**Chapter 10: Fish Husbandry** ([Chapter 10](Chapter%2010.pdf))

* [Tilapia](Lecture%2011b%20Spawning%20Tilapia.pdf) 
  + Breed easily in captivity, [mouth brooders](Mouthbrooding%20Fish%20-%20Curious%20Creatures%20-%20YouTube.html)
  + Can breed when small – unwanted breeding
  + [Broodfish](Til-Aqua%20Natural%20Male%20Tilapia%20Hatchery%20-%20YouTube.html) should be between 150-300g
  + Keep breading populations separated
  + Females can be spawned every 1 – 2 months
* Step 1 - Choose your fish
  + Breeding populations of should be stocked with a sex ratio of 10 females for every 1 males
  + If you have 50 females you will need 10 males
  + A single female will produce 500 eggs
  + The maximum stocking density for broodstock is 10kg/m3
  + Your pond is 2m long and 1.5m wide and 0.5m deep
    - Volume = L x B x H = 2 x 1.5 x 0.5 = 1.5 m3 = 1500 L
    - 1500L/10kg/l = 15kg of fish
    - 15kg of fish / 250g per fish = 60 fish
    - A tank with 60 fish (50 Female 10 Male)
    - 50 fish x 500 eggs = 25 000 eggs every 2 months
    - Assume 20% survival = 1250 fingerlings per month
* Step 2 – [Conditioning the broodfish](Tilapia%20hatcheries(RUA).MP4%20-%20YouTube.html)
  + Maintain a constant water temperature between 26°C and 28°C
  + Ensure a good flow with clean good quality water
  + Feed with a high quality protein rich diet
  + Feed the broodstock fish at a rate of 1.5% body mass per day
    - 60 fish @ 250g = 15kg
    - 1.5% of 15k = 225g \* 15kg x (1.5/100) = 0.225kg
    - You will need to feed 225g per day
    - Feed the fish once per day in the morning
  + Do not over feed as this will reduce breeding
* Step 3 – [Collect eggs](Egg%20collection%20procedures%20followed%20in%20Bangladesh%20of%20Oreochromis%20Mossambicus%20(Tilapia)%20-%20YouTube.html)
  + Check the fish regularly
  + With experience you will get to know your fish and begin good at predicting the right time
  + The fish should be inspected and eggs collected at least once per week.
  + Catch the fish in a net
  + Gently pick up the fish and inspect her buccul cavity (mouth)
  + If there are eggs gently wash the eggs out into a bowl or bucket.
  + Collect eggs from all the fish in this way.
  + Fish without eggs are simply returned to the tank or pond.
* Step 4 – [Incubating the eggs](Tilapia%20Eggs%20-%20Tilapia%20Farming%20-%20YouTube.html)
  + The eggs should be kept in an incubator at 26-28°C
  + The flow should be such that the eggs are kept in suspension
  + But not so fast that they flow over the top…
  + As the eggs hatch they are collected in the tank below.
  + Moved to the nursery for sex-reversal
* Step 5 – [Sex reversal](Tilapia%20Hatchery%20Operations%20for%20Small%20Islands%20-%20YouTube.html)
  + To farm Tilapia well you need use mono-sex populations
  + Sex-reversal - 17-alpha Methyl-tes­tosterone
  + Added to feed at a ratio of 60mg/kg
  + From first feeding for 21 days
  + Fish should eat aprox. 20% body mass / day
  + Feed over 4 feeding during the day
  + Ad lib feeding is best – feed for 5 min adding a small amount at a time, keep adding food until the fish stop eating.
    - BUT – Do not over feed.
* Step 6 – Rearing fingerlings
  + Once the fish have been sex-reversed they can be moved and sorted according to size.
  + Fingerlings can be stocked at 5Kg/m3 (1000L)
  + In 1500L you could have 7.5Kg of fingerlings (23days)
    - About 2 fish/per gram = 15 000 fingerlings
  + Feed at 15% Body mass per day
    - 15 000 x 0.5 = 7.5kg x 15% = 2.25kg
    - 560g of feed 4 times per day
  + But fish grow… ?
    - Feeding charts are a good guide
    - Use on farm data collected over time to develop your own charts
* Size Sorting
  + Size sorting is a good way to keep on track of how many fish you have and how big they are.
  + Use a fish grader to quickly sort the fish into size classes
  + Take this opportunity to examine your fish
  + What is there general condition?
  + Are they growing as fast as they should be?
  + Is the growth uniform?
  + What is the condition of the fins and eyes?
  + Are there any wounds or abnormalities?
* Counting Fish
  + To count the fish we will estimate according to weight.
  + Carefully count out 100 fish
  + Weigh them
  + Repeat this 2 to 3 time
  + Add the weights of the 3 samples together
    - Eg 100 fish = 254.5g
    - 100 fish = 249.3g
    - 100 fish = 247.9g
    - Total 300 fish = 751.7g
  + Now divide 751.7 by 300 fish to estimate the weight of a single fish
    - 751.7/300 = 2.506 grams per fish
  + Now weigh all the fish in the tank
    - Lets say it is 12.5kg
    - Divide the total weight of the tank by the weight per fish to estimate the total number of fish.
    - 12 500g/2.506g = 4988 fish
  + For tilapia you need to do this every month.
* [Catfish](Lecture%2011a%20Spawning%20Catfish.pdf)
  + One of the easiest fish to breed in captivity
  + Males have to be [sacrificed](The%20Simplest%20Way%20for%20Catfish%20Production%20(Spawning)%20-%20YouTube.html)
  + [Broodfish](ARTIFICIAL%20CATFISH%20PROPAGATION%201-%20Broodstock%20conditioning,%20pituitary%20extraction%20and%20injection%20-%20YouTube.html) should be between 2-4kg
  + Larger fish can be difficult to handle and produce poorer quality eggs
  + Females can be [spawned](ARTIFICIAL%20CATFISH%20PROPAGATION%202%20-%20Stripping,%20fertilization%20and%20incubation%20of%20eggs%20-%20YouTube.html) every 2-3months
* Step 1 – Choose your fish
  + Select a number of fish to spawn
  + A single fish will produce 100’s of thousands of eggs
  + Some genetic variability is good.
  + 2-3 females and 4-5 males
    - 250 000 – 1 000 000 [fingerlings](FEEDING%20CATFISH%20FINGERLINGS%201%20-%20YouTube.html)
  + Choose fish that look strong and healthy
  + Select the fastest growers
  + Separate the males and females into conditioning tanks
* Step 2 – [Conditioning the broodfish](How%20to%20Hatch%20Catfish%20Eggs%20Easily%20-%20YouTube.html)
  + Maintain a constant water temperature between 26°C and 28°C
  + Ensure a good flow with clean good quality water
  + Feed regularly with a high protein diet
  + Raw chicken livers work very well for this
  + Approximately 1-2 livers per fish per day
  + 2 to 3 weeks
  + Females abdomen is large and distended
  + Check ovipositor – swollen and inflamed
* Step 3 – Prepare for spawning
  + To induce ovulation in the female and ripen the sperm in the male you will need to inject the fish with a gonadotropin
  + This can be bought from various suppliers – AquaSpawn
  + Alternatively it is possible to make your own!
  + Essentially homogenised pituitary glands from a mature fish
  + Inject intramuscularly
  + A good place is along the back where the muscle is thickest
  + After the fish have been injected make sure they are in separate holding tanks
  + Become aggressive and can injure and even kill each other
* Step 4 – Spawning
  + At 27°C the female should be ready to spawn after about 13-20 hours after injecting
  + Make sure everything you need for spawning is clean, dry and ready
    - Paper towel
    - A towel
    - Bowls
    - Sharp knife
    - Clean water
  + After 13 hours check…
  + When handling a fish
  + Always make sure your hands are wet
  + Be calm and relaxed
  + Do not try hold to tight or restrict movement to much
  + Anticipate the movements and wait for the fish to calm down
  + Examine the belly and ovipositor
  + The belly should feel soft as if full of liquid
  + The ovipositor will be distended and red
  + Holding the fish against the side of the tank or against your body gently add pressure to the abdomen from between the pectoral fins in a downwards direction.
  + If eggs begin to come out the fish is ready to spawn
  + If no eggs are released or you need to use excessive force wait 2 hours and try again.
  + Once satisfied the fish are ready
  + Remove the fish from the tank
  + Place it in a dry towel
  + This is not good for the fish, only dry a fish if you have to
  + Contact with water will reduce the window for mixing with sperm and hence fertilisation to take place
  + Cover the head with the towel to help the fish to relax
  + Wait for the fish to stop flapping
  + Gently hold the fish in the towel to make sure it does not hurt itself
  + Once the fish is relaxed you can begin stripping the eggs
  + Make sure the fish is dry, especially around the ovipositor
  + With one hand hold the tail behind the anal fin, secure the head with your other arm and gently arch the back of the fish to fully extend the ovipositor
  + With your other hand apply pressure to the abdomen from between the pectoral fins, slowly move downwards as the eggs are released
    - Collect the eggs in a clean, dry bowl
    - Do not go to fast, but be efficient
    - Always be gentle
    - Do not try and get every last egg, once the eggs stop flowing freely it is better to stop.
    - It is common for faeces to also be released
      * Make sure this does not mix with the eggs
  + Once all the eggs have been collected it is time to add the milt/sperm
    - Unfortunately the male fish will not readily release their milt and the testis need to be physically removed in order to fertilise the eggs.
  + A single male can fertilise the eggs from many females
  + Additional males are used to ensure genetic variation
    - For “Just in case”
    - A catfish farmer will need more male broodstock than females…
  + Catch the male fish
  + Place the fish in a dry towel and wait for the fish to relax
  + Using a very sharp knife open the abdominal cavity from the anus to below the jaw.
  + Sever the spinal chord by pushing the knife through the spine directly behind the head
  + Remove the gonads
  + The pituitary glands from these males can be removed and used for the next spawning
  + Using a sharp knife lacerate the testis and collect the sperm
  + Add the sperm to the eggs and mix gently as not to burst the eggs
  + Use your finger, or a feather to mix
  + Allow a few minutes for the eggs to be fertilised
* Step 5 – Hatching the eggs
  + Fertilised eggs will become sticky upon contact with water
  + Quickly rinse out excess sperm and proteins with fresh water and transfer the fertilised eggs on a screen in the incubator
  + At 27°C the eggs will hatch in about 36 hours
  + Placing fertilised eggs in/on a grass culture can increase survival
* Step 6 – Rearing the larvae to fry
  + This is the most tricky part of catfish farming
  + Good results here will produce good fish
  + Catfish larvae and fry will only eat live food…
  + If there is not enough natural food the will eat each other
  + Hatching the eggs in a grass culture ensures both enough food and refuge from other hatchlings
  + They will eat this quickly, grass should be added every day or two
  + Living yeast cultures are also very good for rearing catfish
  + Brine shrimp are excellent, but expensive
  + Use all three!
* Step 7 Rearing fry to fingerlings
  + After about 7 days the fry should developed enough to start weaning them onto commercial feed
  + Hard boiled egg yolks should be used as a supplement during the weaning process
  + Reduce the feeding of live food and begin adding powdered fish feed and crushed eggs yolks
  + Feed every 2 hours
  + Watch the fish eating making sure not to over feed
  + Look out for shoots – remove them
  + Slowly wean fish onto only fish feed diet over about 4 weeks
  + By 8 weeks the fingerlings should be about 15-20 grams and can be moved into from the hatchery into nursery tanks
* Size Sorting
  + Apart from good quality feed size sorting is the most important part of growing catfish
  + Tanks must be checked daily for shoots and these must be caught and removed
  + Collect all the shoots in a separate tank
  + Keeping fish separated according to size will help to control and reduce cannibalism
  + Sorting fish is time consuming, but must be done regularly and accurately
  + Sorting by hand will take too long
  + Fish graders allow a farmer to quickly separate different size fish from each other
  + Simple screens can do the same job
  + Once the fish are sorted by size it is important to know how many fish you have
* Counting every fish is impractical
  + Estimate
  + Carefully could out 100 fish
  + Weigh these
  + Repeat this 2 to 3 time
  + Add the weights of the 3 samples together
    - Eg 100 fish = 84.5g
    - 100 fish = 89.3g
    - 100 fish = 78.9g
    - Total 300 fish = 252.7g
  + Now divide 252.7 by 300 fish to estimate the weight of a single fish
    - 252.7/300 = 0.842 grams per fish
    - Now weigh all the fish in the tank
    - Lets say it is 2.5kg
    - Divide the total weight of the tank by the weight per fish to estimate the total number of fish.
    - 2500g/0.842 = 2969 fish
  + For catfish you need to do this every 2 weeks!
* [Carp](Lecture%2011c%20Spawning%20Carp.pdf)
  + Carp are a highly fecund species
  + Produce a lot of eggs 1 female = 300 000 eggs
  + Breed easily in captivity, especially in ponds
  + Typically breed seasonally
  + Once a year in summer when water is warm
  + Breeding carp under natural conditions is best
  + Farmers try to imitate natural conditions
* Step 1 – Choose your fish
  + Females should be kept separately from males
  + At the beginning of summer prepare the breeding ponds
  + Fish will typically spawn only once a year, so it is important to plan your production accordingly
* Step 2 – Prepare breeding ponds
  + Breeding ponds should be shallow around half a meter deep
  + They can be fairly large 10m x 10m or bigger
  + Fertilise the pond with manure and layer it with vegetation (long grass works well)
  + Fill with water and allow the water to go green
* Step 3 – Add broodfish
  + Breeding populations of should be stocked when the water temperature is above 22°C
  + A sex ratio of 5 females for every 2 males good, This is enough fish for a 10m x 10m Pond
* Step 4 – Allow the fish to spawn
  + As long as the water is above 22°C the fish should spawn within a few days.
  + You will notice a lot of activity as the fish chase each other in the shallow water.
  + The female will lay her eggs on the submerged vegetation
  + The eggs hatched after 2-4 days
* Step 5 – Remove the adults
  + Once the eggs have hatched you should notice small fry along the edges of the pond.
  + Partially drain the pond to concentrate the fish are using nets remove the adult fish from the pond.
  + The carp fry will eat the algae and micro-organisms in the water
  + This kind of farming is called green water culture and uses little or no feed
* Step 6 – Rearing the fingerlings
  + The carp fingerlings will continue to eat and grow on the natural productivity of the pond
  + Add compost as discussed previously to help boost or maintain productivity in the water
  + Once the fish are big enough you can supplement with feed to make them grow faster.
  + Stocking density and water flow (oxygen) and linked
  + More fish = more flow
* Step 7 – Size Sorting
  + Size sorting is a good way to keep on track of how many fish you have and how big they are.
  + Carp do not need to be sorted often.
  + When the fingerlings are big enough – (5-10g)
  + Partially drain the pond to concentrate the fish
  + Using a net gently catch the fish.
  + As before weigh a count and weigh a sample to estimate the average weight of each fish
  + Weigh all the fish to get an estimate of how many you have.
* Step 8 Stocking
  + Once you have all your fingerlings you need to stock them into your ponds
  + The stocking density will be determined by the water inputs and feed.
  + Min inputs = 10 fish/m2
  + From one breeding pond you will produce many more fish than you can use
* [FAQ](FAQ%20-%20Chapter%2010.pdf)
* **Videos**
  + The Life of a Fish Farmer - Team Korda <https://www.youtube.com/watch?v=SsmPqnG0yVs>
  + African catfish RAS hatchery <https://www.youtube.com/watch?v=li-O4unFL0E&t=869s>
  + Story Hatchery <https://www.youtube.com/watch?v=f-Scu9ZdZ-s>