ECONOMICS OF AQUACULTURE PRODUCTION

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The information in this bulletin were pooled together to assist prospective and practicing fish farmers to understand the economics and cost analysis of aquaculture enterprise This is to serve as stimulus for profitable fish culture business. All sources of information duly cited in the bibliography are acknowledged. The management of NAERLS funds the publication, while the NAERLS Publication Review Committee did a painstaking job in transforming this bulletin to simple language for easier understanding by readers- Also worth mentioning is the NAERLS Publication and Publicity Program staff who worked tirelessly to edit this work. All the aforementioned are highly acknowledged.

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TABLE OF CONTENT

1.0 INTRODUCTION

Aquaculture (Fish Farming) is the art and science of controlled rearing of fish in ponds, farms and in some instances natural water bodies from hatchlings (freshly hatched" fishes) to matured size. Unlike fish that grow in natural water bodies without human interference, in aquaculture, feeding, fertilization, stocking combination, reproduction and harvesting are controlled.

Aquaculture is a relatively new practice in Nigeria. For this reason it *is* important for potential and practicing fish farmers to know some basic necessities of its management *and* economics in order to boost the returns of their efforts. Like any economic activity in life, balancing investment cost and returns in favour of farmers are important in aquaculture. It is always useful for fish farmers to know the profitability of fish culture in order to guide their decision making. This bulletin is put together to enlighten both practicing and prospective fish farmers on how to make profitable investment in fish farming The major cost components, investment analysis and profitability calculations are explained in simple language as much as possible.

2.0 AQUACULTURE PRACTICES

A wide range of aquaculture practices exists. Aquaculture involves the controlled culture of fin-fish and other aquatic animals like frogs, lobster, oyster and Cray fish (Macrobracium). This could be done based on different criteria.

2.1 Types of Fish Ponds

Fish ponds can be classified using the following criteria

a. Construction design
b. Level of management input
c. Fish culture practices
d Scale of production

2.1.1 Construction Design

I. **Earthen ponds**: These are constructed by digging soil in a carefully selected site that is good enough to retain water for fish culture, Where the soil structure is weak to retain adequate water, dug out earthen ponds can be reinforced with concrete to make it suitable for fish culture. (Figure 1)

2 **Concrete**: These are ponds constructed with concrete.
They are usually above the ground surface with concrete walls• Concrete ponds are used to raise fish in places the soil is porous or very sandy, at house backyards or where land scarcity exist. In general, concrete ponds are more expensive to construct and maintain than earth ponds. Earthen ponds are known to be more productive in terms of fish yield and are therefore more profitable.

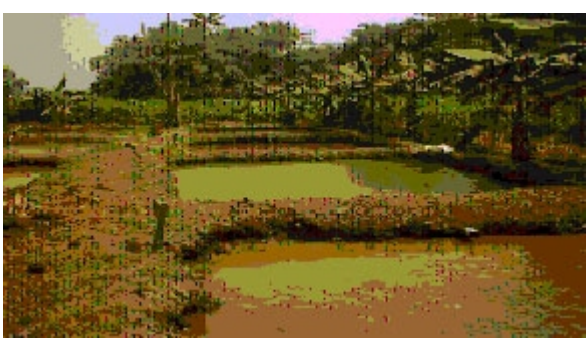

Figure 1. Earthen Ponds.

Figure 2. Concrete Ponds

3 **Barrage ponds:** These are ponds constructed by building a wall across slow running streams in low valleys. The wall ensures enough water retention for fish growth

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4 **Diversion Pond:** These are ponds created by water diverted from a river/stream through a channel. Such a pond is also known as a relief pond.

5 **Rosary Pond:** When ponds are built in a string and each drains into the other and are all managed as a single unit due to their inter connection, they are called rosary system ponds.

6. **Parallel ponds:** These are ponds located In the same area with each having its own inlet and outlet. Various pond designs listed above have peculiar cost implications.

2.1.2 Level of Management Input

Depending on the level of management inputs (especially in feeding, fertilization and liming), pond culture systems can be classified as extensive, semi-intensive or intensive. Returns on investment for each other differ depending on the level of input.

1. **Extensive Culture System**: When food base of a pond is exclusively dependent on nature without supplementation (either by feeds or fertilizer) the culture system is an extensive one. Extensive culture attracts less cost, but are often less productive and less profitable.
2. **Semi-Intensive Culture System:** In this system, there is occasional supplementary feed addition and natural food supply is augmented with manure. This attracts more cost, but better productivity and profit are assured compared with the extensive culture system.
3. **Intensive Culture System:** This system demands the highest level of management input. Protein rich feeds are intensively applied following appropriate recommended rates. The ponds are occasionally disinfected against para site and diseases. Fish grow very fast when intensively managed and grow least in extensive management. Intensive culture system requires high expertise. It also demands high level of supervision. Investment cost is comparatively higher but commensurate higher productivity and profit are certain.

2.1.3 Fish Culture Practices

Culture practices can be classified as monoculture, polyculture or Integrated.

1. **Monoculture**: This is the practice of culturing only one species of fish in one or more pond units. Un der monoculture; the farmer may grow for example only Tilapia or Clarias in the pond. One disadvan tage of this practice is that the farmer will only know more about the management of that fish than other species that can be cultured. However, the pur pose of culture determines the investment cost. Growing one type of fish could limit the maximum exploitation of natural and supplementary food in the pond, thereby affecting pond optimal utiliza tion.

2. **Polyculture:** This is the practice of culturing more than one species of fish in the same pond e.g. Clarias and Tilapia. Fish yield under polyculture can be high because food items in the pond are properly utilized since the different fish species exploit food at different levels. Well managed ponds under polyculture can he highly profitable since food utilization is maximized and less risk of project failure is assured.

3. **Integrated Culture:** This involves rearing fish with other animals or vegetable gardening. Integration of fish culture with livestock/gardens can maximize production space and productivity. Understanding the know-how of managing such integration is important to a farmer in order to maximize profitability of this culture integration.

2.1.4 Scale of Production

1. **Homested/Backyard Ponds.** This is a fishpond that is managed to augment family protein intake. The size of such a pond could vary according to land space available- e.g. from 25m^2 to l00m^2. Such ponds can be homestead/backyard or located in farm.

2. **Commercial Fish Ponds/Farms**: This usually has an area of land not less than half a hectare under culture (for earthen ponds). Such a farm will demand more attention from the fish farmer, since income generation is the rnajor purpose behind its establishment A large capital base is also required for commercial farms. However concrete ponds of 100-200m^2 can also be utilized for commercial purpose especially under intensive management.

3.0 COMMONLY CULTURED FISH SPECIES

Generally the purpose of rearing fish is to have enough to eat and generate additional income especially in commercial farms. Not all fish -species perform creditably well in culture. For a profitable venture, the fish farmer's ideal candidate species must have some of the following qualities.

i. Fast grower e.g Heterobranchus and Clarias
ii. Accept and utilize supplementary feeds properly. e.g Tilapia or clarias.
iii. Hardy and resistance to disease, e.g Clarias
iv. Tolerant to poor water quality e.g Clarias
v. Easy to breed in captivity e.g. Tilapia
vi. Attract low production cost (Tilapia/Clarias)
vii. Acceptable (marketable) to consumers, e.g. Carp and Heterotis, Tilapia and Clarias.

In Nigeria. certain fish species that are found only in freshwater bodies (that is rivers and lakes) do well under culture (Table 1). Some other species that inhabit the marine environment can be cultured in brackish water (lagoons and estuaries) (Table 2).

Table 1: Commonly Cultured Fish Species In Freshwater Ponds In Nigeria

COMMON NAME	SCIENTIFIC NAME
Tilapia*	*Oreochromis, niloticus*
	Tilapia melanopleura
	Tilapia guineensis
	Sartherodon galilaeus
Mud cat-fish……..	*Claria gariepinus*
Common Carp*……	*Cyprinus, carpia*
Spotted Cat-fish**…..	*Synodontis filamentosus*
Redmud Catfish……	*Heterobranchus bi-dorsalis*
Niger perch**…….	*Lates nilotus*
African bony tongue**.	*Heterotis nilotcus*
Grey cat-fish…….	*Chrysichthys nigrodigitatus*
Trunk-fish**……..	*Gymnarchus niloticus*
Silver catfish…….	*Bagrus bayad*
African Carp**……...	*Labeo coubie*
Moon fish**…….	*Citharinus citherus*

Table 2: Commonly Cultured Fish Species In Brackish Water Ponds

COMMON NAME	**SCIENTIFIC**
Flat head grey mullet*	*Mugul cepalus*
Tilapia	*Tilapia zilli*
	Tilapia guinensis
Atlantic Tarpon**	*Meggalops atlanticus*
Ten pounder**	
(West African Lady fish)	*Elops lacerta*
Grey cat fish**	*Chysichthys nigrodigitatus*
African red snapper**	*Lutijanus gorensis*

* Casual labor/maintenance wages.
* Transportation maintenance {fuel, etc)
* Consultancy cost where necessary.
* Other consumables.

8.0 FARM BUSINESS ANALYSIS

This is often used to show the levels of cost, return and profit that accrue to a fish farm. The profitability of each option is determined to show the strength and weakness of any acuaculture system. It is the difference between the total revenue and total cost of production. The revenue include items such as fish sold, harvest consumed at home/farm, those given as gift and change in inventory.
Below (Table 6) is an empirical cost and returns analysis of a typical for a two-fish combination under polyculture- This could also be dune for the monoculture and multi-species combination in polycultur. Based on the assumption that the two-fish types have been accepted as the most feasible. Other profitability ratios can then be derived. Of course it could be derived for the other aquaculture types and comparison made. These could be used to determine the efficiency of the enterprise chosen.
These ratios serve different purposes on the farm. For instance, if a farmer uses labour on hired basis, the rate of return on operating cost is very essential. These indicators are useful for both the fish farmers and other stakeholders in the fishing industry -

The cost and returns analysis is not static; consideration should be given to some of the variations and interactions of factors affecting production and profit.

trial, and domestic effluents to prevent pollution and subsequent death of fish. Fish could easily *be* wiped out by pollution leading to great economic losses to farmers.

4. Security

Natural and man-induced enemies of fish exist Natural enemies include snakes, frogs. turtles, etc. These can cause substantial losses to a farmer since they are predators of fish. Cleaning the surroundings of pond site of bush and grasses will minimize risk of attack by predators. Human poaching on ponds can also result in great losses. Efforts must be made to provide adequate security.

5. Natural Disaster

Natural disasters may not be within the ability of a farmer to control, but exercising caution can make a fish farmer to avoid or limit its impact to the barest minimum. Fishponds should not be sited in flood plains and hilly lands that are subject to flooding. When constructing a. pond, adequate provision should be made for a well-compacted pond wall (clay), inflow and outflows, and spillway to take. care of possible flood.

6. Management practices

Abuse of aspects of management practices can make a farmmer incur great economic losses making the whole fish culture enterprise un-interesting. Recommended stocking, feeding, fertilization and liming rates should be adhered to, for profitable fish culture business.

7. Gestation period

Initially, the gestation period for fish reaching the table or

market size could appear long to a potential investor. But with good management, the pay back period on loan could still be achieved. Most fish under semi-intensive and extensive system can be harvested within period of 9-12 months. A farmer can then hervest periodically as planned under intensive culture, a growth cycle of 6 months for fish to reach table size of 1-1.5kg id possible.

8 Marketing of Products.

Fortunately, marketing risk is not pronounced in aquaculture in Nigeria. Fish products have an unsaturated market demand with annual demand-supply deficit of between 35-45%. However, the fish farmer should be aware of the attitude of consumers within the locality to the species of fish that the farmer wants to culture. This is more important to a large-scale farmer that is interested in quick investment turnover. Fish species that are likely to attract high market prices should be grown. Such include *Gymnarchus niloticus, Clarias gariepinus and, Heterotis niloticus* etc.

5.0 FACTORS TO CONSIDER FOR PROFITABLE AQUACULTURE

Under the right condition, aquaculture can be very profitable. The following checklist of questions can help determine whether an aquaculture enterprise is feasible for a particular situation or not. This does not over look the other aspect of accounting principles that are dealt with later in the bulletin. Also answering “yes” to cost of items/issues raised would not guarantee success just as answering “no” does not guarantee automatic failure. It is very advisable to contact your local extension agent for more technical details.

5.1 Management

The role of management is central to the success of any business enterprise. Management involves the integration of manpower, materials and money in a judicious way, such that anticipated profits can be assured. Practicing and potential aquaculturists should be guided by the following questions.

- Do you already have suitable pond or a site suitable for ponds?
- Do you have most of the machinery and equipment needed?
- Do you have the necessary financial resources?
- Is the potential of profit higher in aquaculture than that of other possible enterprises?
- Will the expected profit be adequate compensation for your labor, management and risk?
- Will investment and operating capital interest rates permit a reasonable profit?
- Is mono culture, polyculture or integrated the most suitable for your
- condition?
- Will you be able to forego income until you sell your fish crop? Are you able to absorb occasional losses?
- Are you willing to devote daily the time and effort required?

Aquaculture is capable of significantly expanding the availability of fish products and the basic economic law of demand and supply will cause prices to fall as supplies increase.

5.2. Marketing

In fish farming. market has key role to play in the management decisions taken on any aspect. Management decisions, which affect customers, are part of marketing and must be considered from marketing point of view.

Marketing strategies for fish farmers involve the following procedures.

1. Identify changing demands of market places
2. Match production to market need
3. Select ideal candidate fish species for culture i.e. fast growers, hardy, and good feed converters•
4. Evaluate market acceptance of fish species to be grown
5. Attempt satisfying buying pattern of consumers. More demand should lead to farm expansion.
6. Match production and consumers needs to available resources.
7. Apply the marketing mix concept. (4ps)
   a) Product planning and development
   b) Place for transfer of product to consumer i.e. ideal selling location.
   c) Promotion of product sales by advertisement and other sales promotion
   d) Price determination and pricing policy

Relevant questions in marketing the fish are: -

- Do you know any established market for your fish?
- Will the market for your fish at the planned sales time be available?
- *Are* there suitable arrangements for harvesting your fish?
- Can you be flexible and harvest fish during the off-season?
- Is there an alternative marketing strategy which you hope to fall back to in case there is a problem with current arrangement?

5.3 Physical Conditions

Good physical conditions that are required for fish to grow well under culture are prerequisites to successful enterprise. Topography, soil structure, regular water supply, and security issues are important. Consider these questions in meeting adequate physical. conditions

- Is the topography of the area suitable for pond construction?
- Will the soil retain water?
- Are there enough water supplies to replace any water loss?
- Is the pond area liable to flooding?
- Are the drains adequate for proper water drainage?
- Can wild fish be prevented from entering the pond?
- Is the pond bottom stump-free to prevent difficulties in harvesting?
- Is the pond close to your residence for prompt management and monitoring?

5.4 Production

Major factors of production that are indispensable in economics are: land, labor and capital. In aquaculture, the source of fingerlings, adequacy of feed inputs and drugs, availability of technical support (extension and consutancy) and feed storage facilities are also important production factors.

Farmers should face the challenges of the following questions for enhanced production: -

- Are good quality feeds readily available at competitive prices?
- Do you have reliable supply of drugs and other vaccines?
- Is the source of your fingerlings reliable?

- Do you have dependable labor?
- Is your feed storage facility a good one?
- Do you know the extension agent/fishery officer in your area?

6.0 RECORD KEEPING

Many at times the major problem of most farm enterprise is lack of reliable economic data. The best source of data is farm record either in commercial, pilot or experimental farms. There are many forms of records, but most of them simply list the input and output operation both in physical (kg) and monetary terms. The collection and analysis of data on costs and returns based on farm records provide among others the information necessary to:

- determine the relative profitability of various production techniques or systems,
- compare the productivity of major inputs, such as land, labor, and capital, with that of alternative production activities and
- improve the efficiency of the farm operation.

Seasonal records on the other hand are annualized data to show production and marketing trends over the years Such records enable a farmer to respectively assess farm performance and project future production trends for possible new investments.

There are two types of farm record, namely, daily and seasonal records. Daily records are important so that the performance of the farm operations can be fully evaluated. It is therefore necessary to keep this record as simple and comprehensive as possible. A record per pond can be kept. On the other hand, records on a number of ponds in similar condition could be kept• In any case, each record can he kept in a separate book or on separate pages of the same record book.

Where computers are handy separate file can be kept for each pond or a number of ponds as the case may be. However, it is always advisable to keep back- up copies of such files elsewhere either in hard copies from time to time or in *a* soft copy on flash discs, diskettes, CDs, etc. Types of information that can be kept in records of aquaculture farms are discussed below:

6.1 Input records

There are two kinds of inputs: -variable and fixed, Variable inputs are those which vary with the level of production such as fingerlings, feeds, fertilizers, labor, drugs fuel, electricity and water. Variable inputs often have variable costs. Fixed inputs on the other hand, are those that do not change with the level of farming activity. Included in this category are items such as rent on land, tax, interests, insurance premiums, depreciation on fixed assets, and staff salaries. It is very important to describe each of the variable input and or cost in as much detail as possible. For example, if polyculture is practiced, then the stocking materials should be classified by stocked species and by sizes such as fingerlings, juveniles and adult fish. Feeds that are used should be well specified in relation to the kind, e•g. pellet, rice meal, ground-nut cake etc. In the ease of fertilizer, the kind should also be specified e.g. poultry or pig manure, inorganic fertilizer etc. **Table 3** shows a typical example of how each could he recorded in terms of amount, unit and total cost.

Table 3: Daily records of a Typical Fish Farm

Date	Item	Kind	Quantity	Unit cost (N)	Total Cost
	Variable Inputs				
	-Fingerlinsgs	Clarias etc	250	10.00	2500
	-Feed	Rice Bran	3 bags	150.00	450.00
	-Fertilizer	Poultry Manure	3 Trucks	200.00	600.00
	-Water	Up Stream	40,000lt	0.20	8,000.00
	-Fuel/Electricity	Diesel	3000 Litres	22	6,6,000.00

Aquaculture practices other activities such as pond fertilization, stocking, feeding, pond maintenance, harvesting and marketing. These activities require labor. In that case it is very important to keep a separate record for labor. The kind of labor should always be specified in terms of adult, children, male, female. All wage payments should be recorded too. One other important variable is farmer's family labor. This must be adequately recorded. **(Table 4)**

Table 4: Labour Input Record for a Typical Fish Farm

Date	Economic Activity 2	Kind of Labour 3	Duration (Day, Hour) 4	Wage Rate (per Man-day N) 5	Total Labour Cost 4=x5
	Pond Preparation Feeding Harvest	Adult Male Adult Female Male Children	3 Man-days 4 hours 5 hours	150.00 15.00 12.00 **Total**	450.00 60.00 60.00 **570.00**

A list *of* fixed assets with their initial or current cost and their estimated years of economic life is needed for calculating depreciation• The easiest and commonest is the straight-line method. In this, the cost of the asset is divided by the expected economic life span of the asset. Where there is a salvage value, it is deducted from the initial cost before annual depreciation is calculated. Where an asset has been used for same years, the current replacement cost should be used instead of its original cost of purchase. It is important to note that if the fixed asset is shared between aquaculture and other far, activities, an appropriate proportion should be determined for the fixed asset before computing depreciation. Table 5 below shows hypothetical fixed asset and depreciation.

Table 5: Fixed Asset Record of a Fish Farm

Item	Year of purchase	Cost (N)	Current market value	Salvage Value (N)	Depreciable Balance (N)	Estimated Economic Life(yrs)	Proportion Used for fish Farming	Depreciation
	1	2	3	4	5	6	7	8=5/6x7
Pond Water Pump Office	1996 1997 1996	2000.00 1100.00 150,000.00	800.00 160,000.0	150.00 200.00 100,000.00	1850.00 900.00 50,000.00	10 5 40	100 80 50	185 144 625

6.2 Output Record

The following are important items that should be included in output record: Date of harvest, species harvested, (with amount and unit price), and the, disposition of product. When determining or computing gross revenue on the farm, cash and credit sales *of* the product should be recorded. In addition computed values of home-consumed products as well as those given out should be recorded. To get the computed values of the home consumed or those given out, it is advisable to use the current market prices of the fish. It is also important to have a record of inventory at each period of accounting. Thus beginning and closing inventory should *be* kept. At the end of each cycle or the year, the quantity and value of production by species and the operation cost by items of each fishpond or a group of ponds in similar conditions should be summarized and presented in a single sheet The purpose of this is *to* be able to know at a glance the farm's production situation.

These records are important for various reasons as stated below:

1. Records help the farmer to establish a number of facts or efficiency standard which form the basic tools of diagnosis and planning
2. Records can provide the farmer with information on production situation in the farm
3. A good record provides an effective mechanism for monitoring and evaluating the farm
4. Records provide information for appraisal which may show the strength or weakness of management pattern the farmer adopted on the farm.
5. Records give data that may be used to formulate plans and provide estimates
6. Records could be used for meeting some legal/contractual arrangements

7. Records add credibility to the claim of many business organizations
8. Records may be used to create the spirit of competition among farmers/workers, it could also form the true basis for giving incentives to workers.

7.0 COST COMPONENTS TO CONSIDER

The cost items as earlier explained are composed of the fixed and variable costs. While the fixed cost include items such as salaries of staff, interest payment on loans depreciation on assets, taxes and rents on land. The items of variable cost include payments for casual labor, feeds, fingerlings, fuel and other consumables.
In a typical fish farm, the fixed arid variable cost items are outlined below.

A) Fixed cost items.

* Land *(*purchase*)* taxes and rents*)*
* Pumps/tanks and accessories and ether farm equipment.
* Farm structure (buildings, pond structure, etc)
* Brood stock acquisition
*
* Interest payment on loans,
* Depreciation on assets.

B) Variable cost items.

* Fish seed/Feed/Medication
* Fertilizers/manure/lime

* Casual labor/maintenance wages.
* Transportation maintenance {fuel, etc)
* Consultancy cost where necessary.
* Other consumables.

8.0 FARM BUSINESS ANALYSIS

This is often used to show the levels of cost, return and profit that accrue to a fish farm. The profitability of each option is determined to show the strength and weakness of any acuaculture system. It is the difference between the total revenue and total cost of production. The revenue include items such as fish sold, harvest consumed at home/farm, those given as gift and change in inventory.

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The cost and returns analysis is not static; consideration should be given to some of the variations and interactions of factors affecting production and profit.

Table 6

Cost and Returns of Tilapia-Clarias combination in a Poly-culture System.

No	Item	Tilapia – Claris			% of Total Cost
1	Cost	Unit price (N)	Quantity	Value	
A.	Operating Cost				
	Labor	120	126 Man-days	15,000	12.4
	Feed	5	2600kg	12,500	10.3
	Seed/fingerlings	-	-	-	-
	Tilapia	5	2,400 No	12,000	9.9
	Clarias	15	3,000 No	45,000	37.3
	Fertilizer	30	400kg	12,000	9.9
	Lime	-	-	-	-
	Other	-	-	-	-
	Total Variable Cost	-	-	96,500	80.0
	Fixed Cost	-	-	-	-
B	Salaries	2,000	12 months	24,000	19.9
	Depreciation	-	-	-	-
	Taxes	-	-	-	-
	Interest Payment	-	-	-	-
	Total Cost	-	-	120,500	100
2.	Production and Revenue Output				
	Tilapia	20	600	12,000	-
	Clarias	100	1200	120,000	-
	Gross Income	-	-	132,000	-
3	Profitability				
	Net Income (132-120.5) '000			11,500	
	Rate of Return on Investment			9.5%	
	Rate of Return on Operating cost			11.9%	
	Production per man day			14.4Kg	
	Value of production per man-day			₦1056	

9.0 INVESTMENT ANALYSIS

For a sound decision to be made a good analysis of records and data on the farm is necessary. We shall consider a farmer who is trying to go into either monoculture or polyculture practices for better understanding. He has to determine how profitable the venture would be and then make a choice. Below are the various profitability measures, which he can use.

9.1 Payback Method: -It is simply the time taken for expected enterprise to fully recover the initial investment. In order words, it is the time taken for the investment choice to fitly pay the exact amount invested in the project. Depreciation. interest and tax charges are usually not included in this computation. For example, consider the options shown in **Table 7** below. The payback time is *5* years for option I, since by end of the fifth year enough cash has been generated to recover the initial investment of N 2,900.00 with N 600.00 to spare. For option ll, the payback time is 3 years. By the end of 3 years enough profit has been made to recoup the initial investment ofN2,900.00. With regards to option 111, (Tilapia-Bargus-Clarias) the payback time is 6 years. The payback method is useful for closing the project, which repays the initial investment in the shortest time. According to this method therefore, Option II(Tilapia — Clarias) is preferable as the initial investment is recovered within 3 years as against *5* years for option I (monoculture of Tilapia) and 5 years for Option (polyculture of Tilapia-Bagrus Clarias). Payback period method builds on the need to avoid risk by valuing early returns highly. But then, returns beyond the payback period are ignored, hence some very profitable opportunities may be forgone.

Table 7: Illustration of Payback Periods for different stocking combinations

	Option Tilapia	Option II Tilapia-Clarias	Option III Tilapia Bargrus-Clarias
	₦	₦	₦
Year 0	(2,900)	(2,900)	(2,900)
Year 1	700	1,000	510
Year 2	700	1,000	510
Year 3	700	1,000	510
Year 4	700	2,000	510
Year 5	700	2,500	510
Year 6	700	0	510
Year 7	800	0	510
Year 8	900	0	450
Year 9	0	0	510
Year 10	0	0	900
Cumulate Net Cash Flow	3000	4,600	1,000

The other advantages of this method are;

a. It is a simple cash flow, easily understood by farmers
b. It values early returns and keeping liquidity (cash a*t* hand) in a situation of cash storage
c. Projects needing small capital outlays that payback early in their expected life are easily identified without spending much time on more complex studies
d. It helps to isolate poor projects that have a long pay back time.
e. This method helps in a situation where a risky project needing quick recovery *of fund is concerned*. It thus saves time by automatically accepting or rejecting many possible investments.

Nevertheless, one of the major disadvantages of this method is that it does not take into account the time value of money.

9.2 The Peak-Profit Method:

This involves presenting the level of profits in the best year as a percentage return on the sum invested. Using the figures in Table 7 for Option II, (Tilapia), the highest profit was obtained in the 8th year (N900.00) which is 3% of the original investment. For Option (Tilapia-Clarias) and III (Tilapia-Bagrus-Clasias) their peak-profit was 51.0% (5th year) and 20.4% (10th year) respectively. Therefore Option II (Tilapia-Clarias) with the highest peak profit is preferable to the other options.

This method assumes that peak profit is a reliable guide to average profitability of a project. The use of this method has some disadvantages though. Some projects reach their peak profit early while it may take a considerable time for others. A project with a low, early and consistent profit that give higher profit later can be a good option as early profit may be re-invested. Therefore, overall profit maximization may likely involve more than maximizing peak profit.

9.3 Net Present Value

This is sometimes called excess present value. It is the *present value of future net cash in flows* **minus** *the initial capital cost.* That is, the present value of the surplus profits expected after repayment of principal and interest. This is based on the understanding that a Naira today is better/higher than a Naira tomorrow. Consider the three options with an initial capital outlay of N 2,900.00, and the streams of incomes as shown in columns 2,4 and 6 in Table 8. If the streams of profit are capitalized i.e exchanging the streams of future receipts for a single, discounted value, we can then compare the projects more easily.

Given some time preference rate, each year's net cash flow can be reduced to a present value by multiplying it by $1/(1+r)^n$ Where r = Interest Rate and n is the year considered. This process is known *as* discounting. This may be difficult to calculate using the above formula. Luckily there are tables which gives the value of $1/(1+r)^n$ for a wide range of values of r and n. The figure obtained is known as the discount factor. The present values of all the annual net cash flows can then be summed up to give the Total Present Value. If the initial investment is subtracted from the total present value, the result is called the Net Present Value (NPV).

For example, assuming that the three aquaculture projects with initial capital outlay of N 2,900.00 gave different returns (profit) for different years as outlined in Table 8, the Net Cash flows have to be brought to their present values (discounted). These values can then be compared and a choice made depending on how favourable the venture to be chosen is. This has been done and presented in Table 8 below,

Table 8 Net Present Value (NPV) of three aquaculture system

Year	Discount factor	Project 1 Tilapia		Project II Tilapia-Clarias		Project III Tilapia Bagrus-Clarias	
	20%	NCF	PV	NCF	PV	NCF	PV
0	1	2	3=1x2	4	5=4x1	6	7=6x1
1	1	(2900)	(2,900)	(2,900)	(2,900)	(2,900)	(2,900)
2	0.8333	700	583.31	1,000	833.3	510	424.98
3	0.5787	700	405.09	1,000	578.7	510	295.14
4	0.4823	700	337.61	2,000	964.6	510	245.97
5	0.4019	700	281.33	2,000	803.8	510	204.97
6	0.3399	700	237.93	-	-	510	173.35
7	0.2791	700	195.37	-	-	450	125.60
8	0.1938	800	186.08	-	-	510	118.63
9	0.1615	-	-	-	-	900	174.42
10	0.1615	-	-	-	-	700	113.05
Cumulative NCF		2,800	NA	4,100	NA	2,020	NA
Total Present Value		NA	2,712.8	NA	3,071	NA	2,230.25
Less Initial Investment		NA	2,900.00	NA	2,900.00	NA	2,900.00
Net Present Value		NA	-187.2	NA	171	NA	-669.75

PV = Present Value
NCF=Net Cash Flow

When the training of the net cash flow is accounted for, it is clear that only Option II (Tilapia-Clarias) can repay the capital cost with an interest of 2O percent in ten years. Option II is the most favored and therefore chosen. In this case an average of 20% has been used for explanation purposes. Using a discount factor of say 16 per cent may show a different picture of the options. It is worthy to note that a reasonable discount rates that takes the rate of inflation and interst into consideration is preferred. This is because different rates give.different ranking between projects. It should-be noted that when using the Net Present Value, a negative figure shows that the project considered is not worth investing in but if a choice must be made the one with the lowest negative value is chosen. The major disadvantage

of this is its inability to give an adequate indication of what choice to make in the case of different options. Another simpler tool that could be used is the Benefit cost ratio. It shows the ratio of the accrued benefits of the project to the expended funds. A ratio of less than one shows that the project is not viable.

9.4 Internal Rate of Return (IRR)

This is perhaps the most commonly used method of capital investment analysis. It considers net earning over the entire life span of the investment. Simply put, it is the rate at which the net present worth of the cash flow equal zero. It could be represented mathematically using our example in Table 8, we can calculate the IRR which could be termed a response to a question in the mind of the investor. This question is, what interest rate will this option (II) earn considering the fact that it has a positive Net Present Value that is highest among the three options? We equally have a question such as what is the earring power of the money invested in this option? This is termed IRR. It is calculated using the following method (It uses two discount factors as follows).

IRR=Lower discount rate+ Absolute difference (Present worth of cash between the two flow at the lower discount rate) Discount rates (Absolute difference between the present worth of the cash flow at the two discount rates)

$$= 10+6\frac{(2,194.6)}{(786.8)}$$

$$= 26.7$$

$$= 27\%$$

The IRR for the Tilapia-Clarias project is therefore 27%. The major advantage of this is that the outcome of this analysis is often stated in percentages. The actual rate of returns as could be seen is that found by an interpolation between discount rate to say 10 per cent or by increase it to 25 per cent as deserved. The implication of the result above is that every naira invested in the project will generate 27k.

The IRR for Options I and III, are 18% and 14% respectively using the above formula and thus confirming our earlier choice using other methods. It should be noted that, it is usually a project that has an IRR above the cost of borrowing of capital that is accepted, Projects are ranked in order of the value of IRR. It is not that this method is error proof, but major problems that could arise due to trial and error can be overcome especially by using good electronic calculators. Another problem is that of over simplification in assuming a uniform return that is constant over a period of time and constant inflation rate that is dealt with through the process of discounting.

10.0 CONCLUSION

Fish culture is an interesting enterprise that can be highly profitable. Prospective investors should know the basic investment analysis that will guide them in taking decision. This is what this bulletin has tried to provide, With detail preparation of feasibility of projects, financial institutions and some non-governmental organization will have adequate information to assist prospective fish farmers. It is hoped that the information in this bulletin will go a long way in helping fish farmers to keep production and financial records for sustainable and profitable enterprises.

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