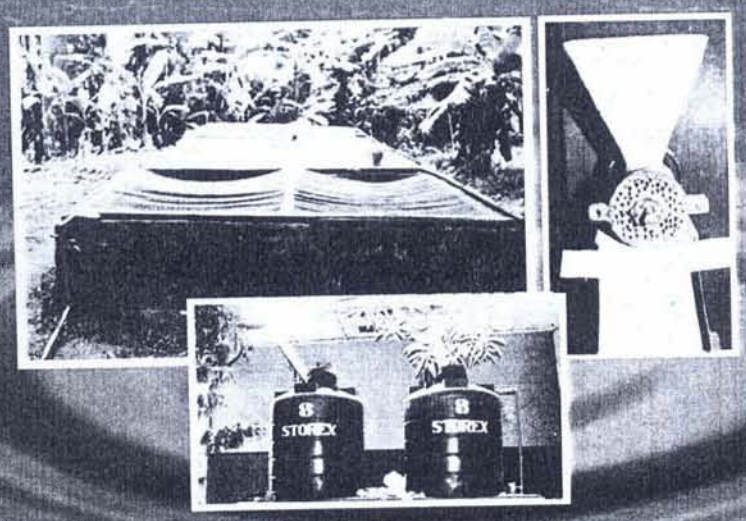
Homestead Pond Management



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HOMESTEAD POND MANAGEMENT

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Content

Acknowledgements

I acknowledge God's faithfulness which was expressed inadvertently by the Publisher of this book, Mr. Taye Akomolafe of John Archers (Publishers) Limited ten years ago (2000), when this book was first published. Prophetically he said then that another edition might be necessary in due course. It is now ten years hence and almost all the initial copies are sold out.

I am encouraged to do a another edition by the edifying comments of my colleagues mentioned and unmentioned in the previous editions, many who are newly introduced to aquaculture through reading of the previous editions and who have

ventured into homestead fish production as a life-investment. These farmers cut across the young, the elderly, the uneducated, the educated including professors contemplating retirement or already retired.

I also acknowledge with thanks the touching suggestions on how to improve this edition. These came from Professors Falaye A.E., Faturoti E.O. and Ayodele I.A.; my colleagues, Drs. Omitoyin and Ajani, and all my students. I shall always be indebted to my husband and children. I am grateful to Professor A.E. Falaye for consenting to write the Foreword.

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Introduction

The second edition was produced only four years after the first because of the pressing need to make adjustments incidental to the first edition, and to update information that have become obsolete. This edition is necessary to update previous editions.

The adoption of this method of fish culture is spreading like wildfire during the harmattan, and making silent millionaires of otherwise poverty-striken retirees, women and job-seekers, making many employers of labour rather than employees; supplying highly digestible animal proteins to families, thereby improving their health. This was the vision when the first edition was written and it gladdens my heart that the purpose for which the book was written is being achieved.

I sincerely hope that more and more people will adopt this mode of fish culture and transform it to a higher level. This production technique could be commercialized at local government and community levels, possibly on the national, regional and international levels, too.

This is my desire and I hope that as you buy this book you will catch the spirit behind its production.

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Foreword

In the past few decades wild fish stocks have been recorded to be under heavy fishing intensity and dwindling catches realized. The world of fisheries appear to be in a precarious state; with many fish stocks over-exploited, while some are declining at alarming rates. Fish sustainability would, therefore, be the obvious choice, and aquaculture provides an effective means of rational fish production. Aquaculture offers great potentials in boosting fish supply, with minimal damage to the resources.

Homestead Pond Management provides practical guidelines which have been simplified, particularly suitable for beginners in backyard fish culture practice, and it is also valuable for experienced fish farmers. The author is a diligent and dedicated academic who herself is a practicing backyard fish farmer and is current

with efficient fish production techniques.

In simple and comprehensive language, the book describes types of homestead ponds from their construction through stocking of suitable fish species, fish feed preparation and feeding. Vital aspects of fish breeding and maintenance of fish health were well described as hints on general homestead fish pond management. The book, therefore, has my support and it is recommended for academic reading as well as those wishing to set up fish farms for the acquisition of practical tips in successful fish culture.

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1

Introduction

Fish farming is a relatively new study in Agriculture. It is about 50 years old in Nigeria. There are many views as to where it started in Nigeria. Some researchers claim that the first experimental fish farm started 50 years ago at Onikan, Lagos and the first industrial farm (20 acres) was constructed in Panyam, Plateau state by the Federal Government (Ayodele and Ajani, 1999).

What is Aquaculture?

Aquaculture is the farming of aquatic organisms in enclosed water bodies such as ponds, dams, pens, raceways, aquaria, etc.

What are Aquatic Organisms?

Aquatic organisms are farmed in water. They include fish, mollusk and shrimps. Farming implies intervention by man in the rearing process of any organisms to enhance production. Such processes include regular stocking, i.e., introduction of the young stages of the organism, e.g. in fish fingerlings. Feeding (the introduction of feed, whether life organisms like shrimps or tadpole, etc.) or artificial food, protection from predators such as insects, frogs, snakes or man. Farming can be of various dimensions:

(i) The farming of crops on land is referred to as agriculture.

(ii) The farming of fish in water is known as *aquaculture*.

Aquaculture can be done in fresh, brackish or salt water. If in salt water it is called mariculture. Therefore, aquaculture is a form of agriculture practiced in a water environment.

Aquaculture is practiced in fish culture enclosures constructed for raising fish. These enclosures could be natural, but they are usually artificial. One of such enclosures is the fish pond.

A pond, according to the *Chamber's Mini Dictionary,* is a small lake or pond of water. When fish is raised in this enclosure, it is called a fish pond. But when a fish pond is

located at the backyard of the farmer's home, and it is on a small scale, from a few metres (2-100m^2) to as few fractions of an hectare (01-1ha)^2 then it is a homestead pond.

Table 1: Homestead fish ponds in Oyo State - (2000)

LGA	No. of fish farm	Total size m^2	Annual production (kg)
Ibadan North	9	193	7340
Ibadan S/E	10	491	7220
Ibadan S/W	6	145	5190
Ibadan N/E	5	108	4850
Akinyele	3	650	2400
Ejioku	12	650	4830
Lagelu	2	115	2000
Ona Ara	2	40	1100
Afijio	1	60	500
Ogbomoso N	1	60	500
Ogbomoso S	1	24	100
Total	52	1951	46,030

Source: IFAD sponsored committee on farm adaptive trial of the cage culture project (2000)

Status of and Need for Homestead Ponds in Nigeria: the Oyo State Experience

The experience of most fish farmers in Nigeria with respect to harvesting the products of their labour is a sad one. Most of the time, itinerant poachers deprive the bona fide owners of fish ponds of their production. The reasons for this experience are as follows:

(i) fish farms are located in isolated areas and are far away from towns and villages;

(ii) most ponds do not have any form of security;

(iii) markets are located everywhere, hence security check is difficult.

In spite of these shortcomings, there is a conspicuous increase in the construction of fish farms. For instance, the number of fish farms in Oyo State rose from a few tens in the number of homestead ponds from 3 in 1994 to over 50 in the year 2000 (Tables 1 and 2). Between 2004 and 2009, the number of homestead ponds within the state has risen only slightly to 63 but with a leap in annual production. Hence, the objective of this documentation is to:

(i) Sensitize the public, especially the women-folk about the possibility of having homestead ponds.

(ii) The economic benefits of such a venture.

(iii) The possibility of improving the protein intake of the members of their families and the nation.

(iv) The potential of reducing Nigeria's dependence on foreign exchange, for the importation of frozen fish

(v) The creation of jobs and the provision of recreational facilities.

Table 2: Homestead fish ponds in Local Government Area based in Oyo State - (2009)

LGA	No. of fish farm	Total size m^2	Annual production (kg)
Ibadan North	9	193	4,040
Ibadan S/E	10	491	7,500
Ibadan S/W	6	145	20,000
Ibadan N/W *	1	NA	290
Akinyele	12	650	13,300
Ejioku / Egbeda	12	650	8,540
Lagelu	2	115	7,800
Ona Ara	2	40	1,500
Ido *	6	NA	32,650
Afijio	1	60	Not Added (NA)
Ogbomoso N	1	60	NA
Ogbomoso S	1	24	NA
Total	63	1951	95,620

Source: Field Survey by Eyitayo O. P. 2009
NA = Not Added
*** = Newly Created***

2

Types of Homestead Pond

Introduction

Homestead ponds are of 3 main types:

(i) Earthen

(ii) Concrete

(iii) Make-shift containers, e.g. fibre-glass, bathroom tubs; abandoned dugout or plank canoes, plastic containers, earthen pots, etc.

Construction of an Earthen Homestead Pond

An earthen fish pond has all the sides made up of earth, dug up or surrounded by earth.

What is Necessary to Build an Earthen Pond?

(i) Certificate of occupancy.

(ii) A suitable site, with a gentle slope and should be located in the surrounding of the house to make it an homestead pond.

(iii) Desirable vegetation. Avoid thick forest to reduce cost of pond construction. If the site is woody, stump and remove thick roots and stem.

(iv) Good soil. A good soil must be able to hold water in both the dry and rainy seasons. It must contain a minimum of 20 percent clay and a maximum of 60 percent clay.

(v) Water. Water is very important in fish culture. Water can be obtained from direct or indirect sources such as run-offs, steams, springs, lakes, rivers, reservoirs, irrigation canals, wells or boreholes, tap water and even the sea. Wells and boreholes are expensive because they require pumping. Where river or stream water supply is not reliable; conservation dams may be built to store water. Water must be available in the right quantity and quality all year round.

(vi) Interest and Devotion. Interest in seeing the fry/fingerling of fish grow

will keep the fish farmer going. There is a need for devotion. If you are a retiree, a housewife, an applicant or an employee and you are interested and devoted, you can make a success of homestead fish farming.

How to Test the Top Soil?

(1) Take a handful of wet top soil, mould it into a ball and throw the ball into the air. Allow it to land. If the ball does not break, the clay content is good for water retention.

(2) Roll a handful of wet soil between your palms to form a continuous thread, use the thread to make a ring. If the ring is

continuous and does not break, the soil contains enough clay.

(3) **Confirmatory test.** Dig a hole, knee- or half a metre deep. Fill with water. Cover the hole with banana leaves or a board. Leave till evening and check. Fill it again, measure the depth of the water with a stick or ruler. Leave the water hole covered for 24 hours. Measure the water height again. If the water left is 50 percent or more of the original level of water the soil will hold water and will be good for fish pond (Figure 1).

Types of Earthen Ponds

Embarkment ponds: These are constructed by building wall above the ground level to impound water. This type of pond is difficult to fill with water but easy to drain. Pumping is needed to fill the pond.

Excavated Ponds: These ponds are built by digging out the soil. The excavated pond is easy to fill with water but difficult to drain. Pumping is neither needed for filling nor for draining.

Partially excavated pond with low walls: Soil from excavation is used to build the low walls of this pond. The ideal site has a slight slope so that the water supply channel can be constructed slightly above the discharge

channel which is slightly below the level of the future pond. In this way, pumping is neither needed for filling nor for draining.

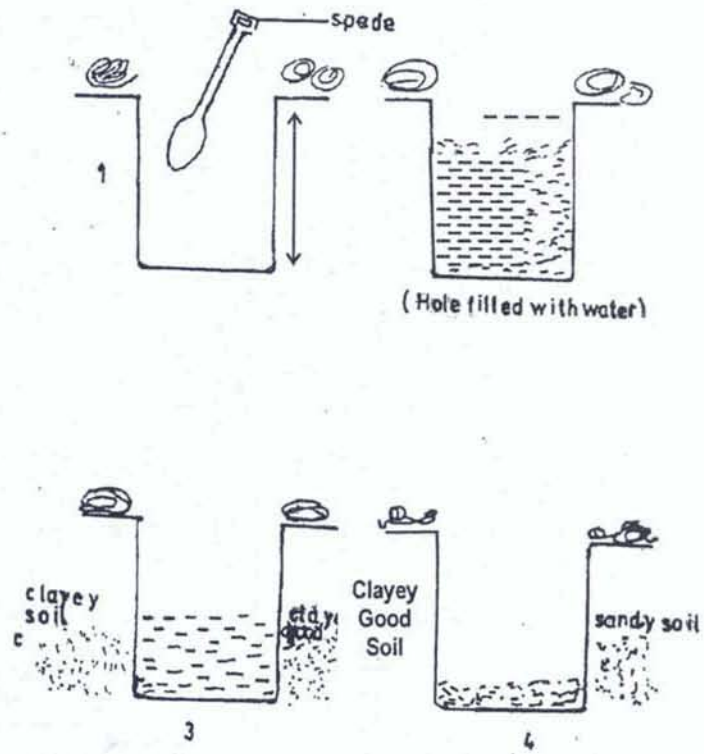


Fig. 1: Confirmatory Test for Testing Soil Types

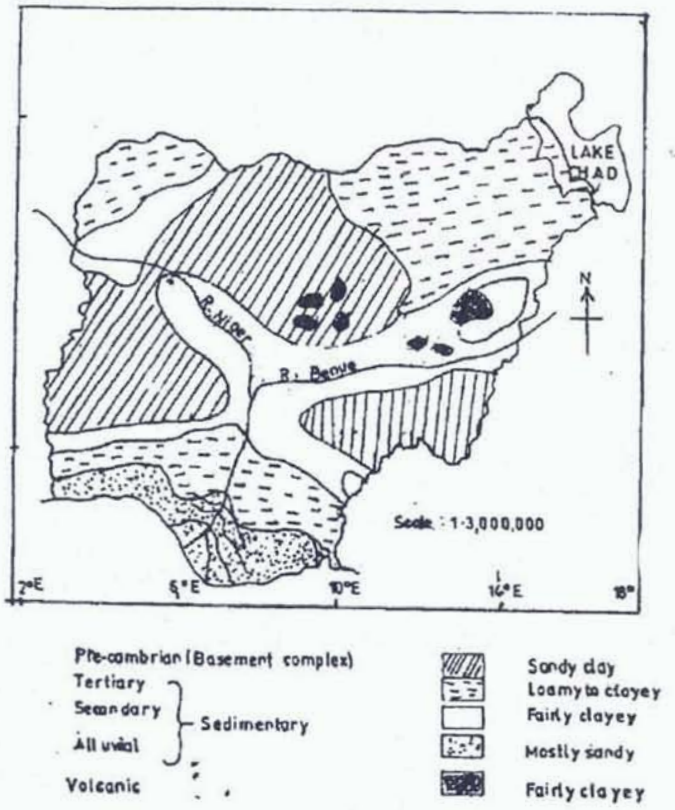


Fig. 2: Map of Nigeria Showing Zonation of Soil Types.

Concrete Homestead Fish Pond

A concrete homestead fish pond is a pond constructed with concrete or brick walls. For sandy soils of the upper northern parts of Nigeria from Sokoto across to Maiduguri (Zone C), for swampy soils of southern Nigeria including Lagos, Rivers and Balyesa States, use reinforced concrete (Zone A), for sites liable to floods near river beds and in valleys anywhere in the country, use concrete walls. From the Middle Belt up to southern Kaduna State across the country use hollow concrete block (Zone B) (see Figure 2).

Make-shift containers

These can be earthen or plastic pots, fibre glass (rectangle or circular) containers like old bathroom tubs that do not leak; abandoned not leaking dug-out canoes or plank canoes can be used as homestead fish culture systems. Taupalin and reinforced polystyrene are recent development.

They can be used at different stages of the life of the fish, e.g. in breeding, for raising eggs to fry/fingerling, as nursery ponds, production ponds, or to transport fry/fingerlings or breeders from one farm to another.

3

Construction of Homestead Pond

Structure of A Pond

A typical pond must have the following parts:

(i) Retaining walls (made of earth or concrete or blocks called a dyke. It's function is to retain water.

(ii) A water inlet which can be made of a concrete water channel with sluice gates a pipe or a tap to supply fresh water.

(iii) A water outlet which can be made of a PVC pipe, a valve, a monk to let out unwanted or excess water.

(iv) An overflow pipe to prevent unexpected flooding

(v) A water channel or gutter to take away excess water.

Table 3: Equipment and Material for *Pond Construction*

Equipment for large ponds	Equipment for small ponds	Materials for both small and large ponds
Bulldozers, excavators, pay-loaders, wheel-scrapper, roller	Shovels, wheel-barrow, head-pans, diggers, cutlass, matchets, ropes, stakes, spades, hammer, pegs	Sand, gravel or granite, iron-rods/bars ½" and ¼" planks, cement, expanded wire mesh, nails, planks, tape measure, rope, carpenters leveler, and water.

Procedure for constructing a simple homestead pond

Size 10_m x 20_m x $1.5(m^3)$

(i) Clear the selected site (if necessary)

(ii) Peg out the desired size of the pond. The size depends on available space and fund. In this case, peg out 10m width and 20m length. This represents the inner rectangle ABCD (Fig. 3)

(Iii) Peg out the outer rectangle. Measurement should be 3.25 + 10m + 3.25 = 16.50m for width and 3.25 + 20 + 3.25m for length = 26.50m.

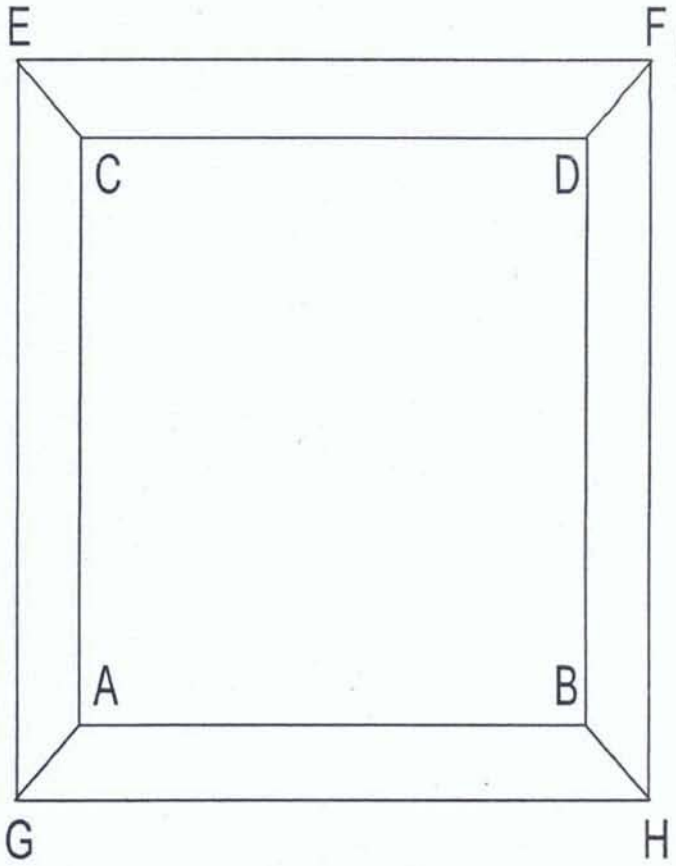


Fig. 3: Lay-out of a pond

(I) Dig up the inner rectangle (ABCD). Pile up the earth in the corridor between the inner and outer rectangles which will form the walls, called dykes. Continue to dig until the depth is 1.22 (4ft) if an earthen pond). Compact the dyke as you remove with feet of labourers or rollers.

(ii) Using a mixture of cement, sand, and gravel in the ratio of 1:2:4 with water, concrete the pond floor to a thickness of 7.5-10cm (3-4inches). Level the concrete floor to drain toward the outlet pipe (if a concrete pond)

(iii) Erect block walls along the four sides of the pond, using 2.5cm (6inches) or 18.75cm (9inch blocks) solid or hollow

blocks according to soil types, until a pond depth of 1.83cm (6ft) is reached. For Zone A(coastal areas), Zone C (sandy areas) of the North, use reinforced concrete walls, for the Middle Belt, use hollow blocks.

(iv) Plaster the wall to about 5cm (2``) thickness, using a rich cement/sand mixture in the ratio of 1 bag of cement to 6 tubs of sand.

(v) Reinforce the four corners of the pond wall with rich cement mixture to avoid leaks.

(vi) Install an overflow pipe (4-6") 7.5cm at 60cm below the top of the wall and an outlet pipe, 4-6" on the same side of the

wall. Install a valve or a stand pipe on an elbow joint on the outlet pipe. Screen the opening of the pipe with fine wire gauze or mosquito netting materials. The screen allows water to escape in the event of a heavy rainfall without allowing the fish inside the pond to escape.

(vii) If electricity is available, install a point of light on each pond to attract insects, which are good sources of high protein for the fish.

(viii) Fence off the pond to prevent children and domestic animals from drowning.

(ix) Effect a "Danger Zone" sign (painted red, to serve as warning)

Table 4: Cost of constructing a 3m x 2m x 1.5m concrete homestead pond (as at March 2000)

S/N	Item of Expenditure	Amount (₦)
1	Excavation: 4 man days at N600:00/man	2,400:00
2	Total number of blocks required 140 at N40 each	5,600:00
3	1 load of gravel at N5,000:00/load (Ikire type)	5,000:00
4	1 load of sand at N5,000:00/load	5,000:00
5	12 bags of cement at N1,000:00/bag	12,000:00
6	1 outlet pipe at N250:00/One	250:00
7	1 overflow pipe at N250:00/One	250:00
8	1 elbow	1,000:00
9	Piping of water into the tank	1,000:00
10	Workmanship	7,200:00
11	Exigencies	3,000:00
	Total	**41,950:00**

(N.B: You can use either the blocks hollow, or fill the blocks with a concrete mixture to reinforce the walls, or build the walls with sand concrete depending on the zone. The other alternative is not to buy blocks but mould the walls with reinforced concrete mixture, i.e. insert some iron rod networks in the concrete mixture as you erect the walls (Consult a professional bricklayer).

4

Stocking Suitable Fish Species

The purpose of having a homestead pond has been highlighted in Chapter One. One of the major reasons is to supplement the protein intake of the family. Therefore, if this is the objective, the fish to be grown in such homestead ponds must be:

(i) Acceptable to the family: Because of religious reasons some families do not eat fish without scales. For such families, species such as tilapia or carp is suitable.

(ii) In addition, the toughness, resistance to diseases and parasites, how quickly the fish

grows, how adaptable the fish is in accepting artificial feeds, how easy it is able to reproduce under domestication, are all points that have to be considered before choosing any fish to be cultured in an homestead pond.

Tilapia is an omnivorous fish, but it has a peculiar problem. It reproduces very early in life at a size under 50g and before 3 months of age. It has the peculiarity of flooding the system with young ones and not growing big. The biological solution is to grow it with other fishes that are carnivorous, e.g., a catfish like *Clarias gariepinus;* that can feed on the eggs and fry of tilapia, thus reducing the excessive

population of small tilapia in the system. The introduction serves a dual purpose. It reduces aquatic plant (phytoplankton) population in the system and improves the water quality (Person. Comm.).

If the other objective of the homestead pond is commercial,

(i) a fast growing fish species is preferred and

(ii) the chosen fish species must be easily acceptable to the consumers.

Examples of such are the catfishes, e.g. *Clarias gariepinus*, hybrid *Clarias (Heteroclarias)* and *Heterobranchus*. The latter has carnivorous tendencies and requires a high protein diet.

Other species to be considered if the

homestead pond is an earthen pond, is carp (a bottom feeder), *Heterotis,* if the pond is big and preferable it should be grown in a polyculture with other fish species like tilapia and carp.

Where to Get Fingerlings?

Fingerlings of most of the above-named fish species can be obtained from

(I) the State Ministry of Agriculture (Fisheries Department)

(ii) Federal Ministry of Agriculture

(iii) Agricultural Development Programme (ADP) centres;

(iv) Reputable private fish farms, and

(v) Individuals who are professionals. If in doubt, seek advice from professionals, not quacks who go about as consultant.

5

Hints on Homestead Pond Management

The interest of a pond owner shows vividly in how well he takes care of his ponds. The security of a pond, pollution by chemicals, destruction or stealing is taken care of by locating it near the home. The production of the homestead pond depends on the following factors:

(i) water quality management
(ii) fish stock management, and
(iii) pond-wall, floor, installations management.

Water Quality Management (Temperature)

Temperature is a very important factor that affects the quality of the water. It affects the dissolved oxygen (DO) in the water. The amount of oxygen present in the water also affects how well the fish feed and whether they stay alive or are dead.

Most of the fish mentioned in Chapter Four are referred to as warm-water fish, i.e. they require water with a temperature range of 25- 30°C to feed, grow and reproduce well. There are others which are refered to as cold-water fish, i.e. they grow well in temperatures of 15-22°C. Below or over these ranges they do not feed well and they become stunted in growth and may also stop feeding. At this point, it is easier for them to be infected with

diseases or/and parasites which eventually may lead to death.

What to do?

(1) When temperatures are too low, reduce amount of feed given, or stop feeding. Uneaten food leads to pollution of water.

(ii) When temperatures are too high:

(a) reduce or stop feeding

(b) increase fresh-water inflow

(c) cover exposed parts with banana leaves, palm fronds or mats.

(d) feed very early (7-8a.m.) in the morning or very late in the evening (6-7p.m.)

Dissolved Oxygen (DO)

DO is the amount of oxygen that is dissolved or available in the water. It is very important

that the DO be adequate for the fish. A dissolved oxygen of 5-8mg/litre is good for most tropical fishes. DO below this amount stresses the fishes.

Test for Adequate DO

When you arrive at your pond in the morning and you suspect low DO, spit into the pond. If DO is adequate, the spit foam disappears rapidly. If it is not adequate do the following:

(i) sit on the edge of the pond and stir the water with your legs or stir with a stick or palm frond

(ii) add fresh water to the pond;

(iii) if you have aerators, bubble oxygen from an oxygen cylinder into the ponds.

When you notice fish coming to the surface of the water with open mouth the DO may be low, or if you see a lot of gas bubbles or foam on the water surface then it is time to act. When you smell rotten egg (hydrogen sulphide) then it is time to flush out the stale water and replace it with fresh water. You can also measure the amount of DO with an instrument called "oxygen meter."

Hydrogen Ion Concentration (pH)

This parameter measures the amount of acidity or alkalinity or the H+ ions in water. The importance of this in your homestead pond is that most fish species, including the tropical fishes mentioned above, have been

found to do well at pH of 6.5-8.5 with little varying fluctuations. Adding lime to an earthen pond is recommended to maintain the alkalinity in order to prevent the acidity from dropping to dangerous levels, which might have been caused by excessive rainfall or excessive photosynthesis (Balarin, 1979). If alkanility is too high, add a little fertilizer to reduce it and if it is too low, add manure. If the water in your pond is leaf green, the probability is that the pH is optimum for your fish.

Turbidity

This term addresses how transparent or cloudy your pond is. Your pond water should not be too transparent or too cloudy. If it is cloudy by being green it is good, but it is not good for fish if it is brownish with suspended particles like mud. Mud does not allow light to penetrate into the pond very well.

A turbidity range of 30-60cm is good (Ayodele, *et al.*, 1999). Use what is called a secci disk or a white-coloured tin to measure turbidity. Lower the secci disk tied to a string till it disappears and reappears as you lift it up again, that is the range of the turbidity in your pond.

Nitrite

High concentration of nitrite in ponds usually occurs when water is relatively cold during the harmattan season or at the height of the dry season. It results when uneaten food accumulates in the pond and it is not broken down in the nitrification process, i.e., to the form the fish can utilize. Colour or catfish exposed to lethal nitrite concentrations has a

characteristic dark chocolate-brown which persists for several hours after death (hence, brown-blood disease).

The brown colour results from the presence of haemoglobin, formed when the iron in the blood (haemoglobin cannot bind oxygen as its concentration increases, hence less oxygen is transported in the blood) (Southern Coop. Series Bulletin 29 Dec. 1983).

FISH-STOCK MANAGEMENT

The quality of the fish you introduce into your pond influences the growth performance of the stock. Therefore, use healthy fish purchasd from reputable fish-farms or hatcheries. If in doubt, see professionals in the Fisheries Department of the Federal or State Agricultural Development Projects (ADPs) and the Fisheries Departments of the Universities.

The recommended stocking density, i.e., number of fish per unit area (m^2) or per unit volume (m^3), is determined by the type of culture practice you choose and the type of fish grown. There are 2 types of culture practices:

(i) Monoculture, i.e., the culture of a single type of fish, e.g. Catfish.

(ii) Polyculture is the culture of two or more type of fish, e.g. catfish + tilapia + carp.

This culture practice may be carried out in 4 major types of systems:

(a) Ultra-intensively i.e very high concentration of fish per unit area. Usually, rearing is in water recirculatory system using different filtration units and feeding of nutrient dense feed.

(b) Intensively, i.e., high concentration of fish per unit area with artificial feeding.

(c) Semi-intensively moderate concentration of fish per unit area with little feeding.

(d) Extensively: i.e no feedings and low concentration of fish per unit area, or fish left to feed on natural food organisms in the water.

General Formula for Stocking

This formula assumes that fish does not reproduce during growing period or early, like tilapia.

Stocking rate = Growth target or total productivity (in kilos) + Loss (number)
Individual growth target (in kilos) e.g., if you intend to grow 1000kg of fish, each fish weighing 1.0kg, with loss in numbers = 50% for *Clarias gariepinus.*

the stocking rate $= \frac{1000}{1} + 500$

= 1500 fingerlings.

Pond Wall, Floor, Installation Management

You need to check that the dyke or concrete wall is not leaking. Whenever there is a drastic reduction in the level of water in the tank, you need to check for cracks and mend accordingly. The inlet and outlet structures should be checked for blockages, and causes of blockage removed for free flow of water.

6

Preparation of Feeds, Feeding Methods and Importance of Feeding

Cultural Beliefs

It is a general belief that fish are created by God to live in water and are fed naturally in their environment. The implication of this statement is that fish need not be fed. However, research has proved that fish that are fed grow better, and that the growth performance of a stock of fish is dictated by the diet fed, and more importantly, the quality of the ingredients making up the feed.

Many fish farmers have imbibed the practice of 'feeding' their fish stock with cow dung, poultry or pig-dung. The purpose of

these agricultural waste is to improve the concentration of natural life organisms in the pond water. They provide very little nutrients for the fish. When fish are fed animal dung, growth is very slow and could be as low as ratio 1 : 5 when compared to fish fed compounded diet with ration 1:1.5 or 1:2 (Pers. Comm.).

Researchers have found out that the possibility of introducing fish diseases and parasites such as worms is very high in farms using waste products of agricultural processes.

Importance of Feeding

The purpose of having a homestead point is to grow fish fast and economically, i.e., as cheaply as possible. To achieve this, it is

essential that you feed your fish with compounded diet to get optimum production for your investment within a short time. The compounded diet must provide the following:

Protein: The essence of this component in the feedstuffs makes the fish to grow well. If the fish is injured, protein ensures repairs of wound. Examples of feed ingredients providing protein are poultry feathers, fish meal, and shrimps. These are examples of animal proteins. Examples of plant proteins include soyabean, cotton seed, groundnut, sesame seed cakes, e.t.c.

Energy: energy can be supplied from corn, rice meals, wheat and other sources like fats and oil. These feedstuffs provide energy for

the fish to move around, i.e. swim and do other activities.

Roughages: these feedstuffs help the fish with digestion by forming bulky materials that move waste out of the digestive system of the fish. Examples include, corn and wheat bran.

Vitamins: Vitamins help the fish to remain healthy. Examples include vitamins A, B, C, D, E and K, etc.

Minerals: help to build up the bones, teeth and scales of the fish. Examples include, bone meal, oyster, shells, calcium, phosphate.

PREPARATION OF FEEDS

All the components listed above must be put together in such a way as to provide what is

termed 'a balanced diet'. A balanced diet must have a predetermined percentage of protein (which is the most important component) at which the fish grows and production is best. The percentage of crude protein requirement has been determined for certain fishes but very few for tropical fishes.

Tilapia requires at least 25%CP (Balarin, 1979). *Clarias* fry do well on 38-50% (Viveen, et al., 1983); 40% for fingerlings/juvenile (Faturoti,1986); fingerlings to adult stages grow best at 32.5 to 37% (Arowosoge, 1988). The culture system may modify the protein content. When concrete tank is used, culture system may modify these requirements. When concrete

tank is used, there is no additional nutrient from the natural environment, the protein requirement becomes slightly increased to between 45-48% (Olukunle and Taiwo 2004).

For a source of protein to provide good growth, such proteins must contain what are called essential amino acids (EAA) that cannot be synthesized by fish, but are nonetheless required by the fish. There are ten of such amino acids; arginine methionine, valine, histidine, tryptophan lysine, leucine, isoleucine, phenylalanine threonine (Nose, et. al., 1974). Fishmeal contains all the essential amino acids (EAA). Many plant proteins contain about eight or less. Altschul (1958)

Formulation of Feeds

Feed formulation takes into consideration the combination of available feedstuffs to meet the nutrient requirements of fish to be reared with respect to age (fry, fingerling, juvenile, adult), size (small, medium, or big), and eating habit (carnivorous). There is need to use available, good but cheap feed ingredients. This is the focus of most researchers in the universities on fish nutrition, Balarin (1979), Falaye (1988), Faturoti et. al. (1986), Arowosoge (1987). For feed formulation, you need to have a knowledge of available feedstuffs, cost and nutrient composition. This knowledge you can get from feedstuffs millers, especially those who market poultry

feeds like distributors for Pfizer, etc. Some of the feedstuffs are called basal feed (they contain less than 20% CP), protein concentrates (contain more than 20% crude protein). Others are called fixed ingredients.

One of the methods used for formulation of feeds is called the **Pearson Square Method.** Using this method, let us prepare a balanced diet for Heteroclarias, containing 30% crude protein (CP) from the following feedstuffs:-

Brewers waste	*6%*	*Basal feed*
Yellow maize	*9%*	
Fish meal	*72%*	*Protein concentrate*
Soyabean cake	*45%*	
Groundnut cake(GNC)	*44%*	*Protein concentrate*
Sesameseed-cake	*53%*	
Mineral pre-mix	*2.0%*	*Fixed*
Vitamin pre-mix	*2.0%*	*ingredients*
Salt	*0.5%*	
Fats	*10.0%*	

Step 1: Assume that the components when added together will be 100% or 100kg.
Step II: Take away the addition of the fixed ingredients

Let's say that

Mineral mix	=	*2.0%*
Vitamin mix	=	*2.0%*
Salt	=	*0.5%*
Fat/Vegetable	=	*5.0%*
		9.50%

that is, the fixed ingredients will contribute 9.5 from a total of 100% or 100kg leaving 90.5% to be accounted for.

Correct crude protein content back to 100%

$$\frac{100}{90.5} \times 30\% = 33.15\%$$

Step III: If the protein concentrate will come from two or more sources and will be incorporated in the ratio 1 : 1, find their average for example

$$\frac{\text{Fishmeal (Fm)} + \text{Soyabean cake (SBC) (45\%)}}{2} = \frac{117}{2}$$

$= 58.50\%$

Similarly, to do the same thing for the basal feed, let's say in the ratio of BW (1): YM(3)

Brewer's waste (BW) = 6%

Yellow maize (YM) = 9%

$$\frac{15}{2} = 7.5\%$$

Using the Pearson's Method

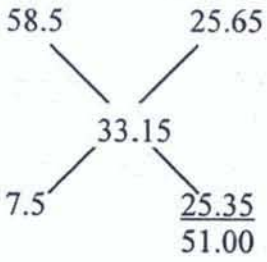
Protein concentrate

Fm 72%

SBC 45%

$$\frac{117\%}{2}$$

$$= 58.5\%$$



BW 6%
YM 9%

$$\frac{15}{2} = 7.5\%$$

Protein concentrate required to be added =

$$\frac{25.65}{51} \times 90.5 = 45.52$$

$$\text{Basal Feed} = \frac{25.35}{51} \times 90.5 = 44.98$$

BW = ¼ x 44.98 = 11.25
YM = ¾ x 44.98 = 33.74

To make 100kg or 100% of feed, the feed ingredients you need to mix together as follows:

Fish meal	22.76
Soyabean cake	22.76
Brewers waste	11.25
Yellow maize	33.74
Mineral mix	2.00
Vegetable oil	5.00
Vitamin mix	2.00
Salt	0.50
	100.01

This method can be used to calculate the energy and amino acids composition of a diet as well. The computer linear programming can do this calculation and costing for you, as it is done in large feed milling farms. The computer programming will help to substitute

local ingredients that are available and cheap when compounding diets.

Grinding and Milling

After formulating the different compositions of the diet, grind each ingredient separately in the hammer mill-grinder (the common grinder) till fine like flour. Sift, using a sieve to give less than 1mm (the common yam flour sieve). Add trace element if available (zinc, iron, manganese or calcium phosphate powder at the rate of 1-2% if available).

Reasons for grinding and milling

(i) To make handling easy

(ii) To improve digestibility

(iii) To improve the water stability of pellets

Mix all the dry ingredients, add fat before

adding warm water (90 - 95^{0}C) until it becomes like dough. Pellet in a meat mincer, or perforated tin/iron sheet, big sized sieve or any material that will give you sphagetti-like strands. Steam in a sieve over warm water (optional). Dry in open hot air or in an oven at 28 - 30^{0}C. Store in waterproof container. Store in freezer where possible to prevent fungi growth or rancidity.

Advantages of Pelleting

(i) It improves acceptability.
(ii) It increases bulk and nutrient in the pellet
(iii) It improves digestibility and water stability
(iv) It destroys some factors that can be toxic or harmful to the fish.
(v) It reduces waste

Application

Pellets are given to fish at the rate of 0.5-1.0% for brood stock, Omitoyin (Pers. Comm.), 3-10% for fry to fingerlings and 3-5% of body weight for fingerlings to adult, let us say the weight of each fish is 5g and you have stocked 1000 fishes.

Therefore, weight of your stock

= 5g x 1000

= 5000g

Weight of pellet to apply

= 5/100 x 5000

= 250g/day

This could be divided into 2 x125g to be given in the morning, and 125g in the evening. The farmer should throw a few pellets at a time at

specific points at the pond sides everyday and watch as the fish come up to feed on the pellets.

Advantages of using Pellets

(i) The farmer can watch his fish feed. You should do trial catches, weigh and calculate what to give every two or four weeks.

(ii) The farmer will know if his fish are diseased because the fish will not come up to feed.

(iii) The farmer can estimate how much feed he requires for a period of time to feed his fish.

(iv) The farmer can calculate how much his ventures will cost and how profitable it can be.

(v) He can compound the fish feed to suit the type of fish he plans to cultivate, e.g. carnivorous fish like *Clarias gariepinus* (37.5%)

require more protein than omnivorous fish like tilapia (25% CP).

(vi) He can vary the sources of ingredients if too expensive, e.g., he can replace fishmeal with groundnut cake or soyabean cake; or if corn is too expensive, he can try cassava, yam or millet flour.

(Note: No plant protein source has adequately replaced fishmeal protein. Researches have shown that there is a progressive reduction in weight as the quantity of plant protein inclusion increases in fish feed. A maximum of 10-15% plant protein is recommended and safe. Usually, plant protein requires processing e.g. Boiling, fermentation, heating or solvent extraction. For further details see relevant books).

7

Fish Breeding and Management

For homestead ponds stocking 1000 to 10,000 fingerlings research has shown that it is not economical to breed by any artificial method. Equally, it is not advisable, reliable nor adequate to depend on collecting fingerlings from the wild, i.e., from streams, rivers, lagoons or even the sea to stock ponds. In case a fish farmer having a homestead pond who wants to turn to fish fingerling or table-fish purposes for commercial production, the knowledge of fish breeding and its management will come in useful. There are

two basic types of reproduction natural and artificial.

Natural Reproduction

This involves the male and female fish coming together to produce eggs which will develop into young fish called larvae or fry without any intervention by man. The fry develops into fingerlings, then to juveniles and, subsequently, to adults. These processes develop in nature without man's intervention. The products of reproduction may or may not be taken care of. In most cases, the fry or fingerlings of fishes are eaten by predators, such as frogs, water snake and bigger fishes. Others are attacked by parasites such as 'ich' or lice.

Artificial Reproduction

This involves the intervention of man in the male and female fishes reproductive products (called the milt and eggs respectively) coming together to form fertilized eggs and, subsequently, forming fingerlings, juveniles and, ultimately, adult fish.

The intervention of man may involve:

(i) Induced natural reproduction.

(ii) Hypophysation of spawners.

(iii) Artificial fertilization method.

Induced Natural Reproduction

Adult healthy matured fish: 50g-100g for tilapia; 400-1000g for *Clarias gariepinus;* 3 to 16kg for carp (Huet, 1958) are chosen. At the beginning of the raining season when temperatures fall slightly to about 26°C-28°C,

mature fish called brooders, male and female, are introduced into the pond and stimulated to spawn by the introduction of spawning substrates like palm-leaves, pipes and rings. At a ratio of one female to one male for tilapia and carp, two males to one female for *Clarias gariepinus,* (Huet, 1958; Viveen, *et al.*, 1985). This may be practiced by lay-fish farmers and it is useful for getting a lot of fingerlings for tilapia.

Hypophysation of Spawners

The female brooders are matured when observed to have distended stomach and emit eggs when stomach is slightly pressed, while the male brooders have reddish coloration at their genital papillae and emit milt when expressed.

The process of hypophysation involves an intro-muscular injection towards the top of the body near the first ray of the dorsal fin, halfway between dorsal fin and the lateral line. It should be injected between 2cm to 3cm deep (¾ to 1 in).

The injection fluid contains prepared pituitary extract (dry or wet), which will help complete the maturity of the spawning fish, the emergency of the eggs and milt which will permit natural or artificial fertilization of eggs.

Both female and male brooders are injected with the right dosage of pituitary extract per weight of fish. The pond environment must be laid with appropriate leaves, etc, for spawning.

After injection, the fish are left in calm waters at a temperature of 17-20^{0}C for carp and 25-28^{0}C for *C. gariepinus*. Maturity will be reached within 18 hours and eggs hatched after 24-30 hours. It is advisable to remove the brooders.

Artificial Fertilization of Eggs

This is technical, but the basic principle is that the farmer can gather the eggs from an induced female fish and milt from the male fish in a spawning receptacle (a small bowl), mix them and watch how the fry come out from ripe eggs within a few days. Eggs from the female are obtained by gently pressing the stomach of a gravid (mature) female fish; and for a male carp, the milt into a bowl but for *C.*

gariepinus, the male fish has to be sacrificed because the milt cannot be released by mere pressing of the abdomen.

Wet Method

Sexual products are mixed with a small quantity of water.

Dry method

The sexual products are mixed without water in a small bowl before water is added.

Super-dry Method

The stripped eggs are sieved to remove the egg fluid before milt is added (Ayodele and Ajani, 1999). After fertilization, the eggs are incubated and allowed to hatch. This method is useful for mass production of fingerlings of carp, catfishes like *C.gariepinus*, *Heteroclarias* and *Heterobranchus*.

Management of the Eggs

The fertilized eggs may be put in bowls, trays or troughs and fresh water is allowed to run slowly over them. This ensures that the eggs have enough dissolved oxygen. You can aerate the water if you have access to aerators.

As soon as the eggs hatch, and the fry swim out, it is essential that they are fed. Fry of carp; and tilapia will accept fine artificial feed, but larvae of catfishes require life-foods called zooplanktons for the first ten days of life. After this, the hatchlings are transferred to earthen or homestead pond already fertilized, green and rich in zoo and phytoplankton.

(**NB.** Breeding exercises are better done very early in the morning, between 7-9a.m. and late

8

Homestead Fish Pond-turned Commercial Enterprise

The homestead fish pond-turned commercial enterprise is the focus of this documentation i.e., breeding, raising table fish and fingerlings for profit.

FINGERLING PRODUCTION

A single unit of homestead pond (2m x 3m x 1.5m) costing approximate N40,000:00 naira can be used to raise between 500 and 2000 fingerlings of *C. gariepinus* within 4 weeks. Other major requirements for operating this

system are 4-5 pairs of breeders costing N500:00 each = N2,500:00. Add N100:00 exigencies for feeding, handling, etc. From each pair of breeder expect approximately 700 fingerlings.

Total fingerlings from 5 pairs of brooders: 700 x 5 = 3,500; fingerlings with 60% survival = 60/100 x 35009 = 2,100 fingerlings.

Each fingerlings of *C. gariepinus* sells for N5:00. Hence, every month after you have perfected the process, and from each homestead pond you can make about N5:00 x 2,100 = N10,500:00.

Feasibility of Project

(I) *Total Expenditure Estimate*

- Construction of one unit of homestead pond	N41,900:00
- Operational cost of each unit/month	N 3,500 :00
	N45,400:00

(**N.B:** Labour to be provided by the operator alone and his household at their spare time.)

(ii) *Income*

Each month, from each unit, N8,400:00 is expected.

Repayment

If the operator pays back N5,000:00 per month with the recurrent expenditure of N3,500:00, the initial capital of N45,400:00 will be paid back within 10 months.

There is a demand for fish fingerlings

and the present fish breeders have only satisfied less than half. If you produce *Clarias* fingerlings and you do not have buyers, contact government fish farms. Fisheries Departments of the universities and ADPs for help.

Table Fish Production

If you desire to produce table fish, you may have to tie down your money for a minimum of 5 - 12 months. With the same units of 2m x 3m x 1.5m, you can raise table fish of 0.5 - 1kg of *Clarias* within 6 -12 months.

Expenditure

First year

(i) *Capital cost*

Construction of 1 unit homestead pond
2m x 3m x 1.5
Is approximately = N41,500:00

(ii) *Operational cost*

Stocking of pond at 100 juveniles/m^3 = 900 juveniles/m^3

(a) Cost of juveniles at N20:00/juveniles
= N18,000:00

Assuming 90% survival

= 90/100 =810.

Feed at 1.5kg of feed to produce, 1kg of fresh fish

Therefore,

you require 1.5 x 810kg of feed (48%CP)

=1,215kg

(b) If 1kg of feed cost N120:00

Therefore, Cost of 1,215kg of feed

=N145,800:00

Total expenditure for (i) + (ii) + (b)
= N205,700:00

(iii) Exigencies at 5% = N10,285:00

N215,985:00

(**N.B.** The total cost of feeds can be reduced if agricultural wastes such as processed poultry offals, fish entrails (without the gills bones); processed unhatched incubated eggs; and dead poultry birds, etc., are used to supplement the feeding).

Viability of Project

At the end of the first year, no repayment may be made. At the end of the second year of table fish production, = 810kg of 1kg fish is available for sale. If 1kg of fish sells for N350:00 farm gate price 810 of fish will sell for 283,500:00 end of 2nd year

Profit = N283,500:00

During the second year of operation the capital cost of Construction N215,985:00 will not be expended

Cost of Stocking 900 juveniles = 18,000:00
Cost of feeding =145,800:00
Exigencies (5%) = 8,100:00
N171,990:00

will be spent.

Survival will definitely improve to about 95% because of experience; hence, survival will improve to approximately 855kg.

1kg of fish sells for N350:00 (Farm Gate price), if not more

Returns = 855 x 350 = N299,250:00 (or more)

Profit = N299,250:00 N171,990:00

=N127,260:00

You can enhance profits by retailing to your friends at N400:00 per kg, which is still better than the cost of N500:00 per kg in the market.

Production of tilapia is cheaper, but it does not bring as much returns. It is difficult to get one tilapia fish weighing 1kg because of the reproductive problems raised in Chapter 4: rather, at best, you may get 4 pieces of tilapia each weighing 250g. However, because of the dual advantage discussed in Chapter 4, tilapia can be introduced into concrete tank (Personal Communication.).

9

Maintaining the Health of Your fish Stock

INTRODUCTION

It is very important that your fish stock is maintained in good health. Any fish species raised under optimum conditions can, in general, resist the pressure of infection agents in the water like viruses, bacteria and parasites. The following conditions in the environment disturb the fish stock: poor water quality, bad feeding regime, rough handling. The result is reduced activity of the defence system, and a sudden outbreak of a disease. Fry and fingerling are easily affected

since they are yet to build up immunity. Stressed or diseased fish show the following abnormal symptoms.

(1) Lack of appetite for food
(2) Nervous or 'wadding', scratching, twitching, swimming
(3) Swimming slowly and weakly
(4) Staying in vertical position on water surface
(5) Mutilated barbells or fins
(6) White or red-brown spots on the skin
(7) Pop-eyes
(8) Swollen abdomen
(9) Broken head disease of catfish

The behaviour of the fish and the conditions of the water should be monitored

daily. Whenever one or two of these symptoms are observed, attention of professionals knowledgeable in fish diseases should be called for a closer observation. Invariably, one or two diseases may be identified. The disease may be identified either as parasitic, bacterial, fungal, or nutritional. After the diagnosis of the disease, specific therapy can often be started immediately.

PARASITIC DISEASES

These may affect the fish in internally (they are called endoparasites) or external (ectoparasites). Usually, the parasitic diseases are water borne, i.e., polluted waters in the pond or hatchery stress condition of the fishes like putting too many fish per unit area

or volume, low DO concentration, increased organic materials, causing a rise in acidity by increased temperature.

Symptoms

Fish stay in a vertical position at water surface, nervously rubbing their heads or sides over the pond walls or bottom. Sometimes, there is a grayish white mucoid film on the skin or the gills. To know the right diagnoses, a microscopic examination is required because the causative agent is too small for the eyes to see.

Diagnosis

The following parasites may be found:

a protozoan - a microbe
A trematode - a flatworm/flukes
a cestode - a flat/tapeworm
a nematode - water-insect
a hirudinea - leeches

Treatment

For specific treatments consult relevant books, but the following tips may be useful:

(i) Increase the rate of flow of water, or change entirely the water in the pond.

(ii) Remove the cause of the stress, e.g. reduce the population per unit area or volume.

(iii) Aerate the pond.

(iv) Remove excess organic material.

(v) Reduce the acidic content by liming. Do not lime a concrete pond.

Bacterial Disease

Symptoms:

Fish remains in a vertical position on the water surface, waddling or splashing nervously. White spots are noticed on the skin, especially around the fins, the gills and the mouth.

Diagnosis:

You need a microscope to see the structure of these organisms.

Treatment:

Antibiotics are needed. They are usually added to the feed or water of the fish. (See the fish veterinary doctor at the venues mentioned in the earlier chapters).

Fungal Diseases

Symptoms:

Infected fish have cotton wool-like growths- on the skin, mouths and barbells. The fungus grow especially on skin injuries. So, avoid injuries to the skin of the fish by handling, netting or ectoparasites. Such fish exhibit 'waddling' while swimming. The cotton wool-like growth can also occur on the eggs leading to losses of the eggs and death of the larvae.

Treatment:

This disease is caused by microbe called *Saprolegnia.* It is treated with a chemical called malachite green oxalate added to water in low concentration. For the dosage, consult appropriate books.

NUTRITIONAL DISEASES

Nutritional diseases are caused by giving fish stock infected, spoilt feeds or feeds that have run rancid or feeds that are deficient in essential components. Rancidity is caused by storage of feedstuffs for a long period and the fat or oil becoming oxidized.

Symptoms

The fish-stock may stop feeding or eat very little amount. They may have reduced or defective growth; popping eyeballs or bleeding from unusual places.

Treatment:

Change the diet by: Adding particular vitamins as directed by professionals.

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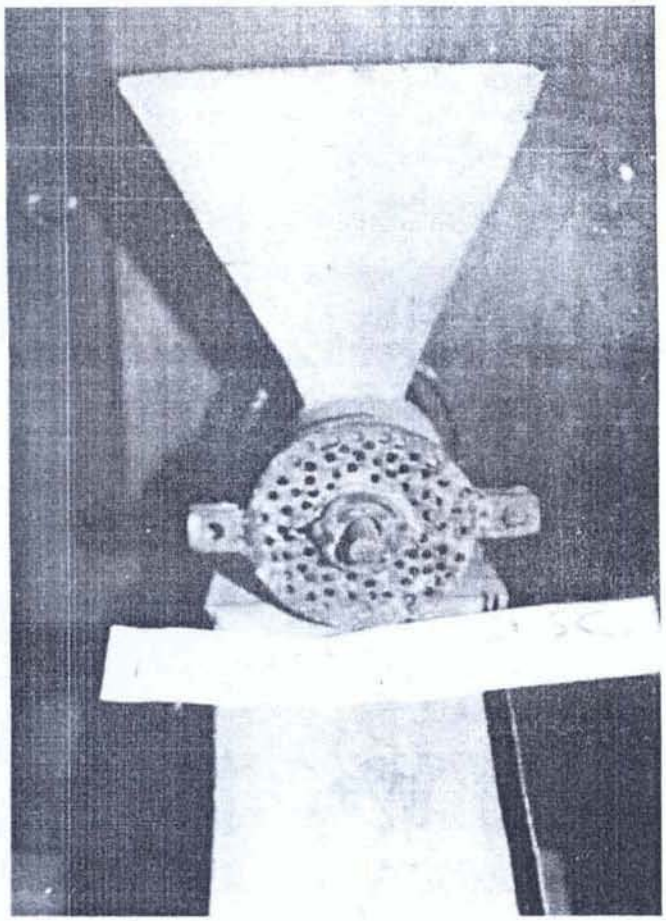
HARVESTER



PELLETIZER

CONCRETE POND

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