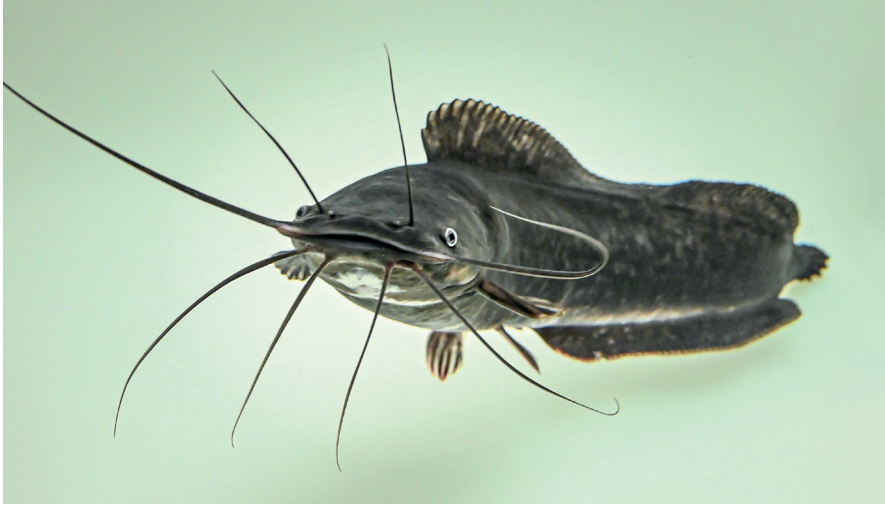
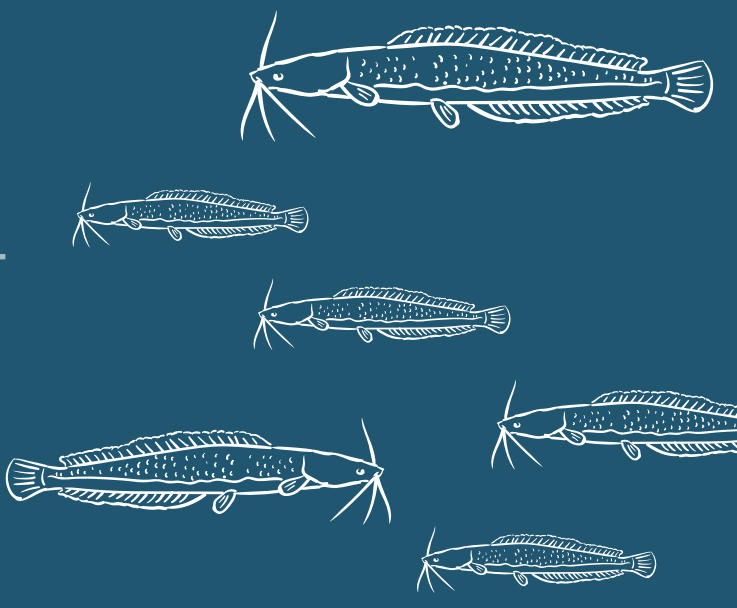


CATFISH HANDBOOK

BY ALLER AQUA



ALLER AQUA

Authors
Dr. Robert Tilner
Dada Mofoluso
Nurudeen Lasisi

Writing Contributors
Dr. Alexander Greilling
Dr. Akele Koulou Joel

Reviewers
Kenneth Patrick Madsen
Pernille Franck Jespersen
Przemysław Rutkowski
Katrine Evans

Images/Illustrations
Dada Mofoluso
Przemysław Rutkowski
Pernille Franck Jespersen

Graphics Design/Layout
Pernille Franck Jespersen

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Courtesy of other images are indicated seperately.

FOREWORDS

It is with great pleasure that we present Aller Aqua Catfish Farming Handbook.

Catfish farming has evolved into a vital industry across Africa, providing livelihoods, improving food security, and supporting sustainable aquaculture practices. This handbook is created as a comprehensive guide to serve as an essential resource for both aspiring and experienced catfish farmers.

This handbook is designed to address many unique challenges and opportunities in catfish farming, focusing on sustainable practices, efficient feed management, optimized production techniques and marketing. At Aller Aqua, we believe in supporting farmers with the tools and insights needed to enhance productivity, and this guide reflects our commitment to sustainable aquaculture practices.

Whether you are new to the field or looking to expand your knowledge, this handbook offers practical strategies and valuable insights for building a successful catfish farming operation. We are confident that it will become a valuable tool for growth in your journey toward profitable and sustainable aquaculture.

LET'S GROW TOGETHER!

CONTENT

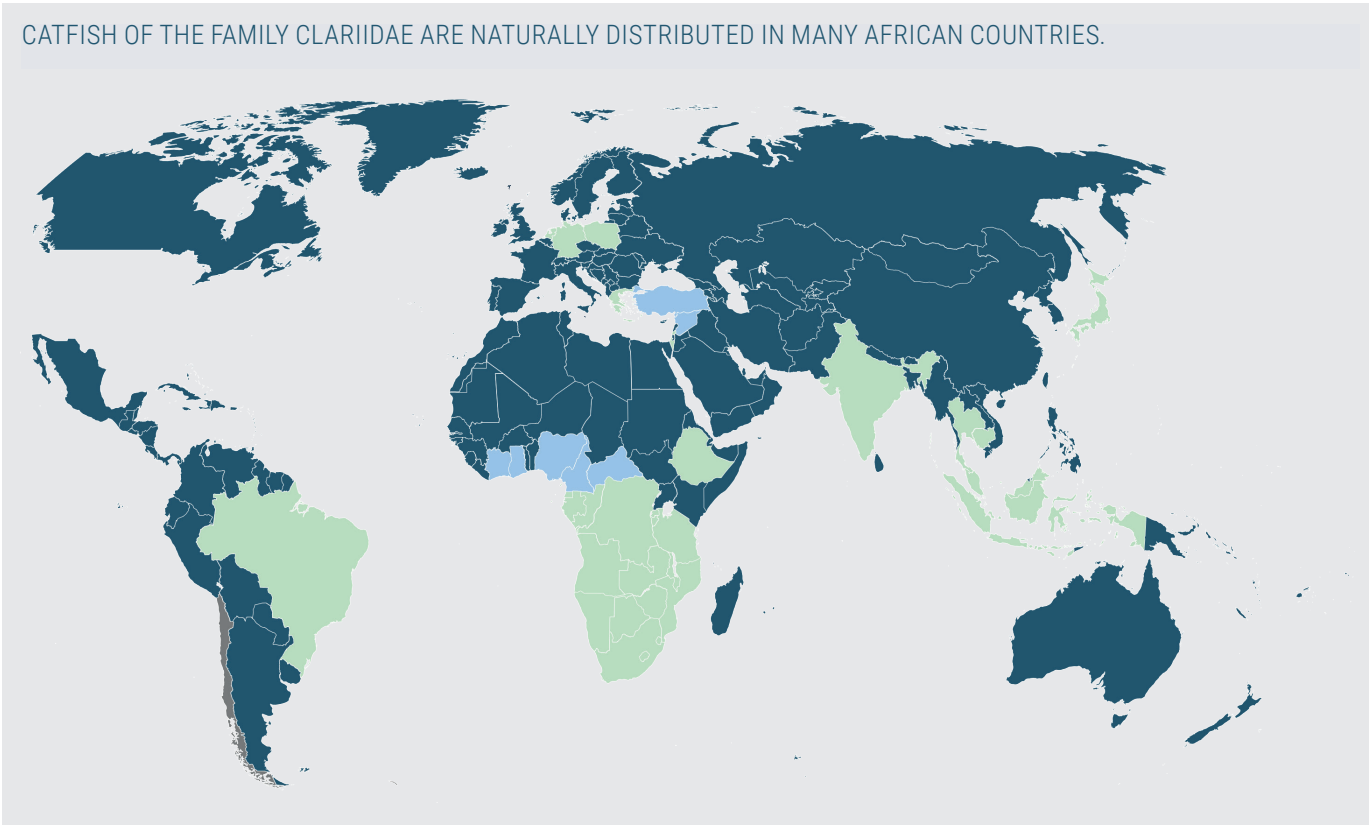
AFRICAN CATFISH

GEOGRAPHICAL DISTRIBUTION

Catfish of the family Clariidae are naturally distributed in many African countries, some areas in the Middle East, the Indian subcontinent, and Southeast Asia.

Fish of the genus Clarias ("African catfish") cover most of the species in the family Clariidae.

CATFISH OF THE FAMILY CLARIIDAE ARE NATURALLY DISTRIBUTED IN MANY AFRICAN COUNTRIES.



BIOLOGY

Most species of the family Clariidae inhabit freshwater ecosystems but can also migrate into brackish waters with low salinity.

Besides taking up oxygen through typical gills, fish of the family Clariidae possess a special organ that enables them to extract oxygen from atmospheric air. This way the fish can live through extreme weather conditions during the dry season and survive in low oxygen waters and whilst leaving the water for a limited time, for example for foraging at night and changing waters. For this reason, the genus name Clarias is derived from the Greek word "chlaros", meaning "lively", and has earned one Clarias species, namely Clarias batrachus, the common name "walking catfish".

In general, African catfish are relatively easy to reproduce, have high fecundity, and are not sensitive to diseases which makes them a suitable species for aquaculture.

BESIDES TAKING UP OXYGEN THROUGH TYPICAL FISH GILLS, FISH OF THE FAMILY CLARIIDAE POSSESS A SPECIAL ORGAN THAT ENABLES THEM TO BREATHE ATMOSPHERIC AIR

NUTRITION

In nature, African catfish are predatory most of their lifespan but thrive on a variety of prey, including plant material, amphibians, fish, insects, zooplankton, crustaceans and even birds. Prey is sucked into the mouth and swallowed whole. Digestion takes place in the muscular stomach and gut. African catfish have an enormous appetite and can ingest a large amount of food in one meal.

In aquaculture, African catfish responds to high quality extruded feeds with fast growth, high survival, and good feed conversion.

AQUACULTURE

Aquaculture of African catfish is characterized by a wide range of systems and intensification, ranging from small scale backyard farming in concrete ponds to large scale intensive farming in earthen ponds or plastic tanks.
Fingerlings of African catfish may derive from wild stocks to be used in capture-based production systems or from selected broodstock.

Farming of African catfish with Tilapia is not uncommon. This multi-trophic aquaculture is done to control the biomass of juvenile Tilapia in ponds.

Most farmers of African catfish are small to medium-sized producers and market the final product fresh or smoked on local markets. Nigeria is the country with the highest production volume of African catfish in Africa (FAO FISH4ACP).

It is stated that more than 1.2 million tons of African catfish are produced per year in aquaculture (FAO, 2022), with Clarias gariepinus being the most dominant species, although different hybrids exist which may play a more important role in the future.

CATFISH JUVENILES

OS Logan Farm, Nigeria

CATFISH.

Danijel Farm, Poland

FEEDING CATFISH.

B&G Farms, Nigeria

FEEDS AND FEEDING

HATCHERY FEEDS

For catfish between 0.3-10 g, ALLER INFA EX 0.1 – 0.4 mm are recommended. These feeds are specifically suited to the needs of the catfish fry, based on carefully chosen ingredients. Granulates are the original form of industrially processed starter feed.

The advantages of granulates are many, but most importantly they:

- spread on the water surface over a large area,
- sink slowly and allow the fish a natural eating pattern in all depths of the water,
- have a size distribution that caters to the natural spread in fish sizes of ungraded fry,
- have an open structure, allowing the digestive fluids of the fish fast and effective access to the nutrients in the feed. This is of great importance in the fry's short digestive system.

DISSECTED CATFISH SHOWING ORGANS

Aller Aqua Research

CATFISH GUT.

Aller Aqua Research

Granulates have a large surface area and a low density. It is therefore easy to get the granulates to spread on the water surface before they slowly sink. An effective feeding, which ensures the fry the possibility of eating all the feed, is attainable with all the most common feeding technologies.

Use ALLER INFA EX fry feeds according to recommended levels from the *datasheets* (find these online www.aller-aqua.com) and spread the daily feed amount across a minimum of 5-6 feeding events per day. This will ensure fast growth, a uniform fish stock with low mortality, and maintain optimal water quality.

GROW-OUT FEEDS

Extensive systems often use leftovers from other types of food and feed production which often leads to low feed costs but also poor growth. The best performance is achieved using high quality extruded feed which contains all essential nutrients and may provide extra health benefits. Using a feed with a medium level of energy and between 38-45% protein provides the best possibilities for growth and optimum feed conversion. If the energy content in the feed is too low, African catfish may use the precious protein in the feed for energy rather than to gain biomass. Floating pellets should be preferred to sinking pellets to guarantee a fast feed uptake and optimal control over feed intake, and thus reduce water pollution.

African catfish sized between 10 g and 1.5 kg require grower feed, preferably as high-quality extruded pellets. ALLER CLARIA FLOAT is formulated specifically to achieve fast growth and a healthy fish stock, and thus the biggest possible yield for our customers. Like other types of feed from Aller Aqua, the grower feeds have been thoroughly tested in numerous trials at Aller Aqua Research, partner institutes, and trial farms, and are continuously re-evaluated and optimised utilising the latest research within fish nutrition and feed production.

Use the grower feeds according to recommended levels from datasheets and spread the daily feed amount across several feedings as outlined in the table below:

Fish size (g)	Feed size (mm)	Feeding frequency/day
5 - 25	2	3-4
25 - 170	3	3
170 - 500	4.5	2
500 - 850	6	1-2
850 - 1500	8	1-2

The feeding should be adapted to the farming system and the condition of the fish. Feeding should be reduced or stopped as explained below:

- reduce feeding when the water temperature rises above 32°C,
- reduce feeding if dissolved oxygen drops below 5 mg/L,
- reduce feeding when other environmental parameters are outside of optimal levels,
- reduce feeding when fish show signs of sickness or abnormal behaviour,
- stop feeding at least 10-12 hours before harvest or transportation.

All feeds should be stored in a cool and dry place. Feeds should stand elevated, for example on a pallet, and in a closed room or hall to reduce contamination of animal pests.

FEED CALCULATIONS

Several parameters help the fish farmer to calculate the performance and growth of the fish.
Feed conversion ratio (FCR) measures how much feed it takes to produce one unit of fish: kg feed used / (kg final biomass – kg initial biomass). It is a quick way to evaluate one performance paramater of any given feed.

For example, if the growth of all fish in a pond has been 1,000 kg and a total of 1.100 kg feed has been used in that pond, the FCR is 1.1.

The FCR should be considered in relation to the time within which growth was achieved. For example, if similar FCRs have been achieved, but in different time periods, then the feeds that resulted in the higher growth in the shorter period demonstrated the better performance. While FCR is a good quick measure, there are many other factors, such as number and period of mortality, water quality and management parameters that may affect the FCR.

Daily feed intake (DFI; expressed in % or kg feed per 100 kg fish biomass) is the amount of feed that should be provided to the fish each day. It requires knowledge about the biomass of fish in a pond or tank to calculate the right amount of daily feed. Our datasheets indicate the recommended feeding levels considering fish weight and water temperature.

Specific growth rate (SGR; expressed in %) measures the fish growth rate per day over a given period and is calculated using the natural logarithm (ln) of start and end weight: ($\ln_{\text{end weight}} - \ln_{\text{start weight}}$) / number of days * 100.
If two of either DFI, SGR or FCR are known, the third parameter can be calculated by the following equations:

DFI = FCR * SGR
SGR = DFI / FCR
FCR = DFI / SGR

A practical example:

A farmer has 20,000 fish in a pond, each fish weighing 10 g. That makes a biomass of 200 kg.
The datasheet for a 2 mm feed recommends a feeding level of 5.1 kg feed per 100 kg fish per day (DFI of 5.1%) at a temperature of 28°C.
This means that 10.2 kg feed should be fed to the fish each day.

A farmer stocked 1,000 fish at 5 g each in a pond, equalling 5 kg biomass.
120 days later he harvested 1,000 kg. The SGR is calculated as (ln1,000kg – ln5kg) / 120 * 100, so 4.41%.
1,050 kg feed has been used, so the FCR is around 1.05 (1,050 kg feed used / 995 kg growth in biomass).

Always speak with your Aller Aqua technical and sales officer to help interprete your farm records and discuss the growth and performance of your fish.

OUR DATASHEETS INDICATE THE RECOMMENDED FEEDING LEVELS CONSIDERING FISH WEIGHT AND WATER TEMPERATURE.

FIND OUR DATASHEETS ONLINE **ALLER-AQUA.COM**


African catfish
ALLER INFA EX GR, 0.1-0.4 MM

Fry Feed

DECLARATION

	0.1 mm	0.2 mm	0.4 mm
Crude protein (%)	64	64	64
Crude fat (%)	12	12	12
NFE (%)	4,9	4,9	4,9
Ash (%)	12,1	12,1	12,1
Fibre (%)	1,0	1,0	1,0
P (%)	1,4	1,4	1,4
Gross energy (MJ)	20,8	20,8	20,8
Digestible energy (MJ)	19,6	19,6	19,6

COMPOSITION
Raw materials listed alphabetically. The full composition will appear on the label
fish meal, fish oil, functional ingredients, grain products, krill meal, vegetable proteins, vitamins and minerals.

RECOMMENDED FEEDING LEVELS
Kg feed per 100 kg fish per day

Fish (g)	Granulate	Water temperature (°C)									
			14	16	18	20	22	24	26	28	30
<0.05	0.1 mm	0.1	1,16	1,94	3,1	4,65	5,82	6,98	7,76	6,98	6,21
0.05-0.10	0.2 mm	0.2	1,11	1,84	2,95	4,42	5,53	6,63	7,37	6,63	5,89
0.10-0.30	0.4 mm	0.4	1,05	1,75	2,8	4,2	5,25	6,3	7	6,3	5,6

ENVIRONMENTAL IMPACT WITH EXEMPLARY FEED CONVERSION RATIOS
Figures are per 100 kg fish production

	0.1 mm			0.2 mm			0.4 mm		
Feed conversion	0,5	0,6	0,7	0,6	0,7	0,8	0,7	0,8	0,9
N in faeces (kg)	0,31	0,37	0,43	0,37	0,43	0,49	0,43	0,49	0,55
N in water (kg)	2,06	3,03	3,99	3,03	3,99	4,95	3,99	4,95	5,91
P in faeces (kg)	0,23	0,27	0,32	0,27	0,32	0,36	0,32	0,36	0,41
P in water (kg)	0,1	0,2	0,31	0,2	0,31	0,41	0,31	0,41	0,52

ENVIRONMENTAL IMPACT MEASURED IN CO_2-EQ
Figures are in CO_2-equivalents (kg/kg feed)

	0.1 mm	0.2 mm	0.4 mm
CO_2-eq. with land use change	1,14-1,99	1,14-1,99	1,14-1,99
CO_2-eq. without land use change	1,10-1,96	1,10-1,96	1,10-1,96

FEEDING STRATEGIES FOR OPTIMAL GROWTH

It is recommended to distribute the daily feed amount among different feedings per day. Small fry should be fed several times per day and the number of feeding events can be reduced as the fish grow, down to 1-2 times daily for large fish. This is because the stomach of fish increases proportionally the bigger they get and they can eat more in one meal compared with smaller fish.

It is important to spread the feed evenly across the pond or tank to ensure that all fish have the chance to feed. Otherwise, only a few fish will eat, and the population will grow unevenly. This will lead to a less uniform growth of your fish which can impact the selling price of your fish when harvested.
It is also pertinent to establish a feeding and time routine for the fish stock, and avoid overfeeding during these times. Training fish to recognise feeding times and other signals can help improve feed utilization and minimise competition. Feeding late in the evening or night should be avoided to minimise risk of stress and health problems resulting from water qaility issues and lack of resting periods.

Monitor feed consumption regularly, adjusting feeding rates as needed. Usually, the feeding quantities for the fish may vary slightly due to weather and temperature conditions. Monitoring your water quality is therefore also important. Aller Aqua provides a feeding chart for African catfish that may be used as a guide for your farm. This guide alongside the feeding strategies can help to optimize growth and minimise feed wastage and environmental impact.

ALLER AQUA FARMERS PRODUCTION RECORD CARD - CATFISH.

DESEASES AND HEALTH MANAGEMENT

"Prevention is better than treatment" is the most valuable advice for fish farmers.

Fish diseases are a threat to every farmer and can arise unexpectedly.

Fish disease is an abnormal physiological state that may present a group of clinical signs and symptoms that sets the condition apart. Disease may be infectious (caused by bacteria, fungi, parasites etc) or non-infectious, resulting from environmental stresses such as imbalanced nutrition, low water quality etc.

Carefully and regularly observe the fish for abnormal behaviour since this is a warning sign for a potential disease outbreak. To better observe fish diseases, a fish farmer should know the characteristics of a healthy catfish.
In general, a healthy catfish:

- Is alert and responds to feeding,
- has a normal growth rate and appetite according to their life stage,
- has no abnormality on its external surface (lesions, rots, white spots, discoloration) and has a colour and aspect that is typical of the catfish species,
- exhibits no abnormal behaviour (e.g. erratic swimming, floating near the surface etc).

Good hygiene practices in aquaculture play a crucial role in maintaining the overall health of farmed catfish. It is therefore important to conduct good farm management practices to maintain good health for your catfish.

In catfish with disease, you may notice abnormal features such as skin colour changes, white spots or injuries, swollen gills, red barbels or fins, pop-eyes, or unusual behaviours such as loss of appetite, erratic swimming etc. At the observation of abnormal features or behaviours in your fish, speak to a fish health expert or Aller Aqua technical and sales officers for assistance.

DISEASES AND TREATMENT

African catfish are relatively robust fish but may occasionally experience infestations with fungi from the genus Saprolegnia. The catfish may show white and grey patches on its body and fins that look like cotton. As a treatment, fish are submerged in 5 % saline solution for one or two minutes. The salt that must be used should be non-iodised and without additional additives, like rock salt for example.

Infestations with parasites on skin and gills are more common in catfish, especially protozoans, and can cause grey thick slime or white spots on the fish. Infected fish can be treated for example with baths in formalin (25-50 mg/L) for up to 60 minutes and a maximum of 3 consecutive days. Ensure water parameters are optimal and aerate water during treatments.

Dead fish should be swiftly removed to reduce disease spread to others.

Viral diseases have not been confirmed in African catfish.

A common environmental disease is the so-called "crackhead" in fish over 10cm, which involves the fish skull getting deformed and cracking open. Proper water quality, avoiding stressful situations and a high-quality feed dosed correctly can likely help avoid this problem.

Gas bubble disease can also occur when excess dissolved gases, particularly nitrogen or oxygen, form bubbles inside the bloodstream, tissues, or gills of the catfish. This can lead to swelling, erratic swimming behaviour and even death if left untreated. It can occur due to supersaturated water from faulty aeration, sudden temperature changes, or high-pressure water sources. Monitoring water quality, allowing water to aerate in open areas or using degassing columns before introducing water to ponds can help prevent this challenge.

DISEASE OUTBREAKS

If disease breaks out:
- stop feeding,
- replace the water in the pond or tank as much as possible with clean water with optimal parameters,
- consult a veterinarian.

Diseases lead to reduced growth and heightened mortality and therefore reduce the output for farmers. Diseases may spread when environmental conditions are not optimal and can in addition cause the fish to experience stress.
At the observation of abnormal features or behaviours in your fish, speak to a fish health expert or Aller Aqua technical and sales officers for assistance.

CATFISH GAS BUBBLE DISEASE.

SIMPLE GUIDELINES FOR BIOSECURITY IN AQUACULTURE

Biosecurity in fish farming involves practices to prevent diseases from entering or spreading within or outside the farm. Fish diseases are hard to eliminate or control once they occur, it is therefore important to follow strict measures for biosecurity.

Some biosecurity tips include:
- Design your farm waterflow systems to prevent contamination between ponds, and avoid waste water accumulation,
- manage access to farm through designated entry points and disinfect visitor clothing/boots,
- differentiate farm areas, using separate tools to avoid cross-contamination,
- establish cleaning and disinfection procedures for farm tools and equipment,
- monitor water quality conditions and regularly observe your fish for signs of diseases,
- train workers about bio-security and encourage quick reporting of any suspicions.

FUNCTIONAL FEEDS

Using functional feeds to ensure optimum health and growth of fish is becoming a widespread practice. The Aller Aqua Support concept is a series of aquafeeds based on a blend of functional ingredients that promote growth and survival in fish as well as disease resistance and prevention. This is done by balancing the microbial community in the fish gut.

ALLER AQUA SUPPORT CONCEPT IS ADDED IN OUR RANGE OF FEEDS FOR AFRICAN CATFISH AS EXTRA ADVANTAGE FOR OUR CUSTOMERS.

FARMING PROCEDURES

ENVIRONMENTAL CONDITIONS

Good water quality with water parameters at optimum levels is the foundation of successful fish farming.

Temperature:
African catfish can tolerate a wide range in environmental parameters, including temperature ranges from 8°C to 35°C. Their preferred temperature is 28°C. Use temperature meter to check temperature daily.

pH:
The optimal ranges for pH are between 6,5 and 8,0. The pH should be checked on a regular basis using a pH meter. The pH can be strongly influenced by heavy rain. Measure the pH before and after heavy rainfall to see if you need to adapt your feeding regime.

Oxygen:
Although African catfish can take up oxygen from the air, dissolved oxygen in the water should be maintained above 5 mg/L and monitored regularly using a dissolved oxygen meter. Reduce feeding when oxygen levels fall below the 5 mg/L mark and provide aeration by air stones or paddle wheels.

Ammonium:
Ammonium levels should be below 0.5 ppm to avoid toxicity from the toxic form of ammonia. This is especially important if the pH is high. Ammonium can be measured using water test kits such as test trips with colour indication.

Pollutants:
The water should always be free of pollutants.
As a general guideline, for concrete, plastic, and collapsible ponds made with tarpaulin material set around steel frames, 25-35% of the water should be let out and replenished daily. This should be done in part 2 hours before feeding and another 4-6 hours after feeding. This last feeding should take place after sunset. For earthern ponds, flow-through replenishment once a week is recommended unless there is a situation involving a disease outbreak or water pollution.

B&G Farms, Nigeria

5 tips to remember:

- Temperature
- pH
- Oxygen
- Ammonium
- Pollutants

PONDS AND EQUIPMENT

Establishing your pond or tank is the first practical step to begin aquaculture production. For farming African catfish there are several types of ponds/tanks which are suitable. The most common are listed below:

1. Earthen pond

These should be dug out in the ground following careful planning, considering the availability of water, the layout, and the size. Make sure to compact the soil to avoid damages caused by heavy rainfall if this applies to your area. Smaller ponds with proper inlet and outlet channels are easier to construct, manage and harvest. Earthen ponds should usually be surrounded by dikes or banking to help manage erosion and flooding.

2. Concrete pond

Concrete ponds are similar to earthen ponds and are created in almost the same way. The difference is in the cladding of the pond with cement to form a more solid construction. Concrete ponds are also easy to put up on already sealed surfaces should you not have land or soil that is stable enough for digging earthen ponds.

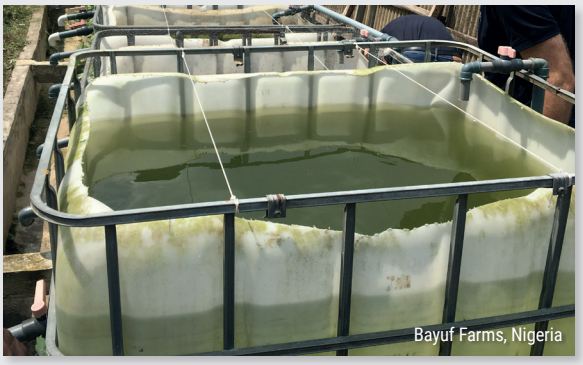
3. Plastic/fibreglass tanks and Wooden Fabricated Pond

Plastic and fibreglass are popular choices for ponds, as the materials are strong but light, and allows for the establishment of an aquaculture farm, without digging.

EXAMPLES OF POND SYSTEMS:


Sej Farms, Nigeria


Online image


Bayuf Farms, Nigeria

For a general setup, the following is required:

- Concrete or plastic tanks or earthen ponds
- Access to a water source with optimum water quality parameters
- Electricity
- Water pump
- Buckets
- Shovels
- Drag nets
- Sorting or grading table
- Water parameter test kits
- Weighing scale
- Farm boots and workwear

For day-to-day routines:

- Book for record-keeping (see appendix 1)
- Temperature meter
- Calculator
- Possibly pH meter
- Possibly dissolved oxygen meter

WASTE MANAGEMENT & SUSTAINABLE PRACTICES

The rearing systems for catfish farming utilise considerable environmental resources, and produces large amounts of waste water. As fish farming grows, it is important to implement sustainable practices that help to manage their impact on the environment.

While modern farms may explore rearing systems such as recircuatory aquaculture systems (RAS), where the water resources are better managed, the more popular traditional systems exchange large volumes of water, including the solid and dissolved wastes with the environment. The traditional systems also take more water resources from the environment.

A practical way for farmers using traditional rearing systems such as earthen ponds, concrete/fibre tanks and tarpaulin ponds with a flow through system include:

1. Consider environmental impact in farm site selection:

It is critical to site farms with large effluent systems in areas less sensitive to environmental and biodiversity disturbances. Ensuring that the farm integrates as best possible with the environment for water supply and its sewage drains through proper channels without polluting or contaminating the environment.

2. Efficient Feed Management:

Providing your fish with high quality feeds such as Aller Aqua feeds, in optimised quantities as advised in its feeding guide, will help prevent feed wastage and high nutrient discharge. Overfeeding and feeding low quality diets with large nutrient/material discharge into water can lead to pollution of water bodies and the environment.

Monitoring the feed conversion ratio periodically as adviced in Aller Aqua farm management manual will help optimize feed usage and minimise wastage that may leach into the environment.

3. Waste management and Recycling:

Implementing waste management and recycling are critical for sustainable catfish farming. Proper waste handling can help improve farm efficiency, converting waste resources into other profitable opportunities and reduce the farm's environmental footprint. Some examples include:

Collected solid organic wastes, such as uneaten feeds and filtered out fish excreta or pond slurs can be utilised as organic compost materials useful for improving crop agriculture yields. Proper processing of fish waste and by-products can generate biogas for homestead use.

Implementing a RAS system that filter and reuse water resources, although expensive and energy intensive today, can significantly reduce the environmental footprint of fish farms, while improving their fish output.

BROODSTOCK AND HATCHERY

African catfish broodstock maintenance
The purpose of good broodstock maintenance is to harvest good quality eggs and sperm. The broodstock should be individually tagged or marked to allow for traceability for each batch of offspring and to have the possibility of entering breeding programmes. The broodstock should be given enough time to recover from spawning and with the individual tagging, it is possible to ensure proper record keeping.

Broodstock should be kept separately from other farm activities for obvious reasons:

- to keep them away from stress and diseases,
- to optimise their environment by ensuring a constant light regiment and to uphold water quality,
- and ultimately to achieve a whole year reproductive cycle.

Recirculation systems in a confined area, with temperature control, if necessary, is preferred. In the tropics, flow-through systems can also work, if flushed with good quality borehole water.

Productivity of female broodstock
The productivity of the female (called fecundity) is expressed as a percentage of the body weight and is usually between 5-15%. The egg size tends to increase with the size of the female. In larger fish, the number of eggs per gram is lower than in smaller broodstock. On average there are 500 eggs per gram. The average female weighs around 6 kg and produces 300-600 g of eggs (150,000-300,000 eggs).
Spawning (i.e. ovulation) can be induced by injection of pituitary gland extracts or ovulation stimulating supplements. There is a wide array of ovulation inducing pharmaceuticals on the market. However, their availability depends on national registration and permission of use. It is advised to ask a local veterinarian for advice on which products are available in one's respective market.

Sperm Harvesting from male broodstock
The male Clarias gariepinus do not release sperm after treatment with hormones like many other fish species. These males have ripe sperm all year round. The gonads are ripe when the fish is at least 1 year old. A lot of variation can be seen between males of the same age in ripeness and size of the testis. In practice, farmers sacrifice males to dissect the testis out of the abdomen. By making incisions in the testis tissue the sperm can be collected. Consequently, new male broodstock needs to be added to the broodstock population regularly when using this practise. Sacrificing males is a big constraint on genetic programmes. It is advised to not use one's own males to replenish the male broodstock to avoid inbreeding.

Rather than sacrificing males, some farmers operate the fish. After tranquillization, a small incision is made in the belly of the fish. Then, using a syringe with a needle, sperm can be extracted from the testis. Finally, the incision in the belly is stitched using veterinary stitching material and the male recovers in 1-2 weeks. During this time the wound closes completely.

Unlike mammal sperm, fish sperm is inactive but will be activated as soon as it is in the water. The sperm is active for less than a minute, so it must find an egg quickly before all the energy has gone.
It is therefore important that all materials, hands, and fish should be completely dry during the procedure of sperm collection. It is not a fool-proof process, however, and the sperm can still be activated accidentally. The sperm concentration of good males is more than one million per ml.

Fertilisation
The eggs and sperm are collected in a dry glass or porcelain bowl and a small dry glass or porcelain cup respectively. A simple but effective way of fertilization is to bring the eggs and sperm together in the egg collection bowl, mix it gently before adding water. Using a soft and flexible stirrer, like a feather for example, can help mix the two together without damaging the eggs.

In literature adding certain fertilizing solutions during fertilization is reported as being beneficial, as they are thought to extend the life of the sperm to improve the fertilisation rate. However, using extra fluids increases handling and can therefore cause problems.

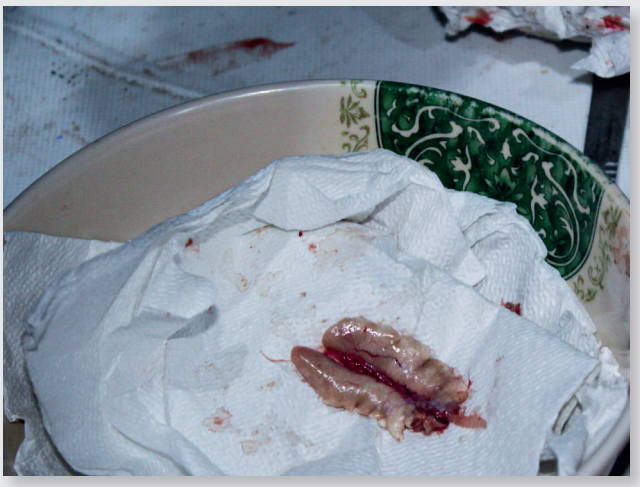
Artificial propagation of African catfish is a relatively simple procedure, and many farmers are skilled in it. However, the successful rearing of the larvae for 1 or 2 months to the juvenile stage much depends on the capabilities of the individual farmer.

EGG COLLECTION

HARVESTING THE MALE TESTES FOR SPERM

SPAWNING COCOON

HARVESTED MALE TESTES (MILT)



Sej Farms, Nigeria

African catfish hatching or incubation system
Glass aquaria are preferred for several reasons:

- easy cleaning,
- observation of the larvae is very easy,
- custom-made for a reasonable price,
- the incubation system should be placed in a room with a controlled temperature. The temperature must be kept at 30°C. Even in the tropics, the water temperatures at night can drop to 24°C, which negatively impacts the growth and health status of the larvae.

Stocking of African catfish in an incubation system
The fertilised eggs are spread over a sieve surrounded by oxygen-rich water, which lowers egg mortality. The eggs hatch in around 24 hours with a water temperature of 29-30°C. The mesh size of the sieve should be big enough to hold the eggs and to allow the hatched larvae to swim through. If the mesh size is too small the larvae will not be able to swim out of the sieve. Dead eggs and eggshells are easily removed with the sieve afterwards. During the first two days, the larvae absorb the yolk sac and develop their intestines. After this period the larvae can swim freely in search of food. The larvae change in colour from transparent green to brown during this period.

Maintenance of incubation system
Each hatching cycle takes 13 days (preparation of the system is 2 days, 3 days hatching and absorbing yolk sac, 7 days growing the larvae, and 1 day harvesting and cleaning). It is very important that between each cycle the system is thoroughly cleaned, disinfected, and dried prior to using the system for the next cycle. Ensure that all cleaning and disinfecting agents are removed completely prior to drying to ensure no remnants will be in the water in the next hatching cycle.

Feeding of African catfish larvae
The first feed for African catfish larvae is live Artemia. Survival rates and growth of larvae fed on live Artemia is higher than for those fed dry larval feeds or encapsulated Artemia. With glass aquaria, you can observe feeding behaviour and see that stomachs fill, and this way avoid both overfeeding and underfeeding. Well-fed African catfish larvae show full bellies, and these fish settle on the bottom of the tank.
See Handbook appendix for Aller Aqua feeding guide and ALLER INFA and ALLER FUTURA EX datasheets.

Fingerling systems
In this system, the larvae can grow from 0.1 g to approximately 0.5-1.0 g. The system consists of a plastic tank connected to a bio-tower and a sedimentation tank. A pump provides the flow, and a UV-C unit ensures clean water.

In Nigeria, these systems are popular and are sold preassembled for a reasonable price. Their maintenance is both simple and low-cost. Ideally, the systems should be placed indoors, where the temperature can be maintained at 28°C. At 0.5 - 1.0 g the fish can now be called fingerlings and are either sold to customers or moved to the juvenile section of the hatchery.

HATCHERY SET-UP


Sej Farms, Nigeria

At this size the fish are large enough to withstand transport in 20-litre polyethene bags filled with 1/3 water, 500-1,000 pieces of fingerlings and 2/3 oxygen. This way the fish have adequate access to oxygen during transportation to a pond.

Juveniles
A juvenile section is required in the hatchery, for growing fingerlings of 1.0 g to juveniles of approximately 8 g. Farmers like this size because they are more robust than fingerlings and mortality rates are much lower. These systems should also be placed indoors. Temperature can be kept at 28°C constantly.

The primary reason for mortalities during this period is cannibalism. Mortality rates can be reduced by proper grading for the individuals that far exceed the others in size, so called shooters. Grading is also recommended during the growth period (see below for an explanation of grading). After this stage, when juveniles grow to table size, mortality should be below 10%.

CATFISH JUVENILES


OS Logan Farm, Nigeria

GRADING CATFISH JUVENILES


OS Logan Farm, Nigeria

Feeding of African catfish juveniles
Fingerlings growing to juveniles should be fed several times a day in regular intervals also during the night. Their stomachs are still relatively small at this size and regular meals are therefore recommended to achieve optimum growth. See Handbook appendix for Aller Aqua feeding guide and Aller Claria Float datasheet.

Grading African catfish
The secret of the success of many hatcheries lies for a large part in the management of grading. African catfish is a carnivorous fish that displays cannibalistic behaviour from the moment the larvae have absorbed the yolk sac and start eating. To minimize the effect of cannibalistic behaviour on the overall survival of the fish grading must be performed at precise moments during the growth of larvae to juvenile.

Grading is performed with either large mesh nylon sieves for small fish, and with either fixed or adjustable graders with bars for larger more advanced fingerlings and juveniles. Grading takes place when transferring the African catfish from one section of the farm to another. Between moving sections, the African catfish can be graded at fixed times (ex. halfway through the growth period in that section) and when shooters are spotted.

Aller Aqua farmers production record card show recommended grading periods for catfish farming.

Daily routines
The daily routine in Hatchery Farms includes the following:

- careful observation of the larvae and fry in their tanks for abnormal swimming patterns,
- reading of inlet water pH to ensure that it is neutral,
- careful siphoning of residues such as faeces, left-over feeds, dead larvae/fry,
- continuous flow-through of water (depending on the pond system: flow-through system or recirculatory),
- careful feeding of larvae and fry with optimal larvae and fry feed in regular intervals. ALLER INFA EX 0.1 - 0.4mm and ALLER FUTURA 0.5 - 1.3mm are recommended at this age. Please see Aller Aqua feeding guide for optimal use recommendations.

5 tips for Daily routines

✓ Observation ✓ Measuring ✓ Feeding ✓ Recordkeeping ✓ Weekly tasks

GROW-OUT

Ponds should be adequately cleaned and prepared before stocking.
Before stocking for grow-out, the fry should be checked for quality.

Fry should be:

- uniform in size to avoid cannibalism,
- without physical damage, like lost fins, tails and barbels, injured skin and without diseases and deformities,
- actively swimming without signs of stress.

After quality checking, gently transfer the fry into the pond/tank by allowing them to swim into their new environment. Never pour them from any height into the water.

Stocking density depends on the production system. Ponds should be stocked depending on the rearing system implemented. Higher stocking densities are possible when a regular exchange of fresh water is guaranteed. In concrete, plastic, and fibre tanks, 30-50% of the pond water should be renewed daily, unless the system is a flow-through or RAS pond system where the pond water should be renewed either once per week or once per month, respectively. With a water pump and biological filtration unit, 80-200 fingerlings per m^3 can be stocked, leading to a production intensity of more than 1,000kg/m^3.

A guiding schedule for stocking depending on the production system is detailed below:

Rearing system	Earthen ponds	Concrete ponds	Plastic ponds	Fibre tanks
Extensive rearing	~ 1 kg/m^3	1–2 kg/m^3	2–3 kg/m^3	2–3 kg/m^3
Semi-intensive rearing	1–2 kg/m^3	4–6 kg/m^3	6–8 kg/m^3	6–10 kg/m^3
Intensive rearing	2–4 kg/m^3	8–15 kg/m^3	10–15 kg/m^3	15–20 kg/m^3

Daily farm routine in a Grow-out Catfish Farm:

- **Observation**

Careful observation of the ponds and surrounding areas to observe fish swimming behaviour, mortality, and potential invasion of predators (particular in earthen ponds). Mortalities should be retrieved and recorded.

- **Measuring**

Water quality parameters such as ammonia and dissolved oxygen should be checked to ensure that numbers are at the adequate and required level. This can be achieved by ensuring daily continuous water exchange from the pond inlet and outlets. For earthen ponds, water aerators, fountains, pedal wheels, etc can be installed to achieve this.

- **Feeding**

The next step is to feed the fish with rich and nourishing feed such as ALLER CLARIA FLOAT. Feeding patterns and frequency depend largely on the management practice adopted by the farm. Aller Aqua has feeding guides available to guide farmers appropriately to achieve optimum performance and to prevent overfeeding and feed waste.

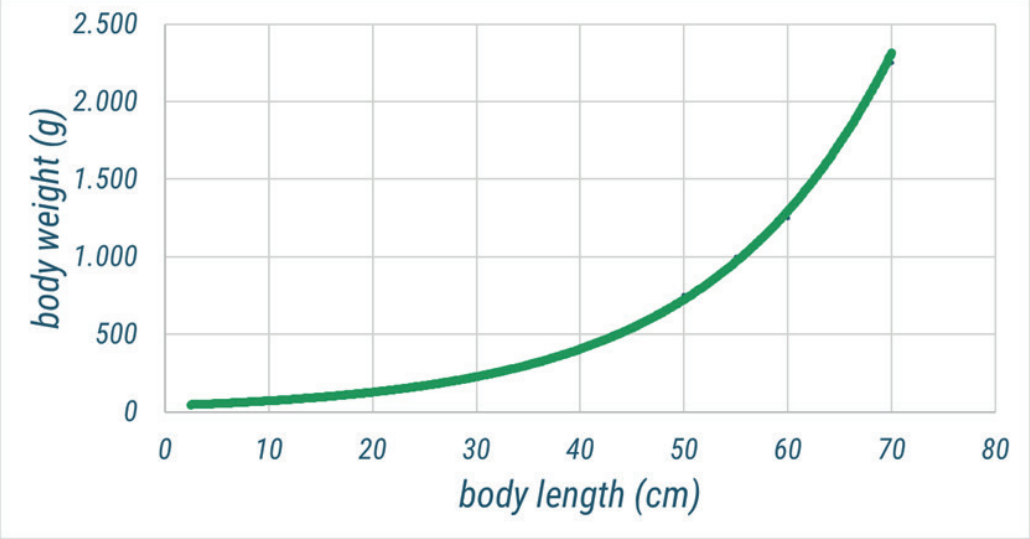
- **Recordkeeping**

Next up is adequately recording of data in the daily record books. Data such as mortality, water pH, water temperature, the quantity of feed fed, etc should be recorded daily (see appendix 1). This will help you track your performance and calculate your earnings.

- **Weekly tasks**

Other required routines such as checking average body weight, fish grading (sorting), etc. should be done weekly, bi-weekly, and monthly by using adjustable graders with bars. Aller Aqua has provided a farm management tool that indicates appropriate times for this tasks.

EXPECTED BODYWEIGHT VS. LENGTH IN AFRICAN CATFISH



Daily farm routine in a Grow-out Catfish Farm:

Observation | Measureing | Feeding | Recordkeeping | Weekly tasks

HANDLING AND HARVEST

Fish are harvested by either draining the pond completely or by netting the fish.

It is important to minimise stressing the fish, as stress negatively influences the quality of the product:

- to reduce stress, stop feeding the fish a minimum of 10-12 hours before harvest,
- harvest early in the morning (from 6 am) and finish it as early as possible before the sun reaches its peak,
- pond water should be on continuous flow-through for the entire harvesting period or at most allow for 10% of pond water to remain for the entire harvesting period,
- scooping of fish from ponds should be done using adequate drag-nets. Avoid concentrating too many fish in one area of the pond during harvest to minimise stress.

If completely drained, the ponds need to be cleared of remaining fish, cleaned, and prepared for the next production cycle.

POST-HARVEST AND VALUE ADDITION

After harvesting, the fish can be transported to local markets and sold alive, fresh, smoked, or salted and dried or a combination of these procedures.

Harvested fish can be graded manually or using a scale, and depending on size, freshness, and physical damage.

Fish Meat & Taste
African catfish has a lean and firm meat structure, only a few bones, and a mild taste. Like other fish African catfish is a nutritious source of valuable protein and omega-3 fatty acids and can be prepared using a variety of cooking methods.

CATFISH FILLET

WISHH & Mosneri Foods

CATFISH PEPPERSOUP

Online image

Slaughter
Slaughter of the fish starts with removal of slime. Slime can be removed using hot water, alum, lime or table salt. Gutting is done to reduce spoilage (guts are full of bacteria and enzymes). To gut a fish, a ventral cut is made from the gill area to the head. Pull out the gut with fingers and thoroughly wash out the cavity. Avoid cutting too deep, this may damage internal organs. Especially when the intestine is severed, this will release a number of bacteria and will increase the chance of spoilage if not rinsed thoroughly.

SMOKING

Fish smoking is a processing and preservation method that requires hot air, usually from a flame, to slow cook and rapidly remove water (drying) from fish. This method of fish processing which is very popular for catfish processing can be achieved using a smoking kiln.

Smaller fish sizes (250 g – 450 g) are folded by holding in place the fish tail in the mouth in a circular pattern (horseshoe shape) before setting, or on special request, can be cut into small sizes before smoking.
Splitting the bigger sized fish makes salting easier and increases the cut surface area that is exposed making drying easier during smoking.

During the smoking process, the fish can be infused with preferred flavouring to enhance the taste of the flesh and other substances from the smoke (or substrates) to preserve the fish and flesh texture.
Smoking can be done using a variety of heat sources. They may include wood, charcoal, briquettes, sawdust, rice bran, melon skin etc.

The kiln
The smoking kiln has technical features that ensure adequate drying for longer shelf-life.
It imparts good smoke flavor without undesirable tar deposit on the products. This tastes better than those from traditional kilns.

There are many types of kilns, but they all have two compartments:

1. The smoke generator
2. The smoking chamber

Procedure
The kiln should be stuffed with appropriate heat source, e.g charcoal, gas, briquettes etc, to generate enough heat (100 ˚C) and must be pre-heated for 20 minutes before setting the trays of catfish. Trays should be arranged from the kiln bottom to the top.

Salting, Preservatives and Spicing
Smoking catfish as a method of preservation allows for a longer shelf life for fish products. However, it also provides good opportunity to impact the taste, flavour and health benefits provided by the fish product.

Salting is a key step in the process of catfish smoking that impacts the quality, taste and shelf-life of the fish product. It involves the application of salt to already prepared fish. It increases the rate of dehydration by drawing out water through osmosis from the fish, creating an inhospitable environment for bacterial growth, and favourably impacts taste and flavour of the fish.

Salting can be done by applying salt directly on the body of the fish before they are placed in the hot kiln, or by brining, where fish is soaked in a salt solution 15-20 minutes.

The choice of a salting method impacts fish texture, flavour and distribution of taste in the smoked fish. While salt improves the shelf life of fish products, other materials and spices also serve as healthy preservatives while improving taste and aroma. For example, common spices that provide antioxidants, antimicrobial properties, and other preservative qualities may include garlic, rosemary, thyme, peppers, and bay leaves. In addition, the application of sodium citrate and black pepper before smoking also extends the shelf life of the smoked product considerably. Salting and the addition of healthy preservatives and spices of choice can be used to create distinctly flavoured products differentiated for consumer preferences.

CLEANING

WISHH & Mosneri Foods, Nigeria

PREPARED FOR SMOKING

WISHH & Mosneri Foods

SMOKING

Online photo

6 ECONOMICS AND MARKETING

Usually, the goal of a business concern is to be optimally profitable. With a catfish business, it is no different and the peak of a successful production cycle will be profitably selling your fish and fish products.

Before commencing production however, it is pertinent to determine ahead through primary and secondary market research what kinds of fish products one can sell most profitably in a chosen market. Understanding this will help the farmer manage production economics and decision making from an 'end-point' perspective.

ECONOMIC FARMING RESULTS

Catfish farming is considered a very viable venture, with substantial returns for the farmer. To succeed however, it is essential to optimise planning, resource management, technical knowledge of farming activities, and marketing. Feed costs will be a major expense in a normal catfish farming cycle. Farmers are best advised to look for ways to optimise feeding practices, and use high-quality fish feeds for better and optimal fish growth.

Using high quality feeds is essential for achieving optimum growth in fish, but an economically oriented approach will utilize the feed in such ways that guarantee an efficient and balanced achievement of all production objectives. These may include;

- overall cost of raising 1 unit (kg) of fish,
- time expended (or saved) to achieve expected results,
- feed conversion (FCR) for production.

These factors are generally referred to as the "Economic Conversion Rate" (ECR).

A profit oriented farmer will consider the overall economics of raising a unit of fish and not the cost of each bag of packaged fish feeds. For example, farmers using ALLER CLARIA FLOAT can follow the recommended feeding guide provided, to ensure the proper quantities of feeds required per day are consumed by the fish (without wastage). The feed quantity can then be converted into its equivalent currency value and divided by the total fish population to obtain the cost of kg fish produced. (See Aller Aqua Farmers Production Record card).

This approach is a more pragmatic and simplified one that helps describe the growth and profitability trend of their business.

A simple way to describe the Economic Conversion advantage of a high quality feed as ALLER CLARIA FLOAT is a brand example of – Mr. Blue & Mr. Green.

Consider that Mr. Blue and Mr. Green are neighbours who own 300m^3 ponds. They have both stocked 4 fish per sq meter totalling 1,200 fish per pond. Mr. Green using a high quality feed as Aller Aqua will follow the recommended feeding guide and have access to technical support tools and trainings. As a case point, the price of feed per kg will be higher than a cheaper medium/low performing feed, which for context, Mr. Blue uses.

Optimal feed efficiency is achieved through meticulous research and development processes, that aim to continually optimize feed production.

Efficient feed conversion and bio-availability of nutrients in high quality feeds enables the fish to grow faster, healthier and with minimal waste to the environment. This is a concept referred to as Feed Conversion Ratio (FCR), estimated as the quantity of feed eaten by a fish to produce 1 kg of meat.

In a good quality feed, the pellets are less dusty, hold better together and only dissolve when the fish has eaten them up, while poor quality feeds are less stable when they are poured in the pond. Some of Mr. Blue's feeds is never eaten by the fish, while the nutrients taken up are neither complete nor balanced. As this occurs continuously, Mr. Blue is required to give more feed, and for a longer period of time.

While Mr. Green feeds his fish following Aller Aqua feeding guide following the growth measurement tool provided. He will expect to grow his fish to 1kg in 120 days (4 months), and can continue production for 3 cycles in the year.
Mr. Blue spends more time and resources feeding his fish and loses the opportunity to grow more fish in the year.

MARKETING OF YOUR PRODUCTS

Marketing the fish products can be a major determinant in the profitability and success of a farming enterprise. In Nigeria, for example, the marketing of catfish is done in a largely unstructured manner. The products are sold mainly from the farm gate to wholesalers who then take them to open local markets, although there is now a rising trend of selling to food businesses such as hotels, restaurants, local bars, and party caterers. Most commonly, catfish are harvested and sold fresh or smoked, although there are many other approaches to sell them.

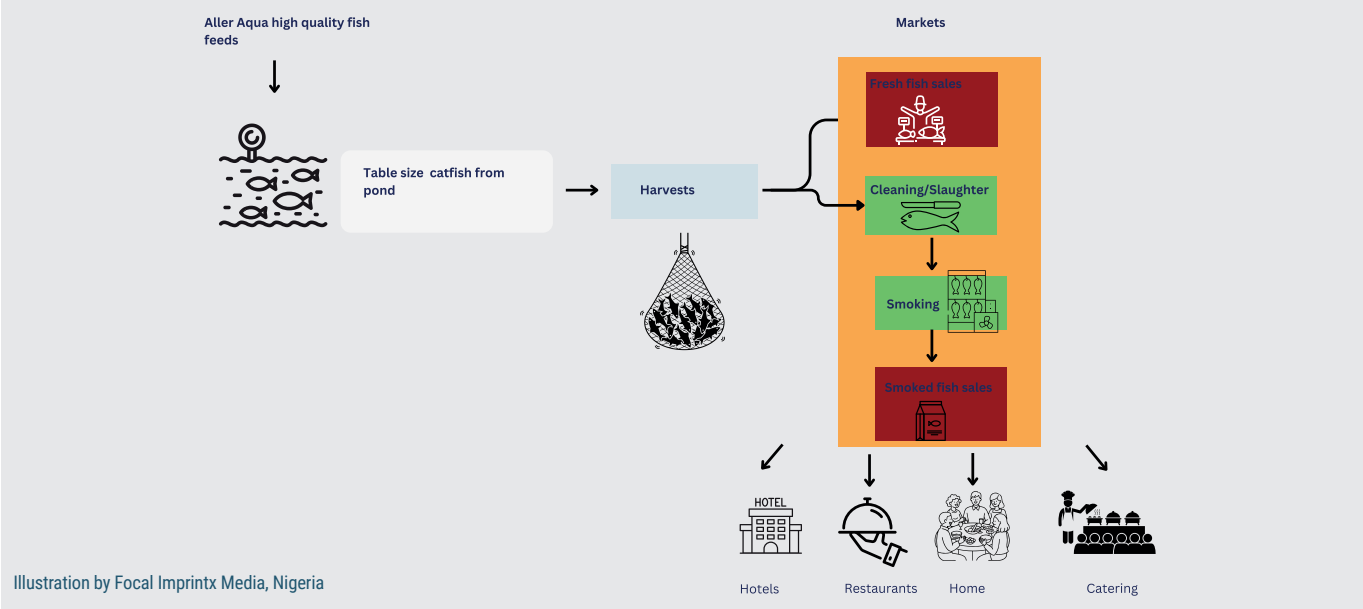


Illustration by Focal Imprintx Media, Nigeria

In marketing catfish, it is important to give attention to many of the principles for marketing products. Lets consider to follow the "**5 Ps**" approach to Marketing, as proposed by Jerome McCarthy:

Products
There are several ways to market your fish and fish products and this decision starts from your harvest planning.
- Do you want ot sell all your stock (all sizes) to a bulk buyer or in small batches?
- Do you want to grade your fish and sell at different prices for each grade?
- Will your fish be sold fresh or other value addition activities will be adopted before a final product is sold?

The answers generated will determine your production plan and the best channels or method for marketing.

Usually, a farmer's market research should inform regarding the following;

1. Target Market location & timing: Will the farm focus on large markets far away or closer smaller markets? How will the farm provide products to optimally manage the seasonality of fish products availability.
2. What are the size requirements of the chosen markets – 250g – 450g, 500g – 700g, 1kg or higher.
3. In what form will the fish be presented – the most common presentations are live whole fresh, dead whole fresh and smoked catfish (whole or steaks). There are however more presentation options possible, especially as value-added fish products (VAPs).

Place
Fish can be sold to fish mongers (middlemen) or wholesalers from the farm gate. They may however also be sold directly in local markets, or to evening bars, restaurants and specialty fish shops. In recent years, the use of social media to sell fish and value added fish products is gaining momentum and investing parts of the farm's efforts in marketing through these channels can prove to be highly profitable.

Promotions
Considering that fish is sold largely as an undifferentiated commodity, it is advisable for farmers to cultivate other value points that enable the sales of their fish. This may be done either as tangible additions to their fish, such as cleaning, spicing and drying/smoking, or efforts as invested in creating unique relationships or payment arrangements with their buyers. Other opportunities for product promotion may include providing a delivery service, online social media advertisements, or engagement in local activities where a target audience may be present.

Prices
Prices for farmed fish remains a key determinant for profit in the fish farming business, especially among small holder farmers who sell in unstructured and informal markets.

Ideally prices should be determined considering lots of production and business risk factors, it is more realistically decided by the buying power of the consumers and the marketing approach employed by the farmer.
Prices can be better negotiated if farmers join part of a regulated supply group, provide unique services to their customers, process and promote their products, or implement a combination of all or some of the above.

People
It is important to properly segment the people who influence your fish marketing and how they do so. The team on the farm may require a certain level of training to manage customers better, and customers may need to be segmented through their buying motivation and feedback. Understanding how to manage the people factor will help improve for fish sales, distribution and income potential.

"5 Ps" approach to Marketing

- Products
- Place
- Promotion
- Prices
- People

ALLER AQUA MANAGEMENT TOOLS

Good record keeping is the foundation of any successful aquaculture business. It gathers facts about farming procedures at any time and enables farmers to evaluate their farming business and project into the future, for example, fish growth, harvest times, and economic success.

As with catfish marketing, it is essential to have drawn a production budget for your farm, ahead of the production cycle. The budget sets expectation of costs for various factors of production such as juvenile costs, costs of various feed rations, farm overheads (various and fixed costs allocated to the production period), insurance, marketing costs etc. A feeding guide and routine management budget is also essential to set expectations for the production activities. When all of the above are in place, record-keeping becomes a tracking tool to measure how the farm's actual activities' line-up with the expectations of the farmer. With continuous learning, knowledge sharing and experience, the farmer then adjusts his activities as needed to ensure minimal deviation from set plans. Keeping records over a period of time can also enable the farmer to evaluate business for the prospect of further investment and third-party financing options.

CATFISH PRODUCTION RECORD CARD

by Aller Aqua

Keeping records of your farm activities helps to show the overall performance of your fish farm business.
It will help you see if you are making a profit or loss and help you keep track of the feed consumption and availability on your farm.
Furthermore, keeping records will help in getting credit support, loans, etc.

TILAPIA PRODUCTION RECORD CARD

by Aller Aqua

This tool will help you see if you are making a profit or loss and help you keep track of the feed consumption and availability on your farm. The farm records will also help you where improvements should be made. Furthermore, keeping records will help in getting credit support, loans, etc. It is important that your staff must be trained to keep clear and accurate records.

FEED CHART - MEASURING TOOL

by Aller Aqua

This measuring tool will help you determine which type of Aller Aqua Tilapia feed that is best suited for your fish size. It is of utmost importance to feed your fish according to their size to ensure that your tilapia receive the optimum type of feed for their best performance, whilst avoiding waste.

FEED DEMAND AND FEED REVENUE CALCULATION TOOLS

by Aller Aqua

Our team can propose a customised feeding regime through our feed demand calculation tool to guide you as a farmer on how to plan the feed usage and the expected results. Our team can also show projections based on the farm's data to show estimates of the profitability in a production cycle.
Reach out to us for more information.

CONCLUSION

Catfish farming, when approached with diligence and a keen eye for detail, can be a rewarding endeavor. It is also more than just a business; it's an opportunity to contribute to sustainable food production, especially in Africa.

We hope this handbook serves as a valuable companion on your path to becoming a successful catfish farmer. By adhering to the principles outlined in this handbook, seeking knowledge, and learning practical skills from your experiences and those of others, you can build a thriving catfish farm that yields you both profit and satisfaction.

LET'S GROW TOGETHER!

APPENDIX

List of Aller Aqua Farm Management Tools:

i. Catfish Feeding guide
ii. Feed demand calculations tool
iii. Farmers production record card

Across Africa, our technical and field sales officers are accessible to help, inform and provide services to support and improve farming practices for growth and sustainability.

Contacts can be found on Aller Aqua website:

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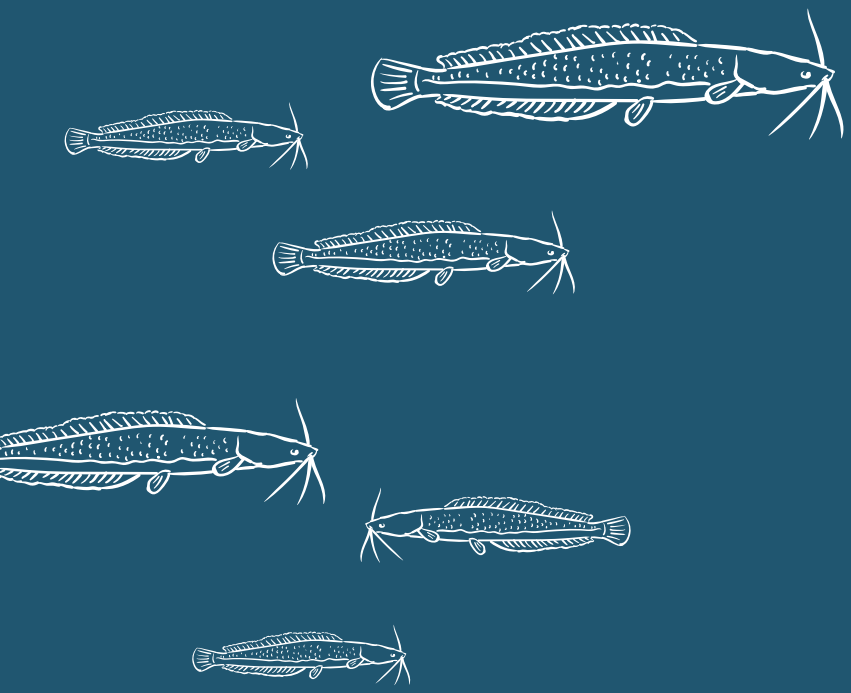
LET'S GROW
TOGETHER



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