readily admit water during spring tide.

Topography :-

→ It is advantageous if the selected site is mapped topographically.

Soil :-

→ Ideally the soil at the proposed site should have enough clay content to ensure that the pond can hold water.
→ Area with acid sulphate soil should be avoided.

Accessibility :-

→ Accessibility is an important in site selection for logical reasons.
→ Overhead cost and delay in the transport of material and product may be minimized with good site accessibility.
→ other factors in the selection of site that should be considered include availability of seed, labour, technical assistance, market demand and suitable social condition.

Pond design and construction :-

→ seabass ponds are generally rectangular in shape and size ranging from 2000 m^2 to 2 hectare and depth 1.2 to 1.5 meters.
→ Pond has separate inlet and outlet gate to facilitate water exchange.
→ The bottom is entirely flat leveling [illegible]

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Pond Preparation :-

⇒ In monoculture, the fish are stocked immediately after neutralizing the pond soil with lime.
→ Ponds are filled immediately after pond preparation.
⇒ In Polyculture, after the pond soil is neutralized, by organic fertilizer (chicken manure) at the rate of 1 ton per hectar.
→ Then water depth is gradually increased for propagation of natural food.
→ When abundance of natural food are observed, selected tilapia broodstocks are released to the pond at the rate of 5,000 - 10,000 per hectare,
→ The sex ratio of tilapia male & female is 1:3, They are reared in pond at 1 to 2 months or until tilapia fry appear in sufficient number.
→ Then sea bass juveniles are then stocked.
⇒ Sea bass juveniles (8-10 cm in size) from nursery are stocked in stocking pond at the rate of 10,000-20000 per hectar in monoculture.
→ And 3000 - 5000 per hector in polyculture system.
→ Prior to stocking, juveniles are acclimatized to pond culture and salinity conditions.
→ Stocking the fish in uniform sizes will be most ideal and should be done at cooler times of the day.

Pond management :-

→ Due to need of the natural food for Polyculture, the water changing should be minimised at once in three days for 50% of total capacity.
→ However, in monoculture supplementary feed is given daily, here chances the excess feed may pollute the water, so, daily water replenishment is necessary.

Food and feeding

→ Supplementary feed is not required in the Polyculture system. But in monoculture, daily feeding is a normal practice. feeding activity done at early morning or late evening

Combination of feed stuff

Ingredient	Percentage
Trash fish	70%
Rice bran or broken rice	30%

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Combination of moist diet	
Ingredient	percentage
fish meal	35%.
rice bran	20%.
Soyabean meal	15%.
corn meal	10%.
Leaf meal	3%.
Squid oil (or fish oil)	7%.
Starch	8%.
vitamin mix	2%.

Case culture :- [seabass culture in case system]

→ case culture of seabass is quite well developed in Thailand, Malaysia, Indonesia, Hong kong, and singapore

Suitable site for case culture :-

→ Protection from strong wind & waves.
→ The tidal fluctuation is influenced.
→ Avoid installing cage where the water current velocity is strong.
→ Salinity ranging from 13-30 ppt.
→ Avoid the polluted area from domestic, industrial and agricultural.

~~Case culture management~~

Design and construction of cages :

→ General square and rectangular cages with size varying 20 to 100 m^3.
→ Seabass cages usually made from polyethelene netting with the mesh size ranging 2 to 8 cm. The mesh size depends on the size of fish.

There are two types cages are used in seabass culture

a) **floating case :-**

→ The floating cage are constructed from wood, GI pipe, or bamboo frames, plastic, drum which is floating material
→ The size floating cage is 50 m^3 (5x5x2 m).

b) **stationary case :-**

→ The case is fastened to the bamboo or wooden poles installed at its four corners.
→ stationary cages are used in shallow bays
They are easy to install.

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5. Culture of Crabs

Intro :-

→ Crabs are decapod crustaceans of the suborder pleocyemata.

→ They live in all the world's oceans, in fresh water, and on land, tropical and subtropical area, terrestrial or semi terrestrial

→ Generally covered with a thick exoskeleton and have a single pair of claws.

→ Crabs vary in size from the pea crab, a few millimeters wide, to the Japanese spider crab, with a leg span of up to 4 meters.

→ The larger species scylla locally known as 'green mud crab' is grow up to 22 cm carapace width and 2 kg in weight.

→ The smaller species is known as red claw is grow upto 12.7 cm carapace width and 1.2 kg in weight

→ Above both species have good demand in the domestic as well as in the foreign market.

→ The commercial scale crab culture is developing fast along the coastal areas of Andhra Pradesh, Tamilnadu, Kerala and Karnataka.

Culture of crab - Larval production :-

→ After fertilization the development is complete, female releases the newly hatched larvae into water.

→ The free swimming tiny zoea larvae can float and take advantage of water currents.

→ They have a spine which probably reduces the rate of predation by larger animals.

→ Each species has a particular number of zoeal stages seperated by moults.

→ The zoea larvae then convert into megalopa larvae.

→ After one more moult the megalopa larvae is change into juvenile.

→ once crabs have become juveniles they will still have to keep moulting many more times to become adults.

→ The moult cycle is coordinated by hormones.

→ When preparing for moult, the old shell is softened and partly eroded away. while the rudimentary begining of a new shell from under it.

→ The feeding for zoeal larvae is rotifers and shrimp larvae.

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→ And megalopal larvae feed with newly hatched Artemia nauplii, and ground mussels of bivalves.
→ When crabs grow 1 cm in carapace width (same to the 2nd or 3rd crab stage) they can harvested for stocking to ponds.

Culture in Pond :-

Preparation of Pond :-

→ Size of pond is about 1-3 ha and shape is square
→ Stocking pond consists of inlet, pumping system and water supply and drainage canals.
→ Eradicate pathogens including viral vectors,
→ Water is maintained from 1.2 to 1.5 m in depth.
→ Bottom of pond should be sandy or mud sandy because crabs hide in the bottom during rest at daytime.
→ Fencing is advisable to prevent the crab walking out.
→ Close the all holes particularly near by sluice.

Stocking Juvenile in Pond :-

→ The Juvenile stocked at the rate of 10/m² or depend on size of crab.
→ The temperature of water up to 15°C.
→ If the culture pond is big it can divide the pond into different compartments of suitable size for stocking crabs.
→ This is good for feeding and easy to monitor and harvest
→ sexwise stocking in compartments is advantageous to reduce the attacks from more aggressive male crabs, and minimize mutual attack and cannibalism.

Culture in Pens and Cages :-

→ Culture in pens and cages also carried out.
→ The floating net cages or bamboo cages in shallow estuarine waterways and inside large ponds with good tidal water
→ The HDPE, nylon or bamboo splits can be used as the netting material.
→ The size of case shall be preferably 3m x 2m x 1m.
→ The cages have to be arranged in a row so that, feeding and monitoring can be easily carried out.
→ A stocking of 10 crabs/m² in cages and 5 crabs/m² for pens is recommended.

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feeding :-

→ crabs are daily feed with trash fish, brackish water clams or boiled chicken waste at the rate of 5-8% of their body weight.

→ If the feed is given twice a day major share must be given during evening hours.

water quality :-

→ The water quality parameters shall be maintained within the range shown below:

salinity	⟶	15-25 ‰
Temperature	⟶	26-30°C
oxygen	⟶	≤3 ppm
pH	⟶	7.8-8.5

Harvesting and marketing

→ Periodically crabs are to be checked for their hardening

→ Harvesting should be done in the early morning hours or evening hours.

→ The harvested crabs should be washed in good water to remove the dirt and mud carefully tied without breaking its legs.

→ The harvested crabs have to be kept in moist conditions, it has to be kept away from sunlight, which has a negative effect on survival.

Unit - II

Marine water Prawn culture

→ Prawn occur in marine, fresh and brackish water habitats.

→ They are extremely delicious, hence Andra good export market.

→ Out of total production in India Maharashtra occupy 50% Kerala 32% and Andhra Pradesh 6%.

→ Prawns are exported in deep-frozen, canned, dried and even in powdered condition.

Penaeid

⇒ Prawns can be grouped into two categories. i.e. Penaeid Prawns and Non-Penaeid Prawns.

1. Penaeid Prawns :-

→ The species of Prawns which belong to Penaeus and its associated species are called Penaeid Prawns. These are generally marine prawns.

→ The important Penaeid Prawn are → i. Penaeus monodon

(Tiger prawn) ii) Penaeus Indicus (White Prawn),
iii) Metapenaeus monoceros, iv) Metapenaeus dobsoni, v) Metapenaeus brevicornis,
(Yellow Prawn) vi) Metapenaeus affinis. vii) Para Penaeus st

2. Non-Penaeid Prawn :-

→ The species of Prawns which do not belong to Penaeus species are called Non-Penaeid Prawns. These Prawns a either fresh water or brakish water forms. The non-Penae Prawns are. i) Palaemon tenuipes, ii) Palaemon styliferu iii) Hippolysmata ensirostris, iv) Acetus Indicus.

⇒ About 45% of Penaeus species are used as food.
→ For every 100 gm of Penaeus flesh · 19 gm of Protein, 1 of Fat, 90 Kcal of energy, 325 mg of Calcium, 280 mg of Phosphates, 5.5 mg of Iron and some vitamins are prese

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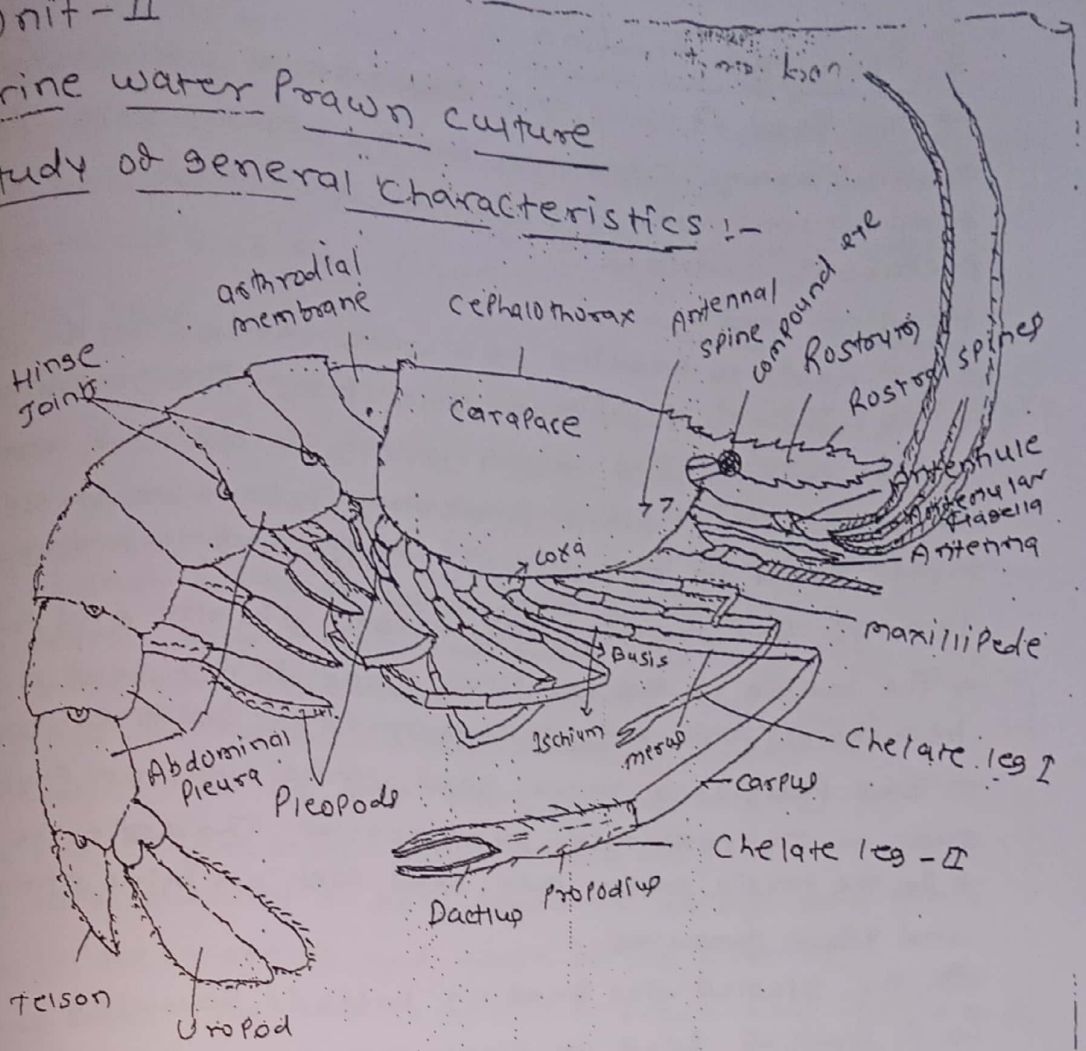
Unit - II

Marine water Prawn culture

1. Study of general characteristics :-



→ Commonly called as Prawn

→ Body is elongated, spindle-shaped, bilaterally symmetrical and deep orange coloured when preserved and measuring about 25 cm in length.

→ Divisions of the body are cephalothorax, abdomen and telson.

→ Cephalothorax is made up of 5 head and 8 thoracic segments. Carapace is anteriorly produced into sawtoothed rostrum.

→ There are two prominent eyes on the head.

→ Abdomen is made up of 6 segments. It is dorsally rounded, laterally compressed and normally bent under the cephalo - thorax so that the animal looks like comma.

→ There are 19 pairs of appendages, one pair in each segment. The cephalic appendages comprise of antennules, antennae, mandibles, maxillulae and maxillae.

→ A large plate like antennal used as a rudder in swimming

→ Thoracic appendages are I maxillipedes, II maxillipedes, III maxilli - Pedes and 5 pairs of walking legs.

→ First abdomen somite is not reduced. Rest five abdominal segments contain paired biramous swimming pleopods. VI th abdominal segment contains paired uropods and a telson. Development includes nauplius larva.

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2. Food and feeding

→ The food, feeding and assimilation is a fundamental importance for the growth rate, population concentrations. gonadial maturation and other metabolic activities.

Feeding habit :-

→ The habit of feeding is a wide range & they are omnivorous
→ The larvae feed on planktonic items. The juveniles, and adult prawns feed mostly on organic detritus, a variety of animals and plant materials available at the bottom.
→ They feeds on crustaceans, polychaetes, molluscs, radiolarians, foraminiferans, fishes, diatoms and algae.
→ The larvae in the nauplius stage do not feed outside because they have food reserve in the form of yolk.
→ But Protozoea larva feed voraciously on phytoplankto such as Terraselmis, synecocystes, Thalassiosira, skeletonem
→ In the mysis stage they feed well on brine shrimp nauplii, and yeast granules.

⇒ The species wise feeding habit is following.

→ P. indicus feed on plant material in the younger stage and older diet on crustacean & Algal filament.
→ P. mondon feed on molluscs, carstaceans, polychaetes and fishes,
→ P. semisulcatus consume large quantities of animals i.e. polychaetes, crustaceans, molluscs, radiolarians, foraminiferans & fishes as well as diatoms and algae.
→ M. dobsoni feed mainly on crustaceans, algal filaments, seaweeds and diatoms such as fragilaria, coscinodiscus, Pleurosisma, Bidduiphia. etc.
→ M. monoceros eat crustaceans including copepods, ostracods, amphipods and decapod larvae in addition to plant materials like seaweeds and algae.

metaponp

~~Artificial feed~~ :-

Supplementary feeds :-

⇒ Supplementary feeds are used in prawn culture to increase the growth rate.
→ So, That prawn can be harvested in a shorter duration.
→ These feeds can be either natural items or artificial feeds

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→ The natural food items are clams and mussels.
→ These are good conversion valued and available in large quantities regularly all through the seasons.
→ They are naturally perishable easily and make artificial compounded food for prawn.

Artificial feed :-

→ The main aim of any artificial feed for prawns is to produce as much increase as possible in the body weight.
→ The standard feed should contain sufficient quantities of carbohydrates, proteins, fat, minerals and vitamins.
→ The cheapest source of carbohydrate is 'tapioca'.
→ The protein source obtained from fishmeal.
→ The minerals & vitamin are available in poultry feed.
~~→ And for vitamin also available for poultry feed.~~
⇒ feeding can be best done in the evening.
→ the prawns are more active during the night.
→ The total quantity of feed could be divided and given once in the morning and again in the evening.
→ hence total food is utilise by prawn and prevent a loss of food.

3. Selection of site

→ The most desirable location is along tidal flats and marsh lands adjacent to brakish water estuaries.
→ Sites of irregular shape and uneven bottom countours are not desirable since they reduce the efficiency of harvesting.
→ Sites located too near to the beach are subject to the threat of erosion.
→ At least a fringe of 15 m should be left between the sea and the farm to ensure protection from erosion.
→ The area chosen should have a sufficient range of tidal movements to allow minimum of 0.7 m of water in the pond at all times of the year.
→ The tidal range of 1.5 m is considered necessary to ensure a free tidal flow.
→ The elevation of the site should not be high than high tides.
→ In subtittoral zone, the main criteria for selection of site is that variation between high and low water levels should be small. There should be enough circulation of water within the neap tide.

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4. Collection of broods :-

→ Mature prawn with ripe gonads are collected from sea water and transported to culture site.
→ Immature prawns may also be collected and allowed to grow in ponds.
→ Mother prawns are easily identified due to the presence of butterfly or diamond shaped ovary, close to the head region.
→ As the mother prawn delicate it is picked up carefully and put in wide mouth plastic bucket containing sea water.
→ If the destination is at a distance and consume several hours to replace the sea water with fresh one it is collected from the same fishing ground.
→ Other method of collection is the mother prawns are replaced in perforated PVC pipe with the help of soft nets and PVC clips.
→ These are packed in polythene bags filled with air or oxygen. The polythene bags should be immersed in a water tank so that the mother prawns can be saved from excess heat generated during transit.
→ The mother prawn spawners are ripe, they spawn overnight and the eggs hatch out into nauplii after 12-14 hours.

5. Mating and Spawning :-

* Mating :-

→ During mating the males closely follow the females. Normally, one male follows one female.
→ The female moults while being followed by the male.
→ This courting behaviour lasts for 3 to 7 minutes, ~~soon after moulting~~.
→ Soon after moulting, the female lays her body sideways and jump about in water bending her body ventrally when the male advances to the side of the female and embraces her on ventral side.
→ The pair by keeping their ventral side close together swim about in the water.
→ during which process it is believed that the copulation takes place.
→ During copulation the male by means of pressing dries the spermatophores released through the openings on the fifth pair of legs to the thelycum of the female.
→ The time spent on copulation is only 3 or 4 minutes. After copulation the male and female separate.
→ The time taken for copulation varies with the species. ~~P. Indicus~~ it takes 3 to 4 minutes in P. Japonicus from 30 minutes to 3 hours in P. monodon.

Spawning :-

→ Prawns spawn at night generally between 8 PM and midnight.
→ The eggs are released while swimming in the columnar waters or near the bottom.
→ During the process of releasing the eggs, they bend down the body posterior to the 4th abdominal segment and show side-wise movement.
→ The fifth pair of legs are held tightly against the body. The eggs are dispersed by the movement of the pleopods.
→ The time required for release of eggs is very short.
→ In some of the species such as M. bennettae spawing and mating are governed by lunar periodicity.
→ Outward run takes place during new-moon-cycle and spawning during full-moon phase.
→ water temperature around 28-30°c and salinity of 28-34‰ are found to be suitable for the maturation of the ovary and spawning.

6. Development :-

→ During of larval development in Penacid Prawns is relatively short.
→ All the 13-15 stages in the larval development in the early life history are being completed in 12-17 days.
→ The adult development is M. dobsoni in 5 months at 50 mm length.
→ The M. affinis in 4 months at 40 mm length
→ The M. monoceros in 10 months at 85 mm length.
→ The P. indicus in 6 months at 80 mm length
→ The P. monodon in 6 months at 160-170 mm.

⇒ The same species attain a size of about 250 mm in one year.

→ The growth rate of P. indicus is considered to be very fast compared to other common Prawns.
→ The P. indicus at the end of third year, developed a 195 mm
→ M. dobsoni at the end of third year developed - 120 mm
→ M. monoceros at the end of third year develop a 160 mm
→ M. affinis at the end of third year develop a 175 mm
→ M. brevicornis at the end of third year develop 155 mm

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7. Water quality for culture :-

→ A constant water supply of clean high quality water must be available, ~~to exchange~~

→ The water should be rich in nutrients and dissolved oxygen. minimum acceptable level ~~of~~ is 3.5 ppm in the pond.

→ The temperature and salinity conditions of the water should suit the physiological requirements of the species.

→ The optimum conditions are considered to be 25-30°c

→ The following important factors ~~for~~ of water for Prawn development.

→ Temperature :-

→ Lower temperature retards and higher temp. accelerates the development of larva.

→ A temp. varying between 24 to 28°c is ideal for most species of Prawns.

→ Salinity →

→ salinity has profound influence on the larval development

→ 28 to 30% of salinity is suitable for P. Japonicus.

→ Coole reported 28 to 30% for P. aztecus and below 25% salinity is best for P. Merguiensis.

→ However the salinity range varies for different species and should be determined by trials for the species selected for the culture.

→ pH :-

→ The optimum pH for the larval development ranges between 8 to 8.2 and has to be regulated carefully.

→ Light intensity :-

→ The larval development proceeds in the darkness. Due to this the tanks are covered with shades and their inner walls are made darker by painting with black colour.

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8. Prawn rearing :-

→ After completing metamorphosis the larvae convert into adult, so, they are now transferred to the rearing tanks.
→ The suitable area of marine water, approximately 250 to 2 with 2-4 m depth is separated at bay by bamboo slates.
→ These slates are tied with the rope to enclose the required area of the sea.
→ The ~~out~~ side of enclosure is covered with the net i.e. 1.5 cm mesh size to prevent predators from entering and the prawns from escaping out of the water body.
→ There are extensive estuaries, backwaters, mangroove, swaps and numerous lagoons all along the coastline suitable for culture operations.
→ A variety of prawns ideally suitable for culture are also available.
→ With these basic requirements as well as large man-power, there is immense scope for the development and establishment of profitable prawn culture in the coastal zone.

9. Larval food supply :-

→ A wide range of feeding material is used by different hatcheries.
→ Generally the larvae feed on planktonic items.
→ Which include nauplius larvae of shrimps, freshwater cladocerans, fish eggs, squid flesh, frozen adult Artemia, rotifers, fish flesh, egg custard, worms and commercial feeds available in the market.
→ The quantity of food to be given depends on the utilization of feed by larvae that vary from place to place.
→ The quantity of feed consumed will increase as the larvae grow.

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10. Methods of fishing :-

I Nets :-

a) conical bag net :-

→ It measures up to 6 to 9 m in length with a mesh size of 5 to 12 mm and is fixed to the mouth of the sluice gate.
→ The net is operated during the low tide when the water is let out through the sluice gate to attract more prawns.
→ The prawns trapped at the end of the nets are removed periodically.
→ Fishing by this net is carried out for 7 or 8 nights in a fortnight. i.e.
→ This type of gear is extensively used in the traditional paddy-cum-prawn cultivation of Kerala, as well as in the bheris of west Bengal in India
→ And in the prawn culture operation in the ponds of pakistan, Singapore, Malaysia, Indonesia, Thailand and Philippines.

b) Pound-net :-

→ It has three elongate, conical shaped collecting nets. attached to the wall of the rearing pond.
→ The net is set in the pond with the wing directed to the shore ward.
→ This type of net is used at night hours.

c) Pump-equipped drag net :-

→ It is constructed in two parts a frame and a drag net.
→ The metal rod frame is in square shape and is fitted with a water pipe on which a number of nozzles are fixed.
→ The pipe is attached to the bottom of the frame.
→ water from the boat is fed at high pressure through a hose to the water pipe.
→ The other part of this gear is the conical-shaped drag net which is connected to the rear of the frame.
→ In operation the net is towed by a motor boat at speed 2 knots passed (and the water pump) at a high pressure (4 kg/cm²) and at the rate of about 0.3 m³/minute to the water pipe of the frame.
→ The water is jetted through the nozzles vertically to the bottom layer of the pond in order to stir up the sand to a depth of 6-8 cm. whereby the prawns are scared out and eventually trapped in the net.
→ This gear is specially designed to trap the prawns during day time when the prawns tend to burrow in sand and become inactive.

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d) Electric Shocker :-

→ This is very similar to the above pump equipped drag net in having the metal framing and a drag net.
→ But instead of the nozzled pipe there are brass bar (12cm long and 12mm wide) situated 20 cm apart from the bottom of the frame.
→ The brass rods are positive and negative electrodes and are arranged alternatively.
→ The wiring is insulated against water.
→ The battery, volt meter, ampere meter and switch board are all kept in the boat.
⇒ In operation, the current from the battery is charged to the electrodes in the frame which touch the bottom, shocking the prawns in the sand and the prawns leap up and are trapped by the drag net.

e) Cast and drag nets :-

→ These nets are employed in the final harvesting when the water level is very low.

II Traps :-

a) Bamboo-screen trap :-

→ The Bamboo-screen trap commonly used in the capture of P. monodon.
→ There are types of traps,
→ In the first type one or two bamboo screens staked and oriented perpendicularly or diagonally from the pond dike.
→ This leads the prawns to chamber from which the prawns are lead into the catching chamber.
→ A light is installed in the catching chamber at night to attract more prawns.
→ This type is more effective during the darker nights when there is tidal movement in and out of the pond.
⇒ The second one which consist of a catching chamber located centrally and two wings to screen the water passage.
→ This trap is so effective in trapping prawns at some narrow gap in the culture pond.
⇒ The third type is having longer screen and two Chambers strategically situated at both sides at the end.
→ This trap is set in the deeper region of the pond and the continuous fishing can be done both during day and night.

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Unit - III - Fish Nutrition

Intro! - Good nutrition in animal production systems is essential to economically produce a healthy, high quality product.

→ In fish farming, nutrition is critical because feed represents 40-50% of the production costs.

→ Fish nutrition has developed with advanced.

→ The commercial balanced diet promote optimal growth and health.

→ The development of species-specific diet formulations support the aquaculture (fish farming) industry.

→ It is satisfy increasing demand for affordable, safe, and high quality fish and seafood products.

Bondgesir.

Fishery

(unit III)

Unit II

mark 4 to 12.

I) Ingredients for fish food:

i) mill-by-Products :-

a) Wheat Germ meal :- गेहूँ का भ्रूण

→ Wheat germ meal prepare from the germ of the wheat berry, bran and some midlings.
→ The wide variety of wheat germs are produced on depending on the area and regional demand.
→ The quality of wheat germ meal is influenced by the added great screening and other wheat product.
→ Due to excessive storage the material of fat will be destroy from rancidity.
→ Generally wheat germ meal have a crude protein level of 25-30 percent, crude fat 7-12 percent, and crude fibre 3-6 percent.

b) Wheat Red Dog :-

→ Wheat red dog prepare from the offal of the mill.
→ This offal material mix with wheat germ, wheat flour, wheat bran.
→ Wheat red dog is a fine, fluffy, light-coloured feed ingredient.
→ The colour may range from creamy white to light brown or light red,
→ The colour is depending on the type of wheat being milled.
→ The wheat red dog acts as a contributor of protein, carbohydrates, minerals & vitamins.
→ Wheat red dog may have a crude protein level of 15 to 17.5%, crude fat 3.5 to 4.5% & crude fibre 2.8 to 4%.

c) Wheat Bran :- गेहूँ का भूसा

→ Wheat bran is the coarse outer covering of the wheat grain.
→ sometimes screenings of other grain ground and added to the bran.
→ wheat bran is a source of carbohydrates, protein, minerals and vitamins
→ Generally wheat bran will have a crude protein level of 14-17%, Crude fat 3 to 4.5% & crude fibre 10.5-12%.

d) Wheat middlings :- गेहूँ मांडीले अपमार्जन

→ Wheat middlings consist of fine particles of wheat bran, Wheat Short, wheat germ, wheat flour and some of the offal from the mill.

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→ The quality of midlings may be influenced by the amount of screening added and the fineness of grind. Wheat middlings have a crude protein level of 15-17%, crude fat 3-4% and crude fibre 8.5-9.5%.

e) Corn Gluten feed :-

[Gluten :- remaining part of wheat after removing the carbohydrate {starch}]

→ Corn gluten feed is that part of commercial shelled corn that remains after the extraction of the larger portion of the starch.

→ Gluten processed in the wet milling manufacture of corn starch or syrup.

→ Generally corn gluten feed will contain a crude protein level of 21-22%, crude fat 1.-2.5% and crude fibre 8-10%.

f) Corn Gluten Meal :-

→ Corn gluten meal is the dried residue from corn after the larger part of the starch and germ have been removed and the bran separated by the process-doing in the wet milling manufacture of corn starch or syrup. or by dry milling treatment of the endosperm.

→ Corn gluten meal may contain fermented corn extractives and corn germ meal.

→ The crude protein level may range from 41-43%, crude fat 1-3%, crude fibre 4-6% and Xanthophyll 160-220 mg/kg.

g) Rice Groats :-

→ Rice groats are the ground rice kernel, without the bran, Rice groats contain approximately a crude protein level is 8.6%, crude fat 1.2%, & crude fibre 1%.

h) Rice Bran with Germ :-

→ Rice bran with germ is primarily the pericarp or bran layer and the germ portions of the rice kernel.

→ The crude protein is approximately 13.3%, crude fat 15% & crude fibre 11%.

i) Rice Polishing :-

→ Rice Polishing are the outer portions of the rice kernel produced by the process used in producing white rice.

→ It have a crude protein 11.8%, crude fat 13.2% & crude fibre 3%.

j) Oat Groats :- Oat groats are the cleaned oats with their hulls removed. Generally oat groats contain protein 16%, fat 6% fibre 2%.

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ii) Oil Extractives :-

a) Soyabean meals :-

→ Soyabean meal is produced two major protein levels by different processes.

→ Soyabean meal must be heated sufficiently to destroy the trypsin inhibitor.

[Trypsin - Enzyme promoting digestion of proteins in the vertebrates, found in the pancreatic juice of all the vertebrates.]

→ Fourty-four percent soyabean meal is usually mechanically extracted to produce a meal of 44% crude protein, crude fat 4.7% and crude fibre 6%.

→ Fourty-Eight percent soyabean meal is dehulled and solvent extracted to yield meal with a crude protein level of 48%, crude fat 0.9% & crude fibre 2.8%.

b) Cottonseed meals :-

→ Cottonseed meal is produced in three protein levels.

→ cottonseed meals are classified as low gossypol if they contain less than 0.04% free gossypol.

→ Forty-one percent cottonseed meal has a crude protein level of 41 percent, crude fat 2% & crude fibre 12%.

→ Forty-eight percent cottonseed meal has a crude protein level of 48%, crude fat 1%, and crude fibre 8%.

→ Although all three cottonseed meals are solvent extracted the lower protein meals may contain some

c) Peanut meal :-

→ Peanut meal is obtained by grinding the cake, chips or flakes obtained by removal of most of the oil from peanut kernels by a mechanical or solvent extraction process.

→ Peanut meal will have a crude protein level of about 46%, crude fat 1 to 7% and crude fibre 10-13%.

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ii)

a) Hydrolyzed Poultry feathers :-

→ Feathers from poultry are collected, ground and hydrolyzed under pressure;
→ During processing the Cystine linkage is broken, increasing the value of the meal.
→ Not less than 75% of the crude protein must be Pepsin digestible.
→ Generally, hydrolyzed poultry feathers will ranse in crude protein from 80 to 85%. crude fat 2.5%, crude fibre 1.5%, Phosphorus 0.75%. and ash about 3%.

b) Meat and Bone meal :-

→ Meat and bone meal is the dry rendered product [render - melt a fat] derived from mammalian tissue, exclusive of hair, horn, manure and paunch contents. [paunch - part of stomach, belly].
→ The relatively high fat content of meat and bone meal apparently helps protect the lysine content during rendering.
→ meat and bone meal generally contain a crude protein of 50 percent, fat 8-11 percent, crude fibre 3%. Phosphorous 4.4-5%. Calcium 8.8-10%. and ash about 30%.

c) fish meals :-

→ Fish meals are manufactured by cooking fish, Pressing to remove water and oil & then drying.
→ Fish meals are often made from a single species of fish e.g. herring meal, but meals containing more than one species.
→ such as bottom fish meal are also sold.
→ Generally the single species meals are more uniform in quality; some typical analysis follow.

	Crude Protein (%)	Crude fat (%)	Crude fibre (%)	Sodium (%)
Herring meal	70	7.5	1	0.5
Menhaden meal	60	7.5	-	0.3
Anchovy meal	64	8	1	0.8
Carp meal	75	9.5	-	-
Shrimp meal	36-48	3	11	-
Crab meal	30	1.7	11	-
Bottom fish meal	60	-	-	-

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d) Blood meal :-

→ Blood meal is produced from clean fresh animal blood, exclusive of all extraneous material such as hair, stomach contents etc.
→ Blood meal may be dried by several processes, but most often by spray drying.
↳ spray dried blood meal has approximately a crude Protein level of 85%, crude fat, 0.5-3%, crude fibre 2.5% ash 6%, and lysine 9-11%. with an availability of 80-90%.

ii) Miscellaneous :-

a) Corn Distillers Dried Grain with Solubles

→ This product is obtained from removal of ethyl alcohol by distillation from the yeast fermentation of corn or corn mixture by condensing and drying at least 75% of the solids of the resultant whole stillage.
→ The product has a crude protein level of 26-27%, crude fat 7-8%, and crude fibre, 8.5-9.5%.

b) Brewers yeast :-

→ Brewers dried yeast is the dried, sterilized, unextracted yeast (saccharomyces) resulting as a by-product from the brewing of beer and ale.
→ Brewers dried yeast has a crude protein level of 45% crude fat 1%, and crude fibre 2.7%.

c) Brewers Dried Grains :-

→ Brewers dried grain is the extracted dried part of barley malt,
→ It has single barley or mixture with other cereal grains or grain products.
→ It is obtained from manufacture work of Beer.
→ Grind it with small particles
→ This product has crude protein 24-30%. Crude fat 4.5-9% and crude fibre 10.5-16%.

d) Dried whey :-

→ Dried whey is the residue [residue - remaining part] obtained by drying whey, a by-product of cheese manufacturing. It contains at least 85% lactose, crude protein 13%, and crude fat 0.8% & NO. fibre

[Whey - the liquid part of sour milk - ছানার পানি]

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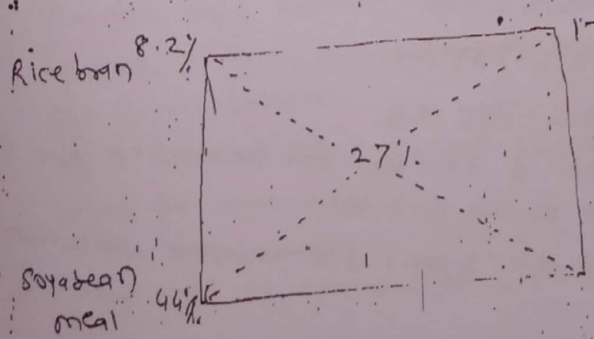
2. Fish food formulation

Intro :-

→ Feed formulation is essentially applied nutrition.
→ The practical use of information is presented on the nature and qualities of various feedstuffs.
→ meaning of terms is formulate. Practical fish diets are crude protein level, energy level, either expressed as metabolizable energy [ME] or as digestible energy [DE] specific amino acid levels, crude fibre level, and ash level.
→ The composition of fish meal is change during ~~dec~~ per season.
→ Generally the lipid levels increase before spawning and decrease after spawning.

i) Balancing crude protein level :-

→ Protein is the most expensive portion and is, usually, the first nutrient that is considered in diet formulation.
→ The energy level of others is adjusted after protein adjustment.
→ The square method is an easy way to determine the proper dietary proportions of high and low protein,
→ The feedstuffs add to a feed to meet the dietary requirement of the fish to be fed.
⇒ for example, suppose rice bran and soyabean meal were available as feedstuffs to prepare a diet for carp that was 25% crude protein
→ A square is constructed and the two feedstuffs are put on the two left corners along with the protein content of each.
→ The desired protein level of the feed is placed in the middle of the square.
→ Next the protein level of the feed is substracted from that of the feedstuffs
→ placing the answer in the opposite corner from the feedstuff.
→ Ignore positive or negative signs.



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To make the 27% crude Protein carp feed, we must mix 17/35.8 of rice bran with 18.8/35.8 soyabean meal.

Rice bran 17/35.8 = 47.50%

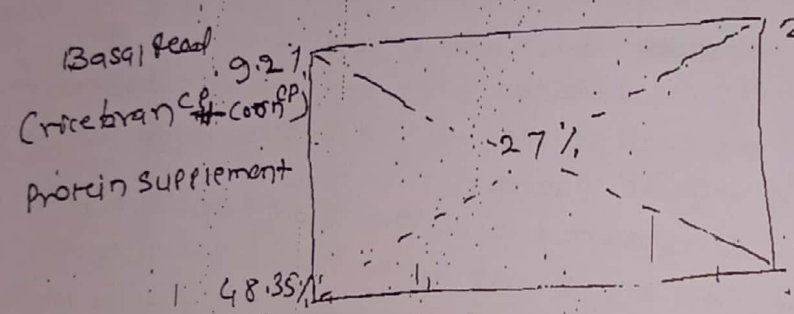
Soyabean meal 18.8/35.8 = 52.50%.

So to make 100 kg of this feed we must mix 47.5 kg of rice bran with 52.50 kg of soyabean meal.

⇒ If more than two feedstuffs are used in a feed, they may be grouped into basal feeds (CP < 20%) and protein supplements (CP > 20 Percent) averaged within each group, and plugged into the square method.

→ For example, suppose shrimp meal and corn were also available for the carp feed mentioned above.

→ The crude protein levels of the shrimp meal (52%) and of corn (10.2%) are averaged with soyabean meal and rice bran, respectively.



Basal feed = 21.35/39.15 = 54.53%

Protein supplement = 17.8/39.15 = 45.47%

Thus to make 100 kg of this feed one would mix the following.

Rice bran = 27.265 kg

Corn = 27.265 kg

Soyabean meal = 22.735 kg

Shrimp meal = 22.735 kg.

⇒ The square method is helpful for balancing for crude protein level as well as energy level.

→ It is easy method doing any formulator without trial and error.

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ii) Steps in feed formulation:

⇒ The first step in diet formulation is balancing the crude protein and energy levels.
→ This can be accomplished by square method for either crude protein level or energy level.
→ At first it is helpful to use at least three feeds stuffs during the initial balancing of protein and energy levels.
→ one high in protein and high in ME.
→ one low or intermediate in protein and high in ME.
→ and one low or intermediate in both protein and ME, once practice makes one more proficient at diet formulation any number of feedstuffs can be used.
→ One must remember to reserve room in the formulation for any feed additive, such as a vitamin or mineral pre-mix.
⇒ The second step in diet formulation is to check the levels of amino acid when required must.
→ The requirement of fish for amino acid expressed as the dietary level or as a percent of the dietary protein level.
→ To convert an amino acid level from the percent of diet to percent of protein,
→ divide the dietary level of each amino acid by the dietary protein level.
→ It might be of interest to calculate the dietary levels of all of the indispensable amino acids.
→ But it is not practical to be fed, the levels of the other six indispensable amino acids will most likely be above required levels.
→ When using unconventional protein supplements the levels of all ten indespensable amino acids should be checked.
⇒ If the diet formulation is low in any amino acid, a feed stuff that contains high levels of that amino acid must be added to the diet at the expense of another ingredient.
→ Once the amino acid requirements are met, the dietary protein and energy levels must be rechecked to,
→ See if any substitution of ingredients has imbalanced the formulation.
⇒ A diet mixing sheet should be constructed to standardize diet formulation.
→ The amino acids listed are for illustration purposes only and may be changed to suit different circumstances.

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iii) Best-buy techniques:-

⇒ The price of the feedstuffs used in diet formulations must be considered to formulate a cost-efficient.

→ Feedstuffs can be compared with one another on the basis cost per unit of protein, energy or amino acid.

→ For example, suppose one has wheat middlings and wheat millrun available for a fish diet, which feedstuff would be the least expensive source of energy.

Wheat millrun costs US $ 0.0858/kg and contain about 1200 kcal ME/kg.

$$\text{cost/kcal} = \frac{0.0858}{1200} = \text{US\$ } 0.00\,00715/\text{kcal}$$

Wheat middlings cost US $ 0.1883/kg and contain 1663 kcal ME/kg.

$$\text{cost/kcal} = \frac{0.1883}{1663} = \text{US\$ } 0.000\,1132/\text{kcal}$$

Thus, the wheat millrun which has a lower ME value for fish is the better buy because it costs less per kcal.

To compare oat ~~groats~~ groats and wheat middlings on a cost per unit ME basis one would do the following.

Wheat middlings = US $ 0.000 1132/kcal, and,

Oat groats cost US $ 0.2652/kg and contain about 2450 kcal ME/kg.

$$\text{cost/kcal} = \frac{0.2652}{2450} = \text{US\$ } 0.001082/\text{kcal}$$

Oats groats, although costing more than wheat middlings constitute a better buy on an energy basis.

→ The cost of protein is often the greatest part of the cost of a ~~diet~~ fish diet.

→ Therefore, substantial savings can be made by using best-buy techniques to determinate least expensive protein supplement.

→ To compare anchovy meal and herring meal, the following calculations are made.

→ Anchovy meal costs US $ 0.5357/kg. and contains 70.9% protein

$$\text{cost per kg protein} = \frac{0.5357}{0.709} = \text{US\$ } 0.7556/\text{kg protein.}$$

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Herring meal costs US $. 0.4709 / kg and contains 76.7% Protein.

$$\text{cost per kg Protein} = \frac{0.4709}{0.767} = \text{US\$ } 0.61395 / \text{kg Protein.}$$

On the basis of cost per unit Protein, herring meal is less expensive as a dietary ingredient than is anchovy meal. To compare feedstuffs on the basis of cost per unit of an amino acid. one can calculate the best buy in the same way as before.

For example, sesame oil cake which has twice as much methionine content as does groundnut cake on a per unit protein basis would be a more attractive buy at comparable prices.

These kinds of comparisons are only valid if the nutrient in one feedstuff is as valuable or available to the animal as the same nutrient in another feed.

Such comparisons should be made whenever prices change.