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ECONOMICS OF INTEGRATED FISH CUM RICE AND POULTRY PRODUCTION

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Introduction

Integrated aquaculture is the concurrent production of fish and other agricultural activities, with the main objective of optimizing the productivity of water, land and the associated resources (Gomez 2011).The basic principle of integrating aquaculture with agriculture is to ensure maximum on-farm resource-use and productivity. Thus the system is knowledge-intensive, and a holistic approach that integrates numerous component and technologies within systems management (Jahan et. al. 2013).The rising cost of high protein fish feed and inorganic fertilizer, as well as the general concern for energy conservation, have brought about increased interest in the utilization of animal manures in aquaculture and in the traditional systems which integrate animal husbandry with aquaculture. Recent experiments have demonstrated that the application of animal manure in the right proportion can support considerable fish production in polyculture systems. It is now established that integrated fish cum livestock farming is a good strategy that can be adopted by small scale farmers in developing countries to boost farm yield and returns. Similarly, integrated farming is a way of ensuring stability in the production processes by spreading the risk of production over several activities. Since livestock and fish production activities are not usually characterized by co-variant risks, the farmer is able to stabilize inter temporal flow of daily income. Moreover, integrated farming maintains environmental friendliness by facilitating productive use and recycling of wastes (Amarasinghe 1992, Nwanna and Ogundowole, 2013).

Advantages of Integrated Aquaculture and Agriculture

According to FAO (1985), the main advantages of IAA include:

Establishment of a man-made ecosystem without any wastes

The manures of livestock and poultry are good organic fertilizers for fish farming. About 40–50 kg of organic manures can be converted into one kg of fresh fish. In an integrated fish farm, the manures of livestock and poultry and the dregs, lees and waste/water obtained from starch processing and wine brewing are all used for fish farming. The pond silt can be used as fertilizers for terrestrial fodder crops which can in turn be used to raise livestock and poultry or directly for fish farming.

Thus, it forms a recycling ecosystem, which utilizes various wastes and afterwards, an agricultural ecosystem can be set up without any wastes.

Increasing the food supply for mankind

Short supply of plant and animal protein is a serious problem especially in the developing countries. The competition for the available food between man and livestock, as well as domesticated wildlife and fisheries makes the prices high. Therefore the use of the feedstuffs in fish nutrition increases the cost of production by over 65% (Nwanna 2002). Organic manure can be applied in fish ponds as a supplementary feed or as a fertilizer to boost natural food organisms in water for the fish which would reduce the quantity of feed applicable to the pond, thereby reducing the cost of production. It is apparent that integrated fish farming can lead to full utilization of the body of water and pond silt, the water surface and the land for maximum productivity. The products from an integrated fish farm are not only fish but may include meat, milk, eggs, fruit, vegetables, and so on. Also in unitary fish farming system, the labour force may not be fully utilized while the integrated fish farm may offer better utilization of labour and sometimes create more jobs.

Reducing the cost, raising the output and increasing economic benefits

Nowadays, the major problem facing aquaculture development in developed countries is the high cost of pelleted feeds, resulting from high cost of energy and shortage of protein feedstuffs. But integrated fish farming system produces feeds and fertilizers for itself, saves energy and reduces cost of production considerably.

Factors to consider for profitable Integrated Fish *Cum* Rice and Poultry Production System

1. **Management**

The role of management is central to the success of any business enterprise. Management involves the use of manpower, materials and money in a judicious way, such that anticipated profits can be achieved. Farmers who want to practice integrated fish cum rice and poultry production should be guided by the following questions.

- Do you already have suitable ponds 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 integrated fish cum rice and poultry production than these of other possible enterprises?
- Will the expected profit compensate adequately for labour, management and risk?

- Will investment and operating capital interest rates permit a reasonable profit?
- Is mono culture, polyculture or integrated system the most suitable for your condition?
- Are you willing to devote daily the time and effort required?

2. Marketing

Market has key role to play in the management decisions taken on any aspect of integrated fish cum rice and poultry production. Marketing strategies for farmers practicing integrated fish production involve the following procedures.

Relevant questions in marketing the outputs are: -

- Do you know any established market for your fish, egg, fowl and rice?
- Will your products be available at the planned sales time?
- Are there suitable arrangements for harvesting the products?
- Can there be off-season harvests?
- Do you have any alternative marketing strategy to fall back on in case there is a problem with the current arrangement?
- Since integrated fish farming system involves the reuse of recycled waste, will the final products be acceptable by the immediate social environment?
- If the products may not be acceptable by the immediate environment, can you make alternative arrangements for marketing of the farm products.

3 Physical Conditions

Good physical conditions are necessary for the success of integrated fish farming system. For instance, good topography, soil structure, regular and unpolluted water supply, climate and security issues are germane to profitable enterprise.
Consider these questions in meeting adequate physical conditions.

- Is the topography of the area suitable for pond construction?
- Will the soil retain water?
- Will the soil support rice cultivation?
- Are there enough water supplies to replace any water loss?
- Is the pond area liable to flooding?
- Are the channels 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?
- Is the climate suitable for poultry and rice production?

4. Production

Indispensable factors of production in economics are: land, labour and capital. In integrated fish cum rice and poultry production, the source of fingerlings/chicks/seeds, adequacy of feed inputs and drugs, availability of technical support and feed storage facilities are also important production factors.

Farmers should take the following questions into consideration 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/chicks/seeds regular and reliable?
- Do you have dependable labour?
- Is your feed storage facility in good order?
- Do you have collaboration with extension agent/fishery officers in your area?

RECORD KEEPING

Farm records keeping refers to the documentation of events, activities, transactions, or news that occur on the farm. Farm record keeping is a key to the success of every farming business. It provides the farmer with a tool to help in farm planning, farm management decision making, and projection of future profitability of the enterprise, with the aim of maximizing farm profit.

Importance of Farm Records

i. Farming is a business and record can be helpful in planning improvements for that business and making proper management decisions.

ii. Farm managers need a complete and accurate farm records system in order to make informed management decisions that will help maintain or improve farm business profitability.

iii. Farm managers can use records to determine what the efficiencies and the inefficiencies are, measure progress of the business and plan for the future.

iv. Farm managers can also use records to compare the productivity of major inputs, such as land, labour, and capital, with that of alternative production activities and thus improve the efficiency of farm operation.

v. Records help the farmer to establish a number of facts or efficiency standard which form the basic tools of diagnosis and planning.

vi. Records can provide the farmer with information on production situation in the farm.

vii. A good record provides an effective mechanism for monitoring and evaluating the farm.

viii. Records provide information for appraisal which may show the strength or weakness of management pattern the farmer adopted on the farm.

ix. Records give data that may be used to formulate plans and provide estimates.

x. Records could be used for meeting some legal/contractual arrangements.

xi. Records add credibility to the claim of many business organisations.

xii. 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.

xiii. Keeping records can help the farmer improve his efficiency to meet the set goals.

xiv. Good farm records help you see what works, what doesn't, and how to make changes to move the business forward.

xv. If you keep a detailed farm record about the specifics of your farm operation - the animals and crops, not just the finances - you're getting a full picture of how your farm is functioning. For example sometimes you may be succeeding at generating positive income on your farm, but you're struggling with an aspect of animal care that requires adjustment. Or, you may find that your profits are suffering, and the root cause is that you are simply charging too little. You won't be able to trace that root cause unless you record how much feed you're buying and how many chickens that translates into.

xvi. Many grants and loans for small farmers require financial records on how much is earned, and the expenses incurred by the farmer among other things.

Farm records will certainly help the farmer to prepare accurate and standard feasibility report to get loans from banks.

Types of Farm Records

There are different types of farm records classified by the periodicity of data entering, types of variable or subject matter the records contain. Although, there are conventional farm records, the format or types of farm records employed must be at the convenience of the farmer. The following are some examples of farm records.

Seasonal records: These are yearly data to show production and marketing trends over the period. Such records enable a farmer to effectively assess farm performance and project future production trends for possible expansion.

Daily farm records: These are records of important events and activities that take place on the farm every day. These records serve for future planning of the farm activities. Example of a daily farm record is shown in Tables 1 and 2.

Table 1: Daily Farm Record

Date	Activity
1st October 2011	200 broilers were sold
25th October 2011	Rice plots were weeded
17th November 2011	Fish pond was stocked

Records of farm implements and equipment: as in the example shown in Table 2 below

Table 2: Daily record of Farm Implements and Equipment

Date of purchase	Type of Equipment	Quantity	Price	Description/ remarks
3rd October 2011	Cutlasses	5	₦2500	Brand new (or fairly used)

Record of agricultural inputs: These show types and amounts of farm inputs such as fingerlings, feeds, seeds, fertilizers etc. The farmer records amount purchased, amount used and amount left for each month.

Records of livestock and livestock products: Each type of livestock needs different records. Eggs records are good examples of livestock products records in this case.

Records of animal feeds: These records show the types and quantity of feeds used and the amount of feed remaining in the store. An example of animal feed record is shown in Table 3.

Table 3: Animal Feeds Record

Date	Type of Feed	Quantity In store	Quantity Bought	Unit Price	Total Cost	Quantity Used	Balance In store

Production records: These records document everything that is produced on the farm. They are mostly prepared on weekly basis which add up to monthly and annual records. These records monitor the value of the farm produce and measure progress in production and enable individual farmers to access farm credits. An example of production record is presented in Table 4.

Table 4: Production Record

Date	Type of Produce	Quantity	Value (Naira)
5th September 2012	Eggs	10 crates	2500
3rd November 2012	Chicken/birds	20	15,000
10th December 2012	Rice	100 kg	20,000

7) **Records of farm use**: These records show the dates for land preparation, pond construction, poultry pen construction/preparation, planting of different plots, stocking of ponds, sales or utilization of produce and rotation programs. They also include difficulties encountered on the farm during pond construction/preparation, land preparation, inoculation and challenges such as disease and pest outbreaks.

8) **Labour records**

Integrated fish, rice and poultry production involves so many activities such as pond fertilization, stocking, feeding, pond maintenance, weeding of rice plots and pond surroundings, cleaning of poultry cages, harvesting and marketing. These activities require labour. In that case it is very important to keep a separate record for labour. The kind of labour should always be specified in terms of adult, children, male or female. All wage payments should be recorded too. One other important variable is farmer's family labour which must be adequately quantified and recorded. An example of labour record is presented in Table 5.

Table 5: Labour Records

Date	Economic Activity	Type of Labour	Duration (Day, Hour)	Wage Rate (per man-day ₦)	Total Labour Cost
	Pond Preparation	Adult Male	3 Man-days	1500.00	4500.00
	Feeding	Adult Female	4 hours	150.00	600.00
	Harvest	Male Children	5 hours	120.00	600.00
				Total	**5700.00**

9) Fixed Asset Record

A list of fixed assets with their initial, current cost and estimated years of economic life is needed for calculating depreciation. The easiest and commonest means of calculating depreciation is the straight-line method. In this case, the salvage value is deducted from the cost of the asset and then the result is divided by the expected economic lifespan of the asset. This method is exemplified in Table 6.

Table 6: Fixed Asset and Calculation of Depreciation

Item	Year of purchase	Cost (₦)	Salvage value (N)	Depreciable Balance (N)	Estimated Economic Life (yrs)	Depreciation
	1	2	3	4= 2-3	5	6= 4/5
Pond	2006	20000	1500	18500	10	1850
Water Pump	2007	1100	500	600	5	120
Poultry house	2006	150000	25,000	125,000	10	12500

10) Accounting/financial records (where income and costs or expenditures are recorded)

11) Market records (for current prices of commodity items like rice, fish, poultry, eggs etc)

12) Inventory records

13) Sales records (which product was sold, to whom and for how much)

14) Workers records: Salaries and other payments

15) Vehicle records: petrol, oil used and any repairs

Consideration of Cost Components

Cost items are made of the fixed and variable costs. The fixed cost is the cost that must be paid even if production changes and they 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 causal labour, feeds, fingerlings, fuel and other consumables.

In an integrated fish, rice and poultry production system, the fixed and variable cost items are listed as follows.

A) **Fixed cost items:**
- Land (purchase or rents)
- Pumps/tanks and accessories and other farm equipment
- Farm structure (buildings, pond structure, poultry house, etc)
- Brood stock acquisition
- Staff salaries.
- Interest payment on loans,
- Depreciation on assets.
- Purchase of rice seeds
- Acquisition of birds

B) **Variable cost items.**
- Feed and Medication
- Fertilizers/manure/lime.
- Casual labour/maintenance wages.
- Transportation maintenance (fuel)
- Consultancy cost where necessary.
- All consumables.

Depreciation

Depreciation is the loss in value of fixed assets over time. If an asset is expected to produce a benefit in future, some of the costs must be deferred rather than treated as a current expense. The business then records depreciation expense in its financial reporting as the current period's allocation of such costs. This is usually done in a rational and systematic manner. Generally this involves four criteria:

- Cost of the asset,
- Expected salvage value, also known as residual value of the asset,

- Estimated useful life span of the asset, and
- A method of apportioning the cost over such life span.

Methods of depreciation

There are several methods for calculating depreciation, Generally, it is based on either the passage of time or the level of activity (or use) of the asset. The methods include straight line depreciation method, declining balance depreciation method, sum -of- years- digits depreciation method, annuity depreciation, unit of time depreciation, unit of production depreciation, group depreciation method and composite depreciation method. However, only straight line, declining balance and sum-of years-digits depreciation methods will be treated in this manual. These three depreciation methods are more relevant to farm business management.

Straight-line depreciation

Straight-line depreciation is the simplest and most often used method. In this method, the company estimates the salvage value (scrap value) of the asset at the end of the period during which it will be used to generate revenues (useful life). (The salvage value is an estimate of the value of the asset at the time it will be sold or disposed of; it may be zero or even negative. Salvage value is also known as scrap value or residual value.) The company will then charge the same amount to depreciation each year over that period, until the value shown for the asset has reduced from the original cost to the salvage value.

Straight-line method:

$$\text{Annual Depreciation Expense} = \frac{\textit{Cost of Fixed Asset} - \textit{Residual Value}}{\textit{Useful life of Asset (years)}}$$

For example, if a poultry house that depreciates over 5 years is built at a cost of ₦170,000, and will have a salvage value of ₦20,000, then this poultry house will depreciate at ₦30,000 per year, i.e. (170,000-20,000)/5 = 30000. An example of the straight-line method of calculating depreciation is shown in Table 7. Book value at the beginning of the first year of depreciation is the original cost of the asset. At any time, book value equals original cost minus accumulated depreciation. Book value = original cost − accumulated depreciation. Book value at the end of year becomes book value at the beginning of the next year. The asset is depreciated until the book value equals scrap value.

Table 7: Straight Line Method of Depreciation

Depreciation expense	Accumulated depreciation at year-end	Book value at year-end
		(original cost) ₦170,000
₦30,000	₦30,000	₦140,000
₦30,000	₦60,000	₦110,000
₦30,000	₦90,000	₦80,000
₦30,000	₦120,000	₦50,000
₦30,000	₦150,000	(scrap value) ₦20,000

Declining Balance Method

When using the double-declining-balance method, the salvage value is not considered in determining the annual depreciation, but the book value of the asset being depreciated is never brought below its salvage value, regardless of the method used. Depreciation ceases when either the salvage value or the end of the asset's useful life is reached. Suppose a business has an asset with ₦10000 original cost, ₦1000 salvage value, and 5 years of useful life. First, the straight-line depreciation rate would be 1/5, i.e. 20% per year. Under the double-declining-balance method, double that rate, i.e. 40% depreciation rate would be used. This method is illustrated in Table 8.

Table 8: Declining Balance Method of Depreciation

Depreciation rate	Depreciation expense	Accumulated depreciation	Book value at end of year
			original cost ₦10,000.00
40%	4000.00	4000.00	6000.00
40%	2400.00	6400.00	3600.00
40%	1440.00	7840.00	2160.00
40%	864.00	8700.40	1296.00
1296.00 - 1000.00	296.00	9000.00	scrap value 1000.00

Since double-declining-balance depreciation does not always depreciate an asset fully by its end of life, some methods also compute a straight-line depreciation each year, and apply the greater of the two. This has the effect of converting from declining-balance depreciation to straight-line depreciation at a midpoint in the asset's life. With the declining balance method, one can find the depreciation rate that would allow exactly for full depreciation by the end of the period, using the formula:

Depreciation rate: $1 - \sqrt[N]{\frac{residual\ value}{cost\ of\ fixed\ asset}}$ where N is the estimated life of the asset (for example, in years).

Sum-of-years-digits method

Sum-of-years-digits is a depreciation method that results in a more accelerated write-off than the straight line method, and typically also more accelerated than the declining balance method. Under this method the annual depreciation is determined by multiplying the depreciable cost by a schedule of fractions.

Depreciable cost = original cost − salvage value

Book value = original cost − accumulated depreciation

Example: If an asset has original cost of ₦100,000, a useful life span of 5 years and a salvage value of ₦10000, its depreciation schedule can be computed as follows:

First, determine years' digits. Since the asset has useful life of 5 years, the years' digits are: 5, 4, 3, 2, and 1.

Next, calculate the sum of the digits: 5+4+3+2+1=15

The sum of the digits can also be determined by using the formula $(n^2+n)/2$ where n is equal to the useful life of the asset in years. The example would amount to $(5^2+5)/2=15$

Depreciation rates are as follows:

5/15 for the 1st year, 4/15 for the 2nd year, 3/15 for the 3rd year, 2/15 for the 4th year, and 1/15 for the 5th year. This is further illustrated in Table 9.

Table 9: Sum of Years Digit Method of Depreciation

Total depreciable cost	Depreciation rate	Depreciation expense	Accumulated depreciation	Book value at end of year
				₦100000 (original cost)
90000	5/15	30000 (90000 x 5/15)	30000	₦70000
90000	4/15	24000 (90000 x 4/15)	54000	₦46000
90000	3/15	18000 (90000 x 3/15)	72000	₦28000
90000	2/15	12000 (90000 x 2/15)	84000	₦16000
90000	1/15	6000 (90000 x 1/15)	**90000**	**10000 (scrap value)**

Cash Flow

In accounting, cash flow is the difference in amount of cash available at the beginning of a period (opening balance) and the amount at the end of that period (closing balance). It is called positive if the closing balance is higher than the opening balance, otherwise called negative. Cash flow is increased by (1) selling more goods or services, (2) selling an asset, (3) reducing costs, (4) increasing the selling price, (5) collecting faster, (6) paying slower, (7) bringing in more equity, or (8) taking a loan. The level of cash flow is not necessarily a good measure of performance, and vice versa. High levels of cash flow do not necessarily mean high or even any profit; while high levels of profit do not automatically translate into high or even positive cash flow. The cash flow statement organizes and reports the cash generated and used in operating, investing, financing activities as well as supplemental information.

Importance of Cash Flow

1. Determination of a project's rate of return or value.
The time cash flows into and out of projects are used as inputs in financial models such as internal rate of return and net present value.

2. Determination of problems with a business's liquidity.
Being profitable does not necessarily mean being liquid. A company can fail because of a shortage of cash even while profitable.

3. Cash flow can be used to evaluate the 'quality' of income generated by accrual accounting. When net income is composed of large non-cash items it is considered low quality.

4. Cash flow can be used to evaluate the risks within a financial product, e.g., matching cash requirements, evaluating default risk and re-investment requirements.

5. The cash from operating activities is compared to the company's net income. If the cash from operating activities is consistently greater than the net income, the company's net income or earnings are said to be of a "high quality". If the cash from operating activities is less than net income, a red flag is raised as to why the reported net income is not turning into cash.

6. Some investors believe that "cash is king". The cash flow statement identifies the cash that is flowing in and out of the company. If a company is consistently generating more cash than it is using, the company will be able to increase its dividend, buy back some of its stock, reduce debt, or acquire another company.

Farm Business Analysis

Costs and Returns in Integrated Livestock *Cum* Fish Farming Systems

Since profitability of a particular enterprise depends on various costs and returns associated with it, it is necessary to identify the various cost and returns associated with integrated livestock-fish farming systems in order to find out the various forces that influence them and to subsequently find out means of increasing the profitability of the system.

The profit function of an integrated livestock-fish system can be written, in a very general form, as follows:

$$\pi = (P_1.Y_1 + P_2.Y_2) - (C_1 + C_2) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

(π = profits; P_1 & P_2 = unit price of animal and fish produced, respectively; Y_1 & Y_2 are animal and fish output, respectively; while C_1 & C_2 are cost of production of the animal and fish.

The levels of Y_1 and Y_2 in equation (1) depend on various biological and technical factors such as stocking rate, growth rate, nutrition, management and technological developments. P_1, P_2, C_1 and C_2 are economic variables, whose magnitudes depend on various economic factors. If the object of farming is profit maximization, then obviously one has to maximize the difference between the revenues ($P_1.Y_1 + P_2.Y_2$) and costs ($C_1 + C_2$).

Cost of Production

A breakdown of all expected cost items in the production of animal and fish in an integrated livestock-fish farming system is given in Table 10.

Fixed costs:

Fixed costs in the animal rearing component of a livestock-fish integrated system consist of those costs incurred from the construction of animal houses and purchase of equipment, and is usually higher than the variable cost items. This cost becomes much higher if the animal enterprise in the system is either rearing of cattle (under zero grazing) or pig keeping, which require strong sheds. However, this cost is lower if the animal enterprise is poultry and if low-cost locally available building material are used.

Table 10: Cost of Production of an Integrated Livestock-Fish Farming System

	Cost of Production		
	Animals (Poultry)	Fish	Rice
Investment Costs (Capital Items)	- Poultry pen - Young chicks - Equipment	- Pond Construction - Fish Seed - Fishing gear	Rice bed Rice Seeds
Variable Costs	- Medical care/Drug - Feed - Labour	Medical care/Drug - Labour	Labour

Farm Budgeting for Integrated Aquaculture

Farm budgeting is a process of estimating costs, returns and net profit of a farm or a particular enterprise. Budgeting is the technique and process for developing and analyzing

alternatives for decision making. It is a management tool that can provide information to answer a multitude of questions if used properly. Budgeting is a key to any successful business and allows farmers to gain control over all spending decisions. Covering inputs into products, allocating resources to alternative products, and choosing combinations of different products are choices whose consequences can be analyzed efficiently through the use of the budgeting tool. With budgets, management can begin to answer such questions as:

- How can the available resources be put to best use?
- What enterprises (crops and/or livestock) can be produced and which will contribute most to returns to investment?
- How much of the controlled land should be devoted to each enterprise?
- What equipment and machinery will be needed for optimal production?
- What production practices should give maximum yield?
- How much labour (both family and hired) will be needed on the farm?
- What are the capital requirements?

Advantages of Farm Budgeting

Farm budgeting has the following advantages.

1. It evaluates the old plan and new plans and guides on the adoption of a better one.
2. It makes the farmer conscious of the waste (leakage) in the farm business.
3. It gives comparative study of receipts, expenses and net earnings on different farms in the same locality and in different localities for formulating national agricultural policies.
4. It guides and encourages the most efficient and economical use of resources.
5. It serves as valuable basis for improvements in farm management practices.
6. It helps in planning for the useful life of assets.
7. It is an excellent device for organizing the farm resources.
8. It is useful in loan application process.
9. It facilitates experimentation before action.
10. It identifies cost and income items that might otherwise be overlooked.

Types of Budgets

There are three basic types of budgets that can be used in the farm business management processes. They include (1) Whole-farm budget, (2) Enterprise budget and (3) Partial budget. Each type of budget provides different information to the manager for use in the decision-making process. The common thread in each type is that, if properly defined and used, the budget format permits the manager to use economic logic to answer questions of

what, how much, and when resources should be used to achieve the goals and objectives as established by the farmer.

The whole-farm/complete or total budget is a classified and detailed summary of the major physical and financial features of the entire farm business. Whole-farm budgets identify the component parts of the total farm business and determine the relationships among the different parts, both individually and collectively. Complete/total or whole farm budgeting refers to preparing budget for the entire farm. Complete budgeting considers all the crops, livestock, methods of production and aspects of marketing in consolidated form and estimates costs and returns for the farm as a whole. A whole-farm budget includes all the enterprises to be carried out on the farm, and projects total income and expenses instead of income and expenses per unit (enterprise budget) or the net changes in income and expenses as a result of a certain management change (partial budget). Therefore, complete budgeting can be specifically defined as "An estimation of the probable income and expenditure for the farm as a single unit. A complete budget is required for preparing new farm or when drastic changes are suggested in the plan of the existing pattern on an established farm". Complete budgeting can be prepared for short run (annual budget) and for long run.

Table 11: Comparative Attributes of Whole Farm and Partial Budgeting

S/N	**Complete Budgeting**	S/N	**Partial Budgeting**
1	The whole farm is considered as one unit	1	It is adopted when a minor aspect of farm organization is touched.
2	All the aspects like crops, livestock, machinery and other assets are considered	2	It is practiced within the existing resources structure of the farm.
3	Both fixed and variable costs are calculated for working out costs and returns.	3	Only variable costs are considered.
4	Net income is estimated by deleting fixed costs and costs of variable inputs from the value of the product	4	Net income is estimated by deleting only cost of variable inputs from the value of the product.
5	It requires more efforts and time for preparation.	5	It requires relatively less efforts and time for preparation.

Whole-Farm Budgeting Process

The following guide lines may be followed in developing a whole-farm budget.
1) List the goals and objectives of the farm.

2) Carry out inventory of the resources available for use in production.
3) Determine physical production data that will be used in the input/output process.
4) Identify reliable input and output prices.
5) Calculate the expected variable and fixed costs and all returns.

For clarity, an example of a whole farm budget is presented in Table 12.

Table 12: A Whole-Farm Budget for Integrated Fish- Rice- Poultry Production

Income		Amount (Naira)
1	Poultry	333,960
2	Fish production	523000
3	Rice	24300
4	Total income (Σ1...3)	881,260
Variable input		**Costs (₦)**
5	Labour	40000
6	Rice seeds/rice processing	4500
7	Feed and medication	294540
8	60 Layers birds purchase at □1000 each and transportation	63,000
9	Fish fingerlings/juveniles	86000
10	Miscellaneous	24402
11	Total variable input cost (Σ5...10)	512442
12	Income above variable input cost (4-11)	368818
Fixed costs		
13	Land rent	30,000
14	Farm implements/tools and accessories (cutlass, shovel, brush, gallon, etc.	2550
15	Machinery depreciation (battery cage and pumping machine)	13083
16	Building depreciation (poultry house/pond/pond reservoir)	12466
17	Total fixed costs (Σ13...16)	58099
18	Total input cost (11+ 17)	570541
19	Profit (4-18)	310719

Source: Raw Data obtained from the University of Ibadan- CORAF Adaptive Research on Sustainable Integrated Pond Based Aquaculture with Rice and Poultry Production: Economic, Social and Environmental Assessment (2013)

Partial Budgeting

Business owners often make decisions about changes they are either contemplating making or that have to be made. Many of the decisions are incremental, such as adding land, expanding or reducing an enterprise or changing how an enterprise is managed. The partial budget is a useful tool for farm managers when these situations arise. Typically, they are used for analyzing the impacts of "small" changes in the business. Partial budgeting is a procedure where receipts and expenses which increase/decrease with a change in organization or procedures are listed in a systematic order. It is a process that allow, the total farm budget to be fine-tuned.

It focuses on the analysis of a defined change to see if it improves the total farm budget. The beauty of partial budgets is that you only consider the aspects of the business that will be affected by the proposed change. A partial budget only includes resources that will be changed. It does not consider the resources in the business that are left unchanged. Only the change under consideration is evaluated for its ability to increase or decrease income in the farm business. The partial budget is useful in analyzing the effects of a change from an existing plan. This budget only considers revenue and expense items that will change with a defined change in the plan. A partial budget helps farm owners/managers evaluate the financial effect of incremental changes. It is a tool that aims at quantifying and comparing the effects of a proposed technology or decision on agricultural production to those of other alternative technologies/approaches. Results from partial budget analysis assist farm managers/farmers in identifying weaknesses (high cost and/or low income) of the technology being developed.

Partial budget analysis shows the level of profitability of and helps to decide whether to adopt a new technology or not. A partial budget shows the effect of change(s) in farm operations. For example, farmers know that fertilizer application will likely increase maize yield, and thus the gross income. The use of fertilizer also results in additional costs. To decide whether to use fertilizer for maize production or not requires a partial budget analysis.

A partial budget could be prepared to ascertain the followings.

- substituting one enterprise for another without any change in the entire farmland area, for example, substituting 1 ha of soybean for 1 ha of maize
- changing to different levels of a single technology, for example, estimating the effect on net benefit of changing from one level of N-fertilizer application to another in maize production
- changing to different technologies, for example, changing from hand weeding to herbicide use for weed control

Partial Budgeting Principles

Partial budgets are based on the principle that small business changes in the organization of the farm will have one or more of the following effects:

Positive Economic Effects

- The change will eliminate or reduce some costs.
- The change will increase returns.

Negative Economic Effects

- The change will cause some additional costs.
- The change will eliminate or reduce some returns.

The net change between positive and negative economic effects is an estimate of the net effect of making the proposed change in the total farm budget. A positive net change indicates a potential increase in income and a negative net change indicates a potential reduction in income due to the proposed change.

Partial Budget Components

A partial budget consists of two columns, a subtotal for each column and a grand total. The left hand column has the items that increase income while the right hand column notes those that reduce income for a farm business. The budget can be divided into four parts.

Added Income

This area is usually an estimate of the cost if a new enterprise is to be added. Use realistic yields, product quality and prices. Over estimation may lead to incorrect decisions and possibly reduced financial performance when the change is meant to improve it. When deciding on a projected price, use average prices from the markets where production is most likely to be sold. Also use average quality unless the change under consideration is meant to improve crop or livestock quality. Income increases may come from expansion of an enterprise.

If the expansion is minor, current production quantities, quality and average prices are reasonable approximations to use. But if the expansion is large, during the early production periods lower yields and quality may result due to start-up difficulties. Keep this in mind when estimating changes in income.

Added Costs

This is the first section of Column 2. List all increased expenses due to the change being considered. Most of these will be costs of production for the new enterprise. This list may

also include non-cash costs such as labor and depreciation. For example, it might be appropriate to include unpaid labor to be certain that the operator is equitably paid for his/her labor and management input. A depreciation charge, if included, will help analyze whether there is a return on the investment that the operator makes.

Reduced Costs

Obvious items for inclusion in the section would be crop or livestock expenses no longer incurred. These costs could be reductions or total elimination of certain expenses. Examples include seed, custom work, repairs, veterinary expense, interest expense and paid labor. Inclusion of non-cash costs such as unpaid labour and depreciation would provide a full economic analysis instead of just changes in cash costs.

Reduced Income

Items to include here might be reductions in product sales or yields due to reduced planting or harvest timeliness. When ownership of equipment is shared, some farming operations may not be completed in as timely a manner as desired in some years. This can reduce quality and yields that reduce farm income. Accurately estimating this factor can be difficult, however.

Partial Budget Summary

A summation of the above four partial budget components is the last step in partial budgeting. Total each of the two factors in column 1 and write this result on the column 1 subtotal line. Repeat the process for column 2. Then take column 1 (added income/reduced cost) and subtract column 2 (increased costs/reduced income) to arrive at a projected net return from adoption of the change under consideration. A negative number indicates the change the as considered will reduce whole farm income. A positive number indicates that the change will be profitable.

Enterprise budgeting:

An enterprise budget is a statement of what generally is expected from a set of particular production practices when producing a specified amount of product. It consists of a statement of revenues from and the expenses incurred in the production of a particular product. An enterprise budget documents variable and fixed costs. It is useful in calculating profitability and break-even values. An enterprise budget provides a format for the manager to use in classifying information so that the economics of alternative enterprises and alternative production systems can be consistently analyzed.

An enterprise budget is a list of all **revenues** (receipts), **variable costs** (operating costs), and **fixed costs** (ownership costs) for a **specific part** (enterprise) of your business. It shows the profitability of that particular enterprise. Enterprise budgets are extremely

useful for planning purposes. An enterprise budget lists all income and costs of a specific enterprise to provide an estimate of its profits. Each enterprise budget is developed on a single common unit, such as hectares for crops or head for livestock. An enterprise budget allows comparison of profits or profitability among different enterprises on the same farm. Enterprise budgets, like whole-farm budgets, are in three parts: income, costs, and profit. However enterprise budget is different from a whole-farm budget in the following ways:

- The number of enterprises considered (only one in an enterprise budget; in a whole-farm budget, all enterprises in the farm are included)
- The size of enterprises (a single unit for an enterprise budget, the entire farm for a whole-farm budget

The purpose of enterprise budget includes:

- To estimate projected costs, revenue, and net returns for a single enterprise in order to assess feasibility or profitability of current or potential enterprises. For example how much will I make on fish and rice?
- To serve as acomperative tool for testing new ideas and identify best ones. For example, how profitable would poultry be? How do Tilapia compare to Clarias?
- To estimate needs for inputs, facilities and storage, and marketing. For example for the crops aspect of integrated fish farming, such questions as how much seed or chemicals do I need? Do I need new/bigger facility? How much grain storage and marketing do I need?

Investment Analysis

For a sound decision to be made a good analysis of records and data on the farm is necessary. Let us consider some of the various profitability measures, which can guide a farmer in adopting a particular technology.

Payback Method:

Payback period refers to the period of time required for the return on an investment to "repay" the sum of the original investment. For example, a ₦100,000 investment which returned ₦50,000 per year would have a two year payback period. The time value of money is not taken into account. Payback period intuitively measures how long something takes to "pay for itself." All things being equal, shorter payback periods are preferable to longer payback periods. The formula used to calculate payback period of a project depends on

whether the cash flow per period from the project is even or uneven. In the case of even, the formula is:

$$PBP = \frac{II}{CI}$$

Where:

PBP = Payback Period

II = Initial Investment

CI = Cash Inflow per Period

When cash inflows are uneven, we need to calculate the cumulative net cash flow for each period and then use the following formula for payback period:

$$Payback\ period = A + \frac{B}{C}$$

In the above formula,
A is the last period with a negative cumulative cash flow;
B is the absolute value of cumulative cash flow at the end of the period A;
C is the total cash flow during the period after A
Both of the above situations are applied in the following examples.

Decision Rule

Accept the project only if the payback period is LESS than the target payback period.

Examples

Example 1: Even Cash Flows
Company C is planning to undertake a project requiring initial investment of ₦105,000. The project is expected to generate ₦25,000 per year for 7 years. Calculate the payback period of the project.

Solution
Payback Period = Initial Investment ÷ Annual Cash Flow = ₦105000 ÷ ₦25000 = 4.2 years

Example 2: Uneven Cash Flows
Company C is planning to undertake another project requiring initial investment of ₦5 million and is expected to generate ₦1 million in Year 1, ₦1.3 million in Year 2, ₦1.6 million in year 3, ₦1.9 million in Year 4 and ₦2.2 million in Year 5. Calculate the payback value of the project.

Solution

(cash flows in million ₦)		Cumulative
Year	Cash Flow	Cash Flow
0	(5)	(5)
1	1	(4)
2	1.3	(2.7)
3	1.6	(1.1)
4	1.9	0.8
5	2.2	1.4

Payback Period
= 3 + (|-₦1.1M| ÷ ₦ 1.9M)
= 3 + (₦1.1M ÷ ₦1.9M)
≈ 3 + 0.58
≈ 3.58 years

Advantages of payback period are:

1. Payback period is very simple to calculate. It is a simple cash flow, easily understood by farmers
2. It can be a measure of risk inherent in a project. Since cash flows that occur later in a project's life are considered more uncertain, payback period provides an indication of how certain the project cash inflows are.
3. For companies facing liquidity problems, it provides a good ranking of projects that would return money early.
4. Projects needing small capital outlays that payback early in their expected life are easily identified without spending much time on more complex studies.
5. It helps to isolate poor projects that have a long payback time
6. 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.

Disadvantages of payback period are:

1. Payback period does not take into account the time value of money which is a serious drawback since it can lead to wrong decisions. A variation of payback method that attempts to remove this drawback is called discounted payback period method.
2. It does not take into account, the cash flows that occur after the payback period.

Rate of Return (ROR) or Return on Investment (ROI)

Rate of Return (ROR), also known as **Return on Investment (ROI)**, **Rate of Profit (ROP)** or sometimes just **return**, is the ratio of money gained or lost (whether realized or unrealized) on an investment relative to the amount of money invested. The amount of money gained or lost may be referred to as interest, profit/loss, gain/loss, or net income/loss. The money invested may be referred to as the asset, capital, principal, or the cost basis of the investment. ROI is usually expressed as a percentage.

Return on investment (ROI) is the concept of an investment of some resources yielding a benefit to the investor. A high ROI means the investment gains compare favorably to investment cost. As a performance measure, ROI is used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. In purely economic terms, it is one way of considering profits in relation to capital invested.

In business, the purpose of the "return on investment" (ROI) metric is to measure, per period, rates of return on money invested in an economic entity in order to decide whether or not to undertake an investment. ROI and related metrics provide a snapshot of profitability, adjusted for the size of the invested assets tied up in the enterprise. ROI is often compared to expected (or required) rates of return on money invested. To calculate ROI for a single-period review, divide the return (net profit) by the resources that were committed or invested. Hence:

Return on investment (%) = (Net profit / Investment) x 100

Or

$$ROI = \frac{TR-TC}{TC} \times 100$$

Where, TR = Total Revenue, TC = Total Cost

Net Present Value

This is sometimes called excess present value. It is the present value of future net cash in-flow **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 more than a Naira tomorrow. Consider the three options with an initial capital outlay of N2,900.00, 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 steams 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 N2,900.00 gave different returns (profit for different years as outlined in Table 13,) 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 13.

Table 13: Net present Value (NPV) of three aquaculture system

Year	Discount factor	Project I Tilapia		Project II Tilapia-Clarias		Project III Tilapia Bargrus-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	4,100	2,020	NA

Total Present Value	NA	2,712.8	NA	NA	NA	2,230.25
Less initial investment	NA	2,900.00	NA	NA	NA	2,900.00
Net Present Value	NA	-187.2	NA	NA	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 20 percent in ten years. Option II is the most favoured 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 rate that takes the rate of inflation and interest 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.

Internal Rate of Return (IRR)

This is perhaps the most commonly used method of capital investment analysis. It considers net earnings 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 earning 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)

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

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 interpretation between discount rate to say 10 per cent or by increasing 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 free, but major problems that could arise due to trial and error can be overcome especially by using good electronic calculators. Another problems 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.

Conclusion

Integrated fish farming can be highly profitable and rewarding. Prospective investors should know the basic investment analysis that will guide them in taking decision. This is the focus of this manual, with a detailed prepared feasibility reports 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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