Pond Fish Culture Facilities in Nigeria

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Abstract: The potentials and importance of pond fish culture to the Nigerian economy cannot be over-emphasized. A good pond culture system when efficiently and effectively practiced with adequate facilities result to several benefits. This study reviews fish culture development, Kinds of fish ponds, sites for fish ponds, pond Inlet, pond outlet, pond over flow, pond shape, size and depth, making fish ponds, equipment for pond construction and management of fish pond aimed at exposing the non financial implications of pond fish culture for interested fish culturist and management decisions in formulation of policies.

Key words: Fish pond construction, processes, types, facilities and management

INTRODUCTION

Too often in the past 20 years pond fish culture has been freely advocated as a form of development of food resources. No especial consideration was given to whether this was really the best development in relation to the environmental conditions and economic state of the area. Before planning any fish culture project, it is necessary first to decide whether it is really the best method of fish production for the area, or whether another form of fisheries development should be considered. In areas where large natural fisheries exist, for example, there is little point in developing any form of fish culture. First, there must be full exploitation of the natural fishery, bringing benefit to as many people as possible in the region.

Generally speaking, the areas in which fish pond culture is likely to be a sound form of development are those which satisfy some of the following conditions:

- There is a shortage of animal protein for consumption.
- There are no large natural fisheries.
- There are adequate surface water supplies.
- There is a ready market for the cash sale of fish.
- There already exists a combination of fish ponds with forms of agriculture such as vegetable growing, poultry, pig farming, etc., or a potential for this combination.

A review of fish culture facilities in Nigeria is aimed at exposing aspect of non-financial implications of pond fish culture. This study reviews fish culture development, Kinds of fish ponds, sites for fish ponds, pond Inlet, pond outlet, pond over flow, pond shape, size and depth, making fish ponds, equipment for pond construction and management of fish pond aimed at exposing the non financial implications of pond fish culture for interested fish culturist and management decisions in formulation of policies.

Fish culture development: Once the form of fish culture development for an area has been decided upon, the development may be put into effect (Awachie, 1969). It has been found by experience that no matter what type of fish culture is contemplated, the development is most easily and surely brought about through the following stages: (a) demonstration; (b) instruction; (c) extension.

**Demonstration** involves the setting up of a demonstration unit consisting of a small unit of fish ponds or conservation dams.

A fish pond unit must be of economic size, sited in a place and constructed in a manner typical of what is possible for the area as a whole. It must also be combined with other forms of agriculture applicable to the region. A conservation dam unit may consist of one or two dams, characteristic of the area, where both good and bad management practices can be demonstrated (Awachie, 1968).

It cannot be overstressed that the demonstration should be typical of what can be done in the area, because individual efforts will exactly reflect the demonstration. It is therefore of little use to demonstrate a unit of barrage-type fish ponds when the terrain of the
development area is better suited to contour ponds. Similarly, a demonstration of large perennial dam management is futile in an area where most dams are likely to be small and no perennial (Awachie, 1979).

Instruction involves the use of the demonstration unit for field days and courses of instruction to show the people of the region how the unit is managed and what results can be obtained. Usually a short time after the demonstration and instruction stages, inquiries are received from potential fish farmers and dam owners. This leads to the third and most important stage of development, extension.

Extension involves the use of trained staff to advise and assist farmers on the spot. This staff chooses sites, lays out fish ponds, advises on pond stocking, and checks on pond construction. In conservation dam fishery development, the staff are required to work with dam owners, whether private or local authorities, and advise on stumping, stocking and cropping. It is even desirable that they should run dam cropping schemes for the first year. Extension work is very important and the provision of adequate staff is most essential.

**Kinds of fish ponds:** Ponds can be described according to where and how they are made and the use to which they are put. The main kinds of ponds are contour ponds, barrage ponds and paddy ponds.

Contour ponds are made on sloping ground. The bottom walls of the pond lie along the contour of the ground. Contour ponds are constructed along the sides of valleys and sometimes dambos (vleis), the water coming in a furrow from a stream or sometimes a conservation dam. A unit of contour ponds is illustrated in Fig. 1.

Walls about 4 ft high are built across the dambo one below the other. Each pond has an outlet pipe and an overflow. At the first pond the overflow is continued as a furrow so that water can be put into the lower ponds when it is needed. Contour ridges are made on either side of the dambo and thus the ponds are not flooded in the rains.

Barrage ponds are made by building a wall across a small dambo or stream and the ponds are therefore like small conservation dams. Water for these ponds comes from a spring, or a “mushitu” or seepage area. It is very important that ponds of this type should not be constructed in places where there will be a very large flood of water down the stream or dambo in the rainy season. Sometimes barrage ponds are made below large conservation dams making use of seepage water. In such cases the water in the first pond of a series must be at least 50 feet from the bottom of the dam wall. Units of barrage ponds are illustrated in Fig. 2 and 3.
Paddy ponds are made in places where the ground is flat, or almost flat, such as in dambos or swamps and flood plains. The water for the ponds comes in a furrow from a stream, or from seepage in the area, or sometimes from springs. Because paddy ponds are made on flat ground, four walls must usually be made to each pond, as compared with three for contour ponds and only one for barrage ponds. The water supply often has to be brought to the ponds on top of a specially constructed dike and is distributed by furrows on top of the pond walls. The walls
of paddy ponds are of a wider construction than the walls of other kinds of ponds because the soil is usually not so firm. A unit of paddy ponds is illustrated in Fig. 4.

In some parts of the world where the culture of fish in ponds tends to be rather specialized, ponds are used for special purposes. In Europe, for example, carp culture requires special ponds for breeding, special ponds for rearing and special ponds for growing table fish.

There should be provision for drainage. In central east Africa where pond fish culture is very largely of the Cichlids, such as *Tilapia* and *Haplochromis*, normally no ponds of special construction are needed for any particular stage of their culture.

Fish breed and grow in the same pond and, in fact, one of the greatest problems of Cichlid culture is their prolific breeding in ponds. With the development of *Tilapia* “hybrids,” it will be necessary to have separate ponds set aside for crossbreeding and separate ponds for growing the progeny to edible size. These ponds will not, however, differ materially in construction, but merely in size and in the degree of control devices.

**Sites for fish ponds:** The place where fish ponds are made is called the pond site. When choosing a site for fish ponds these factors must be considered:

- Water supply
- Soil, rocks and trees
- Supporting services

Of course, fish ponds can be made almost anywhere, but some sites are better than others and may be developed more economically. Fish ponds could be constructed on the top of Kiliimanjaro, but it would hardly be an economic proposition (Ezenwa, 1974).

**Water supply:**

**Amount of water:** One of the most important requirements for the successful development of fish ponds is an adequate water supply. Water is required not only to fill up ponds in the first place, but to replace water lost by evaporation and by seepage. The loss of water by evaporation is greatest in hot dry weather. The amount of water lost by seepage will depend on the kind of soil in the place where the ponds are sited and on how well the ponds are made. If walls are not properly constructed, seepage may sometimes be so great that ponds will not hold water for more than a few hours after being filled up.

New ponds often lose more water from seepage than old ponds (Hayward, 1961). Fish in ponds stir up mud at the bottom and make fine silt that helps to stop the leaks. In central east Africa it has been found that the water supply to a unit of contour ponds could vary between 4,000 and 25,000 gallons per acre per day. On average, contour ponds require between 10,000 and 15,000 gallons of water per acre per day in areas where the rainfall is 30 to 35 inches a year and mean monthly temperatures are within the range of 15º to 26ºC (59º to 78ºF), where there is little pond seepage.

Barrage ponds require less water than contour ponds, because the seepage from one pond is used by the next in the series. Usually with barrage ponds it is necessary only to run water into the first of the series to keep it full. If ponds are combined with the irrigation of vegetables and other crops, then extra water will be needed. For example, for a small holding of half an acre of ponds and half an acre of vegetables and fruit trees, recorded water requirements have been 30,000 to 50,000 gallons of water a day depending on the time of year. In this instance, however, seepage from the pond unit was excessive and irrigation was not efficient (Holden and Green, 1960).
The water supply for fish ponds is very important. If there is not enough water all the year round, it is no good making ponds, as they will dry up and the fish will die. It is better to overestimate rather than underestimate water requirements. Careful planning and situation of ponds can result in a reduction of the amount of water needed, e.g., for contour ponds made in terraces, the lower series seldom require a direct water supply, as they are kept full from seepage from the upper terraces' water table (Mann, 1962).

Fig. 5: Arrangements for water supplies to fish ponds
Water sources: It has already been stated that the water supply for a fish pond is very important and that there must be enough water all the year round. The most important sources of water for fish ponds are:

Perennial streams and rivers: Springs and “mushitu.” (A mushitu is a relict of tropical forests found in certain areas of central east Africa and always has water seeping from it.)

Very large conservation dams: Small dams are not a reliable source of water.

The important feature of the water source is that it must be reliable and adequate. Many rivers and streams in central east Africa have adequate water in the rainy season but stop flowing in the dry season. Such rivers and streams are not recommended as a direct source of water for fish ponds. Where river and stream water supplies are unreliable, conservation dams should be built and used for fish production.

Quality of water: It is not within the scope of this section to deal in detail with the quality of water. Just as some soils are better than others for growing crops, so some waters are better than others for growing food on which fish feed. Water may be improved by adding fertilizers in the same way that soils can be improved. In many parts of central east Africa where plenty of water occurs in rivers and streams the quality of the water is poor. This is not a serious matter because the water can be improved. It is far more important that there should be enough water for fish ponds than that the water should be of good quality.

Arranging the water supply: Various ways of arranging the water supply to fish ponds are shown in Fig. 5. When a furrow is used to supply water, care must be taken to ensure that it is large enough to carry all the water required and that there is not too much seepage. Information on furrow sizes is given on page 151. Since fish pond development is usually part of other agricultural, irrigation development, there is seldom need for fisheries staff to be concerned over furrow sitting.
Soils, rocks and trees:

Soils: Soils are considered here in regard to their water retention properties rather than from the point of view of fertility. There are a number of different kinds of soil which are suitable for making fish ponds. Wet, swampy ground such as that found in dambos is usually very appropriate for this purpose. In fact, swampy ground is most usually used for fish pond sites. Sandy clay, some schists and laterites are also suitable.

Some heavy clays are very good for pond building, others not so good. The reason for this is that heavy clays when dry are very hard and crack, and some are difficult to seal up. If however the cracks are sealed up, then the ponds are usually very good and hold water well.

Well-drained soils and red soils have not proved to be particularly adapted for making ponds as seepage is often very great indeed. Places in which there are anthills must be avoided as excessive seepage will occur through them.

Rocks and trees: Fish ponds must never be made where there are rock outcroppings because they will leak too much and cannot be sealed up properly. Sites having too many trees should also be avoided for it is costly to remove the trees properly. If there are a few trees they must be taken out and all the stumps and roots removed completely. The hole caused by the removal of the tree stump and roots must be filled with soil which must be stamped down hard. If trees and stumps are not taken out completely the pond may leak very badly, and also cannot be netted.

For firm soils  Base width = \( 4 \times \text{height} \)
Crest width 2 – 3 feet
For soft soils  Base width = \( 5 \times \text{height} \)
Crest width 4 – 5 feet

Pond Inlet: The pond inlet is the place where water can be let into a pond. It can be made in various ways and some of those more common and easily made are shown in Fig. 7. To prevent erosion of the side of the pond when filling it with water, there should be an overhang at the inlet, or grass lay as a mat, or stones. It is important that the inlet should be at least 6 in. above the water level of the pond, when the latter is full, and there should also be some sort of a screen. The screen serves to present fish escaping from the pond into the furrow, as well as to prevent “wild” fish coming down the furrow into the pond. Arrangements must also be made for stopping the flow of water into the pond, since it is undesirable in Cichlid culture to have a continual flow of water into and out of the pond (Fig. 6).

Pond outlet: The place where the water can be let out of the pond is called the pond outlet. This is usually a pipe
underneath the bottom wall. In the case of small ponds a pipe of 2-in. diameter is suitable, but for larger ponds a larger pipe is needed (Fig. 8).

The size of the wall for a contour pond made in firm soil such as laterite or clay is above; while the size of wall for paddy pond made in dambo types of soil is below.

A simple furrow type of inlet (A). It is blocked with earth when not in use. The sides of this type of furrow must be sloped (B). An inlet made of a section of pipe or a piece of bark (C). A furrow type of inlet made of brick or concrete, with slots for a control board and a screen. The control board is about ¾ in. thick. The screen can be cut from gravel screening of ¼-in. mesh or of bamboo.

Special kinds of outlets are the sluice and the monk. They are usually made of brick or concrete and are expensive (Fig. 9 and 10).

If a pond does not have a pipe outlet, it can sometimes be emptied by siphoning or even by cutting through the wall (Fig. 11).

**Pond over flow:** The pond overflow is the place where water can flow out of the pond in emergencies - such as when there is very heavy rain - without breaking the walls. If a pond is looked after properly, it should not be necessary to use the overflow very often, because it is not a good thing to have water running through the pond all the time. There are several different kinds of overflow which can sometimes be combined with the outlet, e.g., as in a monk or sluice (Mutter, 1972a).

Should the occasion arise, a screen, such as is used for inlets, can be put across the overflow to prevent fish going out of the pond. Various kinds of overflows are illustrated in Fig. 12, 13 and 14.

**Pond shape, size and depth:** The shape of contour and paddy-type ponds should be rectangular or square, preferably the former. Barrage ponds should have as regular a shape as possible. Ponds irregular in shape are difficult to crop. The size of a fish pond is the area of the pond overflow.
Fig. 10: The monk

Fig. 11: The siphon
Fig. 12: The Pipe overflow

Fig. 13: Another kind of overflow is a pipe through the top part of the pond wall. The pipe should not be less than 2 in. in diameter. A collar of cement or concrete must be put around the pipe to stop seepage along the pipe. This kind of overflow is suitable for paddy ponds

Fig. 14: Spillway overflow
water surface and is usually given in acres. The area of rectangular ponds can be worked out from the length and width in yards (Mutter, 1972b).

A unit of ponds should be planned so that all the ponds are of about the same size. The larger the pond, the lower is the cost of construction relative to the area. For example, the total cost of making 10 ponds, each 1/10th acre in area, could be twice as much as the total cost of making two ponds of ½ acre each, even if made under similar conditions. However, not everyone has sufficient money to build large ponds and in rural areas units of ponds of about 1/10th of an acre each in surface area have
been the most successful. Not only can the owner afford to build one or two ponds at a time, but these smaller ponds tend to be better managed and to produce relatively more fish than larger ones (Mutter, 1973).

A plastic or rubber hose pipe about 1½ in. diam (A). The pipe is put over the wall of the pond. The end of the pipe outside the pond must be lower than the end in the water (B). To start the siphon: Put an airtight plug in the end of the pipe outside the pond, and fill the pipe with water (C). When the pipe is full and overflowing put hand tightly over the end and put it quickly under water in the pond; then removes hand. D. Take the plug out of the pipe and the siphon should start (Phelines et al., 1973).

A pipe outlet can be fitted with an elbow or T-piece into which another piece of pipe is fitted. This pipe is upright outside the pond and is about 6 in. or more below the top of the wall. Water will come out of the top of the pipe if the pond becomes too full. It is only suitable for small ponds.

Overflows made like spillways can be used on large and small contour barrage ponds. The overflow spillway is made near the top of the pond and must be planted with grass. The danger of this kind of overflow is that fish can get into and out of the pond if water is kept running out all the time. Contour ponds can be made in pairs, each with a spillway type of overflow (A), or in series with overflows leading from one to the other (B). Fish ponds must never be less than 1/20th of an acre in area. This is the smallest size worth managing. Small fish ponds can be made with about the same depth of water all over, but it is better if the pond is deeper in one part near the outlet.

If ponds are made with the same depth all over, the depth of water can be about 3 ft. If ponds are made with one part deeper than another, the water in the shallow part must not be less than 1½ ft, and in the deepest part it can be 3 to 3½ ft. If ponds are made in places where the water supply is not reliable, the depth of water in the ponds should be increased to about 5 ft at the deep end. The same is suggested in areas where frosts or severe winters occur. If the water supply fails there is enough water in the pond to last another one or two months, the level dropping gradually.

Making fish ponds:

Fish pond construction time: If fish ponds are made at the most suitable time, the work will be easier and the cost less than if they are made at another time. The best time of the year for making ponds in soils such as clay and laterite is at the end of the rainy season when the soil is soft, rather than at the end of the dry season when it is very hard. The best time of year for making ponds in swampy ground, such as dambos, is in the dry season when the ground is not flooded with water (Pillay, 1962).

Fish pond construction processes: It is not possible in this manual to describe in detail all the ways in which fish ponds can be constructed. There are, however, certain steps to be taken and certain points to be watched to ensure that a pond is properly made.

Walls marking: The place for the bottom wall is marked out first, with height being shown with posts and width of the wall at the bottom with short pegs. For contour ponds the position of the bottom walls of the pond will depend on the slope of the ground. If the ground is steep then the bottom wall will be closer to the furrow than if the wall is not so steep.

For example, if the bottom wall of a contour pond is 15 yd from the furrow and the pond is 1/10th of an acre in area, then the side walls will be 30 to 35 yd apart. A “farmer's” type level, or a line level can be used for marking out pond walls. For barrage ponds the position of the wall will depend on the slope of the stream bed. For paddy ponds made on flat, or nearly flat, ground the bottom wall can be made in any position (Fig. 15, 16 and 17).

The distance from A to D is measured. If this distance is 15 yd (about 15 paces), another line of posts is put in 35 yd (about 35 paces) away, along the slope. These are posts E to H. The distance of the line of posts E to H away from the posts A to D depends on the distance A to D to make a pond of about 1/10th acre. Posts A-E-H-D mark the corners of the pond and show the height of the wall to be made.

It is important to mark out the bottom and side walls in the right places, because if they are in the wrong places it is more difficult to make the ponds and they will cost more. Once the pond walls have been marked out, grass and any small bushes must be cleared away. If this is not done, the pond will leak when it is filled with water (Sivalingam, 1972).

Key or core trench: The key or core trench is a small ditch or furrow dug along the line of the center of the walls, about 1 ft wide and 1 ft deep. As the walls are built, the trench is filled in again with a good clay soil and is well packed. If good clay soil is lacking in the area, the ordinary soil should be well compacted into the trench. The purpose of the trench is to stop the seepage of water underneath the walls. If there are any small anthills along the line of the walls, then the trench must be dug much deeper in order to prevent seepage (Fig. 18).

Posts are put in a straight line across the dambo. The tops of the posts must be level with the top of the center post, A. These posts mark the center line of the bottom wall and the height to be made.

Outlet pipe: Before the walls are made, the outlet pipe is put in. A collar of cement or concrete is put around the pipe at about the middle of the wall to stop water seeping along the pipe (Fig. 19).

Making the walls: Soil for making the pond walls is taken from inside the pond (Welcombe, 1971). For
contour ponds it is best to start digging the part of the pond nearest the intake furrow, i.e., furthest from the bottom wall. More soil is taken from the top of the contour pond than from near the bottom wall. For paddy ponds it is best to start in the middle of the pond and work toward the walls. Where a good layer of fertile topsoil exists it is a good practice to remove this top layer to a pile near the pond site. Then the less fertile soil is used for the walls and on pond completion a layer of fertile soil is replaced on the bottom of the pond to promote pond fertility. The bottom wall is the most substantial and needs more soil than the side walls (Fig. 20, 21 and 22).

When the walls are the right height, stop digging. It is not necessary to have walls 10 or 12 ft high if the water is to be only 3 or 4 ft deep. When finished, the crests of all the walls should be level.

Soil to make the walls is dug first from the top of the pond. It is dug to a depth of 1 ft. Nearer the bottom wall, soil is dug less and less deep. As the walls are built up,
the width is made less and less so that when the top of the posts is reached, the width is only 2 or 3 ft. Then the walls are high enough and digging stops. The bottom of the pond is made smooth.

Earth is dug from inside the pond to make the wall. The wall is made narrower as it is built up. Earth is tamped down with a tree trunk or pole. When the top of the posts is reached, the wall is finished.
Fig. 24: Fencing the pond

Fig. 25: The most important equipment for fish pond management
Soil to make the walls is dug first from the center of the pond. It is dug to a depth of about 9 in. in the center but at the top of the pond it is dug to only about 6 in. At the bottom end of the pond the soil is dug to a depth of about 12 in.

An overflow is made at the side of the pond. An inlet from the furrow is made. A wooden tap or plug is put in the outlet pipe and the pond filled with water. Grass is planted on the walls.

The walls should be sloped below the natural ground level first, and then the slope can be continued to the top of the wall. If the soil is very dry it must be watered. If the pond is made by hand, the soil must be beaten down with a pole or small tree trunk.

**Inlet and overflow:** When the pond walls are completed the inlet and overflow are put in and the pond can be filled with water (Fig. 23).

**Grass planting:** After the pond is finished grass should be planted on the walls as a protection. It can also be cut for fish food. Good grasses are Kikuyu, Swazi, Couch, Star and Rhodes. Tanner grass should not be used because it is very difficult to get rid of the long tough stalks that are in the way when the pond is cropped.

Poles are put in around the ponds (Fig. 24). They are buried at least 2 ft in the ground, with 4 to 5 ft above the ground. Just outside the line of the poles a trench is dug. It is about 4 to 6 in. deep.

Fencing wire is put between the poles at the top (Fig. 25). The wire netting is buried in the ground at the bottom and is bent over outside at the top. The wire netting is tied to the top wire and the poles.

**The fence:** A fence is put around ponds to keep out predatory animals, such as otters, which eat a lot of fish from ponds. The best fence is one of diamond mesh wire netting or chicken netting of 2½- or 3-in. mesh and 4 to 6 ft wide. The netting is buried 4 to 6 in. in the ground and is bent outward at the top. Poles can also be used for fencing and must be at least 5½ ft long, be buried 1½ ft in the ground and put very close to each other.

**Equipment for pond construction and management:** Small ponds are quite quickly and easily made with hand labour using picks, hoes, shovels and wheelbarrows. For larger ponds a tractor with a disk plough and a small bucket scoop or wheeled scraper can be used economically (Welcomme, 1975).

Once ponds have been made certain tools and equipment are needed in management. For a unit of 12 ponds these are:

1 small seine net 1 to 1½ in.-mesh 1 shovel
2 or 3 buckets 1 mattock or pickax
1 or 2 baths 1 hoe
1 balance or scales 1 wheelbarrow
1 hand net 1 sickle

For a demonstration and stock pond unit the additional tools and equipment needed are:

6 small fish cans 2 baths
1 hand net 1 × 56 lb platform scale
× 1 in.-mesh seine net

**CONCLUSION**

Fish culture development, Kinds of fish ponds, sites for fish ponds, pond inlet, pond outlet, pond overflow, pond shape, size and depth, making fish ponds, equipment for pond construction and management of fish pond are important considerable elements in exposing the non financial implications of pond fish culture for interested fish culturist and management decisions in the formulation of fisheries policies.

**REFERENCES**


