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Annex E3

Western Orissa Rural Livelihoods Project (WORLP) Better-Practice Guidelines

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What is Fish Culture?

Fishing and fish culture are popular parts of the cultural tradition for many people in eastern India.

'Fishing' is where people catch fish from a *common property* resource. This may be with or without licenses.

In many areas, people are finding less fish to catch.

Fish culture is becoming popular for food, employment and income generation.

"Fish culture" is where people own and look after a stock of fish. This might involve regular stocking, fertilization and feeding, protection from predators and disease, and taking care of the environment.

Species commonly selected for culture

In India, it is common to select for culture fish species that live in the major rivers of the north of the country – the Brahmaputra, Ganga and Indus and their tributaries.

They are called carps. They have scales on the body but none on the head. The three most commonly grown are called:

Oriya	English	Scientific
Bhakur	catla	*Catla catla*
Rui	rohu	*Labeo rohita*
Mirkali	mrigal	*Cirrhinus mrigala*

Together they are called the Indian Major Carps on account of their large size and fast growth rate.

Catla has a big head and deep body, a wide upturned mouth, a thick lower lip with a fold (but no upper lip), large scales, grayish black on the back and off-white on the belly. It grows to a large size and has reached 30-40 kg in quite a few tanks and reservoirs in Uttar Pradesh and Rajasthan.

Mrigal has a slender body, a small head with golden eyes, a round mouth with thin lips and a tubercle in the middle of the lower jaw. The scales are golden on the back and sides, whitish on the belly and the fins are golden with a blackish tinge. Their maximum size is about 12 kg.

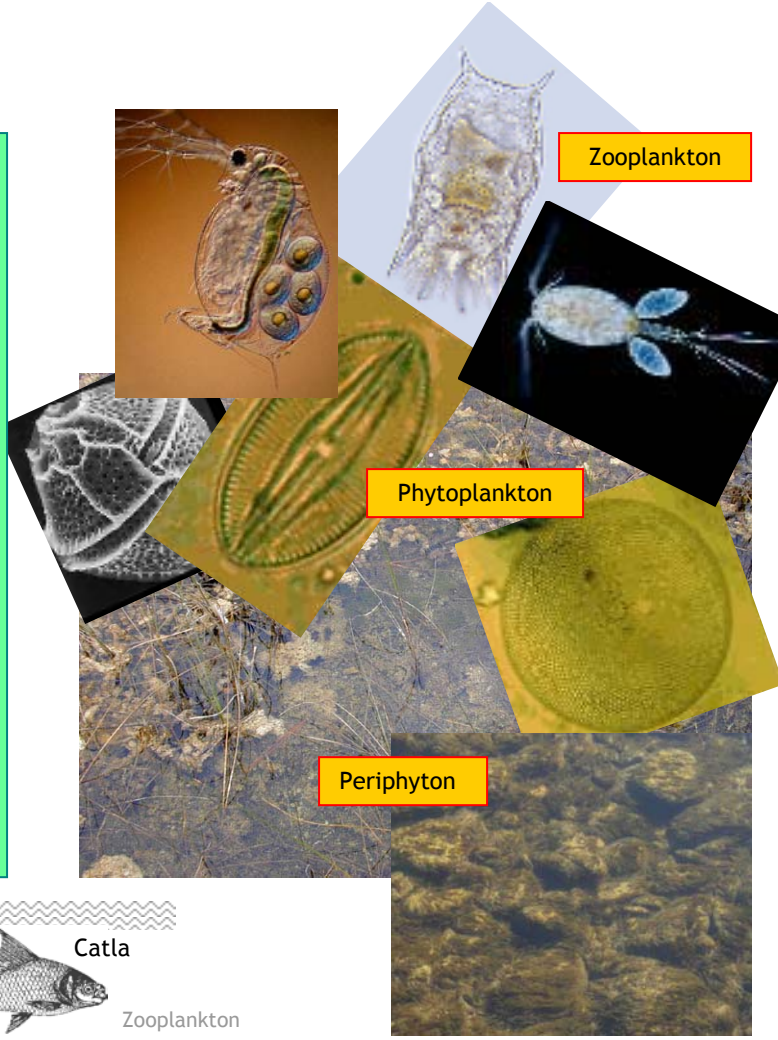
Rohu has a medium-sized head and small mouth. Its scales have a reddish tinge on their margins. It is greenish on the back and grayish below. Their maximum size is about 20 kg.

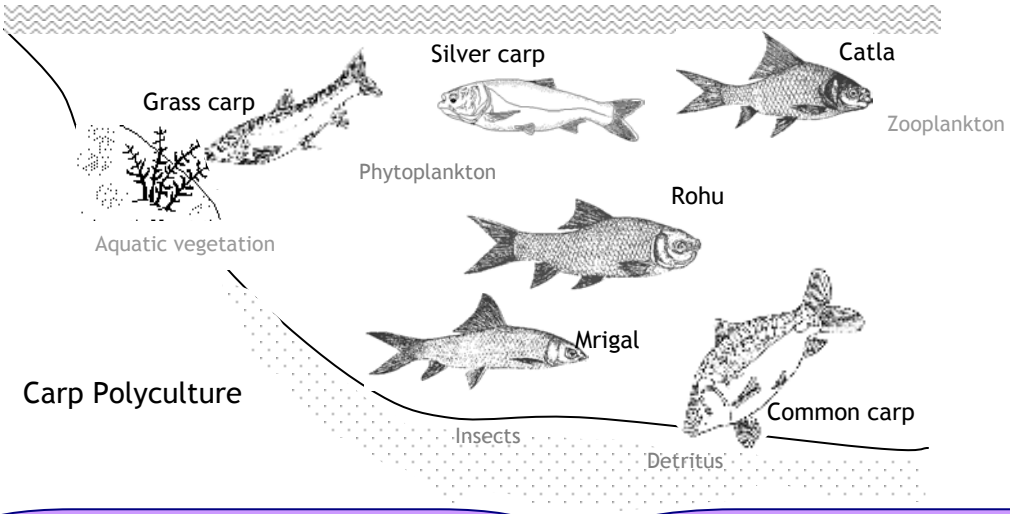
Food and feeding habits

Catla feeds mainly on tiny animals (zooplankton) but occasionally insect larvae, algae and bits of aquatic weeds are also taken. The shape of its mouth is such that it can feed in the surface layers and hence the fish normally swims in the upper layer of water. It is the fastest growing of the Indian Major Carps. Within one year it can weigh 700-800 g in a fertilized pond without adding extra feed, and about 1.0-1.5 kg with additional feeding.

Rohu is a mid-water feeder, eating plankton, vegetable matter and debris. It is well-adapted to graze tiny plants that grow on the surface of submerged objects. After one year in ponds, it weighs 400-500 g without feed, but may even grow up to 1 kg with added feed.

Mrigal is a typical bottom-feeder that picks up large quantities of decaying things along with small animals and plants found in the bottom layers. After one year it weighs 400-500 g in ponds rich in organic matter. When fed, it can reach 1 kg.





Carp Polyculture

This polyculture is a mixture of Chinese Carps and India Major Carps with surface, mid-water and bottom feeders, eating small plants (phytoplankton) and animals (zooplankton), large plants, insects and detritus (on the pond bottom).

Water and soil

You will need to think about where the water will come from and if it is good for growing fish. Will it remain all year or will it dry up?

Seasonal ponds – are often more available than perennial ponds. They dry up completely making it easy to harvest fish and to control predators and problems. But they should be able to produce a crop of fish before the water dries up.

Perennial ponds – are often used by many people. Fish culture may conflict with water use for irrigation, washing or even drinking. They often are a home to large predators which will eat seed and fry and they may be difficult and expensive to fish, due to their size or depth.

You will need to think of the things about the soil and water which affect the fish. Very cloudy waters should be avoided. Fertile soils or water that gets nutrients from fields or settlements can often support fish growth. Overhanging trees that shade out the sun and drop leaves are often not good.

You will need to learn more about water quality and know about things called dissolved oxygen, pH, Hardness, Salinity (which you can read more about later in this series of guidelines).

The water in this pond may be clean and well-oxygenated, but with so many plants there may be predators. Moreover, it would be difficult to net fish from this pond.

What happens throughout the aquaculture year?

Aquaculture has to fit with the rains.
It is good to begin planning early – building or clearing what you need from January. In a hatchery spawning takes place when the rains come in July-August. Nursery ponds are prepared to receive fish seed. Eventually fish of around 150 mm - called fingerling are ready to stock seasonal or perennial ponds to grow to a size where they can be sold.

Actions	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Promoting fingerling supply												
Planning				Develop nursing network								
Hatchery				Condition broodstock			Spawning					
Nursing							Seed to SHGs with nursing ponds					
Fingerling transport								Fingerlings to SHGs for raising				
Raising fish												
Fish raising	Raising fish								Raising fish			

So - what is fish culture?

Fish culture is where you own the fish and care for them.

Fish eat small plants, small animals and things which grow on leaves and rock surfaces.

Many people culture carps like Bhakur, Rui and Mirikali.

A mixture of species is good - to use all the space and food in the pond.

You need to fertilize a pond to increase the number of small plants and animals and can feed other materials like rice bran and oil cakes to fish.

Fish spawn when the rains come - the aquaculture year fits around the rains.

Avoid saline, acid, alkaline, cloudy and hard waters.

Avoid swampy, marshy and peaty soils.

Useful Contacts

Other Better-Practice Guidelines

There are many more Better-Practice Guidelines in this series.

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Pond Construction: Selecting Good Places for Ponds

When selecting a good place for a pond, an engineer may seek advice from local people, a biologist or an economist. It may be difficult to find an ideal site but it is necessary to look at the available sites before the work on pond building begins – so that it holds water, does not collapse or cost too much and will not waste effort and money.

There are lots of things to think about before finally recommending a site. Think about getting to the pond (maybe with a vehicle): make sure this is easy. Avoid tall trees that block the sunlight or drop leaves. Avoid swampy, marshy or peat soils and try to avoid places that flood frequently. Think about how to stop poaching. Near towns, avoid neighborhood factories that give out gases, smoke, fly-ash, or organic or toxic outflows.

A *munda* typical of those seen in Orissa. This *munda* in Kumna block Nuapara is used for fish culture.

Types of ponds

In watershed areas, ponds are often built with dykes or banks that block the course of a seasonal stream (*nallah*) or collect the surface run-off in a low-lying area. These ponds may have one, two, three or four dykes depending on the topography of the land (with a narrow entrance for water).

A *munda* is kind of pond which has four dykes.

The *kattah* in Western Orissa is a fine example of a pond with a dyke on one, two or three sides.

These ponds may hold water for a short or long time depending on the soil quality and rainfall and can play a useful role in the economy of the area, recharging nearby wells and providing a water body for domestic use, stock watering and irrigation. Embankment ponds or tanks are subject to flooding during heavy rains and have to be provided with a waste weir. When constructed for irrigation, they are also provided with a sluice gate.

Dugout ponds are usually dug in low-lying saucer-shaped areas that are surrounded by a dyke. These are usually dug for water storage rather than aquaculture but can be used for fish culture if a proper site is selected.

A *kattah* typical of those seen in Orissa. The *kattah* is a good place for fish production.

How soil feels and why it is important

Not all soils are suitable for pond building.

Not all soils feel the same – they are made up of different things.

Clay is made of small parts.

Silt is bigger than clay.

Sand is bigger than silt.

Loam is a mixture of clay, silt, sand and useful nutrients.

So acid and alkaline soils are not good for fish culture or soils with lots of organic things, or lots of clay; sandstone and rocky soils should be avoided.

To grow fish a pond must hold water. Water holding and how much fish a pond can produce depend a lot on the type of soil. There are lots of different soils; some are good and some less good.

Clay soil is mainly tiny parts close together and water cannot get through. *Loam* is another type of soil that has a mix of all different sizes and has nutrients in it too.

A mix of these *clayey-loam soils* are the best soils for pond building as they hold water well and the nutrients help to make the water green with food.

So-called *black cotton soils* hold water in the pond better than *laterite*, *brown* and *grey* soils which let water through all of these soils are not very productive.

The soils in Western Orissa are, in general, poor at holding water and have few nutrients – but many people still grow fish well in *mundas* and *kattahs*.

Another important thing about soils is called pH, which goes from 1-14. You can measure pH with a special kit which changes color depending on what number the soil or water is on the pH scale.
Low numbers less than 5 (called *acid*) are not good for fish. High numbers, 9 or above (called *alkaline*), are also bad. pH 6.5-7.5 (neutral) soils are the best but those with a pH of 5.5-6.5 and 8.0-9.0 could also be managed through adding lime or gypsum.

If I want to construct a pond, how can I test soil quality?

One way is to take a hand full of soil, mix it with water and roll it into a ball (*laddu*). If it holds its shape and does not crumble, the soil is suitable for building a pond.

Another way is to put a handful of soil into a glass of water, stir it thoroughly and leave it for some time. When it settles, you see different layers – the finest at the top (clay), then silt, sand and the heaviest stones at the bottom.

The thickness of each layer helps you to know about the soil: if it has lots of clay, it will hold water. If it has lots of different layers and organic parts on the top, it is clay-loam, which is good. If it is mainly sand and stones it will not hold water.

So the size of the parts and pH – got it!

Water: Sources and Quality

It is the soil type that helps the pond hold water, but the source and quality of water are equally important because that is what the fish live in.

The water could come from a stream, river, canal, spring or run-off from the forest, hills, pasture land or agricultural fields. Filling a pond with underground water can be expensive. Salty waters are no good for carp. (If someone measures the water the saltiness, called *salinity*, should be less than 3 ppt.)

Cloudy waters (more than 20 mg of clay/l) are unproductive and clog the gills of fish and reduce pond depth (when the parts which make it cloudy settle to the bottom). It is good to avoid such waters from natural sources or run-off from weather-beaten soils. Like soils, waters that are acid (pH below 6.5) and alkaline (pH above 8.5) affect fish health a lot and a sudden change always kills the fish. pH 7.5 to 8.0 is best for fish culture.

Water hardness is something else that people test. Hardness above 160 mg/l gives poor growth and low productivity.

The water in this pond may be clean and well-oxygenated, but there may be predators. Moreover it would be difficult to net fish from this pond.

The pond could be used for extensive aquaculture, but you couldn't really use it for intensive aquaculture.

How do I know if the water quality of my pond is good?

Well, first you have to get someone to test it. Give them a sample in a clean drinking water bottle, washed out in the water you want to test and filled to the top. When you see the results, remember this:

- Water pH 7.5 to 8.0 is best for fish culture.
- Water pH of 6.0-6.5 and 8.5-9.0 could also be managed through adding lime or gypsum (if I can afford that).
- More than 20 mg of clay/l is not good.
- *Salinity* (saltiness) should be less than 3 ppt
- Hardness above 160 mg/l is bad.

What to Look for and What to Avoid

Look for clayey-loam soils.

Avoid laterite, black cotton, brown or grey soils.

Avoid highly acidic soils.

Look for a good source of water from a stream, river, canal, spring or run-off from the forest, hills, pasture land or agricultural fields.

Avoid highly alkaline soils.

Avoid highly organic, highly clayey, sandstone and rocky soils.

Look for neutral soils, neither acidic nor alkaline.

Avoid swampy, marshy and peaty soils.

Avoid saline, acid, alkaline, cloudy and hard waters.

Useful Contacts

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Pond Construction: Design and Layout of Ponds

Any pond can be used to grow fish, but a pond that is dug specially for fish culture usually has a regular shape, a flat bottom with a slight slope along its length.


A nursery pond

When deciding where to locate a new pond, you should consider the **landscape** (find a moderate elevation, gentle 2% or less slope, well drained and not prone to flooding), **land use** (remember - all sources of water contributing to the pond should be free of sediment, pesticides and other forms of pollution), **soil texture** (15% clay is best for pond construction and water holding), **water supply** (consider quality, quantity and seasonality), **security** (from theft) and **convenience** (maybe close to your house).

Fish culture ponds differ in size and depth depending on their functions:

Types of ponds for fish culture

- The smallest and shallowest of ponds for fish culture is a ***nursery pond***. This is about 0.02-0.05 ha. The water is about 1 m deep.
- A ***rearing pond*** is larger than a nursery pond. It is 0.08-0.2 ha. The water is about 1.5-2.0 m deep. ***Nursery*** and ***rearing ponds*** can be seasonal.
- A ***stocking pond*** is much larger, often 0.2-2.0 ha. It should be 2.0-3.5 m deep. This pond might be perennial or seasonal.
- A ***marketing pond***, which is small but quite deep, is used to keep fish caught from a stocking pond for sale at short notice when the demand and price are high. These ponds can be 0.05-0.10 ha in size with a water level of 3-4 m in summer.
- ***Broodstock ponds*** (0.2-0.4 ha) are perennial and have a water depth of 2 m in the summer.
- Fish brought in from outside are first placed in a small (0.02 ha) but perennial (1.5 m deep) ***quarantine pond*** for a time to verify that they are not infected. You can also use this pond to treat diseased fish from other ponds. The one in the picture is concrete lined.


A rearing pond


A stocking pond

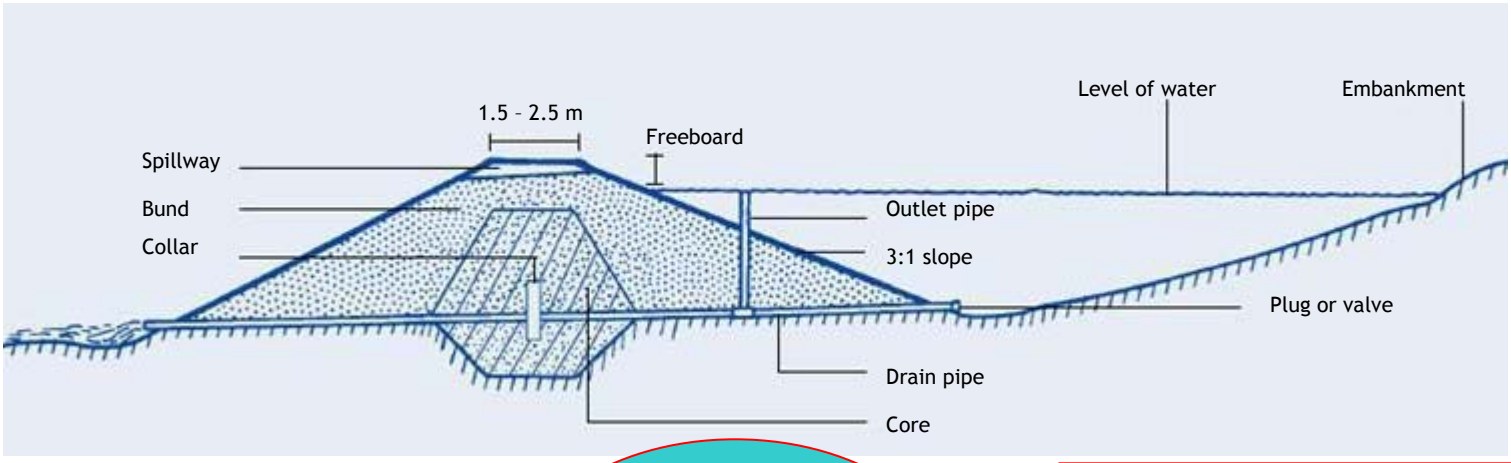

A marketing pond


A broodstock pond


A quarantine pond

Design of ponds

Ponds are dug in the ground or formed behind bunds on one, two, three or four sides, which can be made of earth or building materials such as concrete. The diagram below shows an earth bund and a pond as if it has been cut open to show how it is designed.



The top width of the dam should be at least 1.5 m in the case of nursery and rearing ponds, but not less than 2.5 m for stocking ponds.

The part of the earth bund where waves strike should be well strengthened.

Make the side slopes of earth bunds stable enough to keep the earth fill in place and stop them from collapsing. A slope of 3 lengths along the ground (horizontal) to 1 length upwards (vertical) (3:1) on both the upstream and downstream faces of the dam will be good.

It is best to slope the banks properly when building.

A *berm*, a sort of a step all around the inner side of the bund, slightly above the water level helps the fishermen to move comfortably while dragging a net and also prevents soil erosion.

Small ponds are easy to manage. Normally, ponds meant for aquaculture would be 2.0-3.0 m deep so the width of the bund at the base would be three times this.

Square ponds are cheaper to construct and lose less water, but rectangular ponds (width 1 to length 1.5-2.0) up to 50 m wide are easier to harvest with a drag net.

If the top of the dam is 2 m, the depth 3 m plus 0.5 m freeboard (3.5 m), the bottom of the dam will be 3 times the depth = about 10 m.

A = ½ (b1 + b2) h
{A=area, b1=top, b2=bottom, h=depth}

That means the area will be 23 m^2.

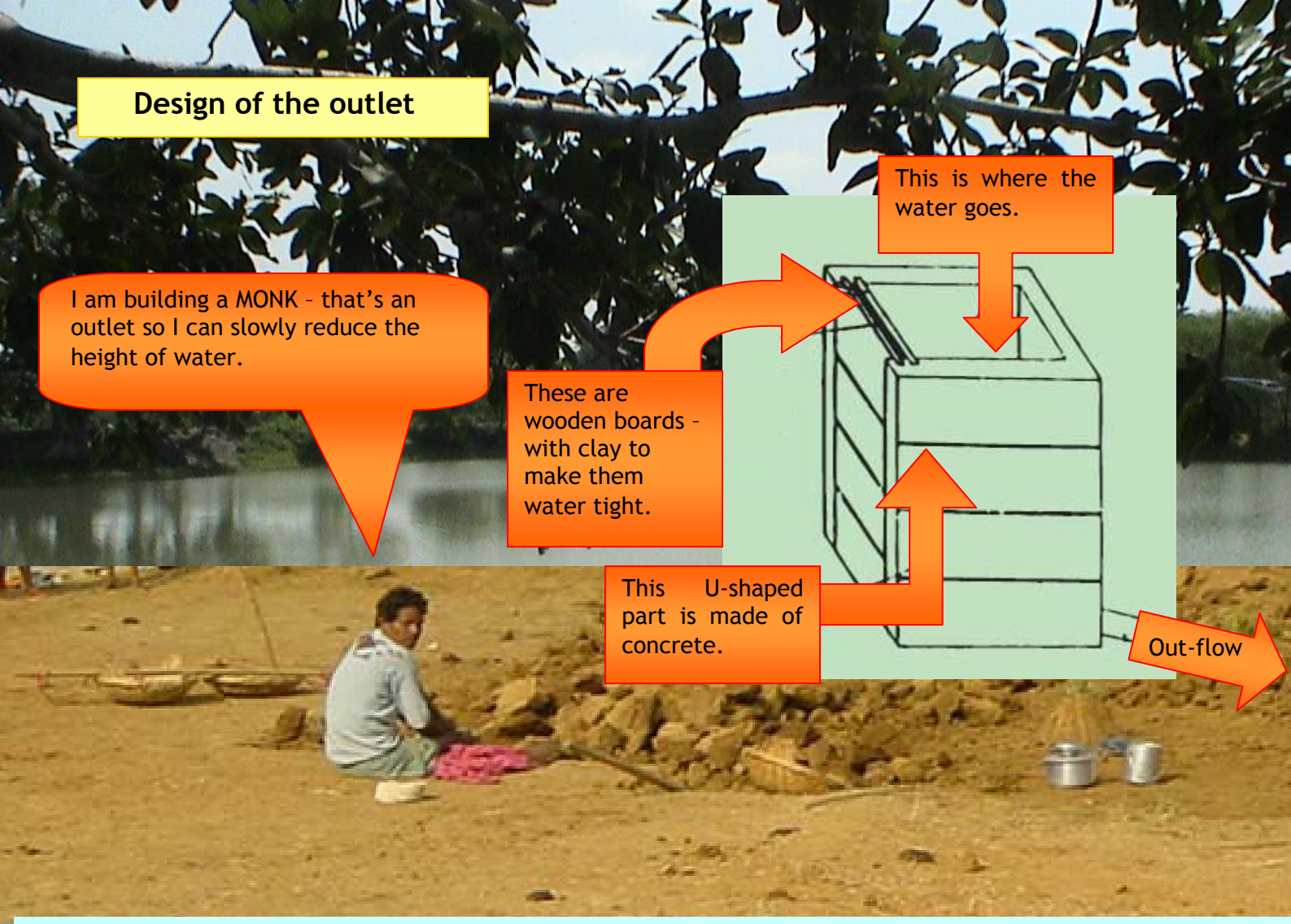
So the earth needed in m^3 will be the length of dam x 21.

The first step is to clean away all trees, bushes, rocks and boulders. There should be no trace of the roots of trees or any vegetation where the dam will be.

So every 10 meters of dam needs 230 m^3 of earth.

20 cm of surface soil is scraped away before building and kept aside and spread over the pond bottom when digging is complete. In case of heavy seepage, the bottom of the pond should be treated either with a heavy dose of wet cattle dung or biogas slurry.

To create the bund, you need to add earth in 20-30 cm layers, sprinkle on some water and ram the earth down to make it strong. Finally, put turf on the dam to protect it from the rain.



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Broodstock Collection, Transport and Maintenance

Broodstock are adult fish used for breeding. Many hatcheries cannot keep broodstock. Broodstock cost a lot and are easily stolen. They take up a lot of space. The cost of feeding is high.

Hatcheries without broodstock have to collect adult fish from nearby ponds, tanks or small reservoirs.

When should I collect broodstock?

If you collect them before the season, you can hold them in small ponds for some days to improve their condition. Broodstock can also be put directly into a breeding pool for spawning.

Collection of broodstock

I have never had broodstock before, should I handle them myself?

Broodstock need to be handled very carefully, you can learn from an experienced fisherman.

Injured fish can get an infection, and may die.

Fish with eggs will not spawn if handled roughly.

How should broodstock be collected?

The best way is by drag-net early in the morning when it is cool.

Then put the fish in net enclosures or hapas in the same water body for 1 to 2 hours.

They get used to a limited space and stop trying to escape (then they don't get injured). They also excrete any waste so it won't foul the water during transport.

Can I keep the broodstock in a hapa?

Don't keep fish too long in hapas. There is not much space or oxygen, and they will produce lots of waste.

Fish kept too long in hapas become stressed and can die in the hapa, later during transport or maybe even after they are stocked in the pond.

So hapas are good for fish up to 3-4 kg kept for a few hours before transport to a nearby hatchery.

If the fish have to go on a longer journey it is better to get them ready in larger net enclosures with a bigger mesh.

Transporting broodstock

Fiberglass containers are good for transporting fish.

- Fiberglass containers have been developed specially for fish transport
- Fiberglass is strong and light
- The containers can fit on a small flatbed truck and can be easily used together with aeration or an oxygen cylinder and a diffuser.

The fish are transported in a tank on a flat-bed truck. A hapa is put inside the tank so that it is easier to catch the fish.

When the truck reaches the hatchery the fish are taken carefully out of the tank and transferred to the holding tank.

The fish are put into hand nets or hapas in a bucket and carried to the holding tank.

The fish are dipped into a bucket with 5 l of water and a 1/8 teaspoon of potassium permanganate.

Some important tips for transporting fish:

- The tank should be completely full of water so the fish do not get injured
- Putting a hapa in a tank help to get the fish out without stress
- The water should be the same temperature or slightly cooler than their pond
- If you bubble oxygen slowly through the water the fish will always have enough

A holding tank has already been prepared. The water is slightly cooler than the pond they came from.

The fish are put into a hapa inside the tank. This makes it easier to catch them if we want to sort them.

A shower puts oxygen into the water, makes the water circulate, and, like rainfall, stimulates breeding.

The tank is covered with a net so that the fish don't jump out.

Looking after Broodstock

What ponds are broodstock kept in?

Broodstock are usually raised in perennial ponds of 50 - 125 decimals (0.2 to 0.5 ha) and 2 to 3 meters deep.

When should the broodstock be stocked?

A larger hatchery will keep broodfish all year and select the best ones for spawning.

A smaller hatchery may buy broodstock before the breeding season in February or March keeping them in a well-fertilized pond free of other fish.

A very small hatchery may buy broodstock and put them directly into a breeding pool for spawning.


Mahua Oil Cake

How about fertilizer?


Rice Bran and Groundnut Cake

Here are 3 ways to fertilize a pond and make food for the fish:

- Mahua trees grow all across Eastern India. People get oil from the seeds ands also mahua oilcake. You can add mahua oilcake to the pond before you stock the fish. 10 kg per decimal kills unwanted fish and insects. After 10-15 days it is no longer toxic and becomes a good fertilizer for ponds. It creates a lot of zooplankton (tiny swimming animals) that Catla eat. [If there are no unwanted fish 5 kg per decimal will be enough]
- Adding cattle manure or a mixture of cattle manure and poultry manure makes the water green with food (phytoplankton) for Rohu and silver carp after a few weeks.
- Sometimes farmers use fertilizer in bags (NPK). This creates plankton quickly. One problem with NPK is that it gets quickly used up and sometimes the plankton die in large numbers. This takes the oxygen out of the pond so the fish may also die.

How about feeding?

You can feed the broodstock everyday, early morning and late evening with a mix of rice bran and groundnut oilcake.

My pond size is:	5 decimil	7.5 decimil	10 decimil	12.5 decimil
Fish:	30 kg	45 kg	60 kg	75 kg
Rice bran:	300g	450g	600g	750g
& groundnut oilcake	300g	450g	600g	750g

My pond is 10 decimals and I have 60 kg of broodfish in it. I need to feed them 1.2 kg of feed a day; half in the morning and half in the evening.

My pond size is:	7.5 dec.	10 dec.	12.5 dec.
Fish:	45 kg	60 kg	75 kg
Rice bran:	450g	600g	750g
Groundnut oilcake	450g	600g	750g

How do I ensure good water quality?

Top up the pond when you can. Feed enough, but take care not to make the water go bad. Adding too much feed can use up oxygen in the water that the fish need.

When will the fish be ready to spawn?

If you look after your broodstock well, you will be able to spawn before the monsoon. If you feed the broodfish well and make sure the water is clean, you can spawn the same brood fish again after about two months.

Any questions…?

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