

Aquaculture principles

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SL	Principles/concept	Application/practice
1	Habitat, niche, food chain	Species (individual) selection
2	Law of thermodynamics	Species (combination) selection
3	Individual size and metabolism	Species/stock size selection
4	Biomass, carrying capacity	Stocking density
5	Fish growth	Production planning, culture type and risk management
6	Limiting factors	Soil-water quality management
7	Food and feeding habit	Rearing
8	Sensitive, tolerant	Habitat management

What are the major aspects of aquaculture principles?

- Environmental principles/concept; water quality; and food and nutrition

How can you select aquaculture species?

- Availability of seed under control condition and culture technology
- Closer to primary producer
- Fast growth
- Tolerance to environmental/climatic condition
- Resistant to diseases and parasites
- Habituated to take supplementary feed
- Amiability
- Tasty/high market demand
- Social acceptance

What is pond dynamics and why WQ is important for it?

- Pond dynamics is the active change in it's population (reproduction, natality, growth, mortality, migration etc.).
- Water quality is an important scientific tool to understand the dynamics of fish pond.
- If the quality of water is not suitable then the following situation could be occurred:
 - primary production as well as natural feed for fish will not be sufficient;
 - the growth of fish will be slow;
 - much more supplementary feed will be required;
 - ultimately excess money will be spent;
 - and finally, the fish production and net benefit will be found poor.

What are the major water quality parameters affecting fish production?

The main physical properties of water are depth, light, temperature, turbidity, transparency etc. whereas the important chemical properties of water includes dissolved oxygen, carbon dioxide, pH, alkalinity, ammonia-nitrogen etc.

Physical Parameter	Significance	Remarks
Depth	Suitable depth required for productive water	1.5-2.0 m is ideal
Sunlight	Sufficient sunlight required for photosynthesis	- Pond well exposed to sunlight - No pond side large trees
Temperature	Suitable temperature required for metabolism, growth and reproduction	25–30°C as optimum
Turbidity	-Suitable secchi depth important for pond management	<ul style="list-style-type: none"> ● 20 cm (indicating too turbidity), there is no need of feed and fertilizer application. ● >60 cm (indicating transparent/clear water i.e., there is no plankton in the water); Immediate fertilizer application is required ● desirable depth is 30-45 cm

Chemical Parameter	Significance	Remarks
DO	<ul style="list-style-type: none"> - first limiting factor - Effects of low dissolved oxygen are: - grasping (fish come to surface & fight for survival); - fish shows faster and abnormal swimming; 	<ul style="list-style-type: none"> -Optimum level is 5 to 8mg/l (carp and prawn). -Cat fish and tilapia can tolerate low dissolved oxygen.
pH	<ul style="list-style-type: none"> - indicative to pond fertility - pH 4.0 is regarded as acidic death point - pH 11.0 is regarded as alkaline death point. 	<ul style="list-style-type: none"> -Suitable range from 6.5 to 8.5 - Regular liming is considered important - Liming dose varies with soil quality

Alkalinity	-Important for buffering capacity and primary productivity - Phytoplankton production is low in water with less than 20 mg/l alkalinity	Desirable alkalinity should be within 40-200mg/l.
NH ₃ -N	-exposure to high concentration affects fish growth; gill damage ; and increase DO demand	< 0.1 mg/l is desirable

Food and nutrition

Fish feed

In simple words, elements that are taken by fish for tissue growth, tissue repair, energy production and reproduction are called fish feed. Fish also needs to take feeds like other animals.

Types of fish feed

Based on the sources, fish feeds are classified in two ways as follows

- (a) Natural feed and (b) Artificial feed

Criteria in Selecting a Feed

- Availability of the feed ingredients
- Farmer's capacity and price of the ingredients
- Age and size of the fish and prawn
- Nutritional requirements of fish and prawn
- Feed preferences by the fish and prawn
- FCR

When we should avoid feeding fishes?

- When feeding response is poor;
- When fish feel unwell;
- At least two days before harvest and transportation
- During depuration
- The Afternoon before sampling and on the sampling day;
- When ponds treated with disinfecting agents like lime, gypsum etc.; and
- When water temperatures are low on rainy days or winter

Why compensatory/restricted feeding is required?

- Reduction in feed wastage
- Maintain good water quality
- Maintain good fish health without hampering growth

<i>Fish/Species</i>	Protein requirement (%)		
	<i>Fry/PL</i>	<i>Fingerlings/ Juvenile</i>	<i>Adult</i>
1. Common carp, <i>Cyprinus carpio</i>	40	35-38	35
2. Rui, <i>Labeo rohita</i>	35-40	30	25-30
3. Catla, <i>Catla catla</i>	35-40	30	25-30
4. Cat fishes			
a. Pabda, <i>Ompok pabda</i>	40	35	32-35
b. magur, <i>Clarias batrachus</i>	40	35	32-35
c. Shing, <i>Heteropnuestes fossilis</i>	40	35	32-35
d. Pangas, <i>Pangasius pangasius</i>	40	35	32-35
5. Tilapia, <i>Oreochromis niloticus</i>	35-40	30	25-30
6. Shrimp			
a. golda, <i>Macrobrachium rosenbergii</i>	35-40	30-35	30-32
b. Bagda, <i>Penaeus monodon</i>	35-40	35-38	32-35

Ingredients fpr prawn feed	feed (30% protein) preparation for larger size prawn	
	application level (%)	supplied level (%)
Fish meal	25.00	14.00
Meat and bone meal	15.00	8.00
Oil cake	15.00	5.00
Rice bran	20.00	3.00
Maize	20.00	2.00
Molasses	5.00	-
Vitamins and minerals	1-2 g/kg	-
	100.00	32.00

ingredients for carp feed	sample-1		sample-2	
	application level (%)	feed (g/kg)	application level (%)	feed (g/kg)
Fish meal	20.00	200.00	20.00	200.00
Meat and bone meal	0.00	0.00	5.00	50.00
Oil cake	45.00	450.00	30.00	300.00
Rice bran	25.00	250.00	20.00	200.00
Maize	0.00	0.00	15.00	150.00
Molasses	10.00	100.00	9.00	90.00
Vitamins and minerals	0.00	0.00	1.00	10.00
	100.00	1000.00	100.00	1000.00

Feed preparation for pangas

ingredients	sample-1		sample-2	
	application level (%)	feed (g/kg)	application level (%)	feed (g/kg)
fish meal	15.00	150.00	12.00	120.00
meat and bone meal	25.00	250.00	32.00	320.00
oil cake	5.00	50.00	0.00	0.00
rice bran	45.00	450.00	50.00	500.00
Maize	100.00	98.00	6.00	60.00
Molasses	1-2 g/kg	2.00	0.00	0.00
vitamins and minerals	100	1000.00	100.00	1000.00

Feeding rate

Feed type	feeding rate	Application	feeding frequency/day
Nursery feed (powder/granule)	10-15% of fish body weight	spreading at 3-4 different locations	3-4 times
Frower feed (Granule)	3-5% of fish body weight	spreading at 3-4 different locations	2-3 times

Body weight based feed application for carps

average weight (g)	daily feed application (%)
<1	15-20
1-5	10-12
5-10	5-7
10-50	4-5
50-100	3-4
>100	3