ECONOMIC PROSPECTS OF INVESTMENT IN INTEGRATED FISH CUM LIVESTOCK FARMING.

By

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ABSTRACT:

The paper defines integrated fish farming as a multiple land use approach in fish culture which combines fish farming with other agricultural production. The concept of integration is explained along with its merits. Financial analysis of integrating fish with livestock such as fish cum-poultry (chicken and duck) fish cum pig, fish cum rabbit and fish cum cattle integration are presented.

It was observed that integration of fish with livestock would yield profit for the fish farmer from sales of products such as eggs, meat and fish. The livestock manure is a good source of organic fertilizer for fish farming and biogas production. With the present high cost of pelleted fish feeds integrated fish farming will help to reduce cost of fish feeds and at the same time yield high economic returns.

PREAMBLE.

Nigeria is a coastal country with a maritime area of 46,300km2, an exclusive economic zone (EEZ) area of 210,900km2 and about 13 million hectares of inland water. Despite this endowment, the per capita fish consumption is estimated at about 6kg. This is far below the WHO accepted minimum requirement of 12kg. According to the Federal Department of Fisheries, the total fish production from the artisanal sector in 1999 stood at about 352,284 metric tons. From the aquaculture sector, a total of 22,562 metric tons of fish was recorded, while the industrial sector produced 31,537 metric tons of fish and shrimps. The overall fish and shellfish production figure of 406,383 metric tones is grossly below the annual demand estimated at 1.5 million metric tons.

At present about 50% dearth in supply of fish requirement is met through massive importation. This translates into huge avoidable drain of Nigeria's scarce foreign exchange. Nigeria spends over N30 billion annually on the importation of fish, because it is yet to attain self-sufficiency in fish production. Efforts made to improve fish production have not yielded positive results due to the numerous problems confronting the industry. Some of these problems are poor management of resources from capture fisheries, lack of enforcement of fisheries laws and regulations by responsible agencies, low fish production from fish farming, high post harvest losses, inadequate statistical data for effective planning and ineffective extension services. The only alternative way of boosting fish production and thereby move the country towards self-sufficiency in fish production is by embarking on fish farming. Fish farming could be integrated with livestock and arable crops to reduce cost of production and increase profit.

INTRODUCTION:

Integrated fish farming is a multiple land use approach, which combines fish culture with other agricultural production systems. Integrated fish farming involves the integration of fish farming with livestock, farming of agricultural crops, vegetable and 'side-line' occupation. The increasing use of this method of fish farming is due to the fact that the economic prospects have been well recognized worldwide. The droppings of the poultry, which serve as fertilizers, act directly on the pond bottom mud and the nutrients are released into the water for use by the phytoplankton and zooplankton. Integrated fish farming is a multiple land use approach, which combines fish culture with other agricultural production systems., which serve as fish food. This system of farming promotes the optimal utilization of waste material in order to produce protein for human consumption. Furthermore it creates more employment opportunities for job seekers and forms a beneficial circulation to keep a balance in the ecosystem. The system of integrated fish farming could be of importance to all developing countries especially Nigeria interested in food security, economic development and in finding a lasting solution to unemployment problems in rural areas.

The concept of IFF is different from that of integrated management of fish, livestock and crop. IFF places more emphasis on fish farming while the farming of livestock and crops are secondary. It is a 3-dimensional activity with fish farming as the major activity. Apparently, IFF ensures sufficient supply of food and manure on the fish farm.

Aquaculture is not an isolated farming activity but is closely related to agriculture and livestock production because fish culture requires the availability of feeds and manure. With the performance of IFF, all products and waste from the farm could be effectively used by different fish species with various feeding habits such as Tilapia, common Carp. and Catfishes such as: Clarias, Heterobranchus etc. In addition to the practice of IFF, the production cost of fish can be reduced and the annual profit of the farm increased. This is because the utilization of by-products and waste on the farm are optimised. With this in mind, there is need for further development and expansion of integrated fish farming in Nigeria.

This paper discusses the economic prospects of integrating fish with livestock as well as waste utilization for biogas production and use by rural communities.

CATEGORIES OF INTEGRATED FARMING SYSTEM

Under integrated farming systems there are 3 types of settings:

Full integration, Semi integration and Free integration.

(i) **Full integration**:

Full integration involves complete integration e.g. Fish-Cum-Poultry. A poultry house is constructed over the pond and so manure is easily introduced into the pond.

(ii) **Semi-integration.**

This is a partial integration. e.g. fishpond integrated with a dairy ranch located a distance away from the pond and manure is then transferred to the pond.

(iii) **Free integration.**

Here the operations are separate e.g. fishpond integrated with hotel or supermarket. These are not connected and so have free or independent operations. Thus there is no energy flow from one to the other. But the money from either local or supermarket is used to develop fishpond and create employment.

ADVANTAGES OF INTEGRATED FISH FARMING (IFF)

(i) It creates artificial ecosystem with minimum waste. Livestock manure is a good organic fertilizer for fish farming. It has been estimated that 40-50kg organic manure will produce 1kg of fresh fish. Pond silt can be used as fertilizer for fodder crops, which in turn can be used to raise livestock, or as fish feeds. Thus a recycling ecosystem is formed.

(ii) Increase food supply. A large variety of output or product from animal husbandry, crop production and fish farming is achieved. This leads to an increase in the supply of proteinous foods. The use of only pelleted feeds and animal protein sources for fish feed is not economical and reduces the quantity of food available for human consumption.

(iii) Employment opportunities Due to the varied nature of an integrated fish farming, more hands are needed.

(iv) Increase output and economic benefit. One of the current problems facing aquaculture is the increasing cost of pelleted feeds. This can be related to the shortages of energy and protein food source. Fortunately, the IFF produces feeds and fertilizers for itself thereby saving energy and reducing cost and at the same time yielding high economic returns.

(v) Sanitation: Hygienic condition in an integrated farm can be achieved. The pond silt comprising mud, leftover of manure, feeds etc. may become detrimental to fish if not removed. Pond silt can be removed to the pond dykes or crop farms and used as organic manure.

LIMITATIONS

(I) Technical complexity.
IFF involves many fields of specialization. The problems of technical complexity arise in management because the farm manager may not be specialized in all the sub-sectors of the farming systems.

(ii) Imbalance of model structure.
This result in production of excessive waste which cannot be fully utilized.

(iii) Water quality.
There is difficulty in water quality control especially in the tropics and sub-tropics where Temperature is high, 02 consumption is great and animal waste production is excessive. Insufficient supply of nutrient will result in less natural food organisms in the pond. As a result fish will not grow and develop well. On the other hand, if animal waste production is too high fish may die due to rapid decomposition, which loosens 02 content in the water body especially in the humid tropics.

APPLICATION OF LIVESTOCK MANURE

Livestock manure can be used both as base (during pond construction) and additional manure. Manure application enriches the nutritional value of the water and promotes the proper proliferation of natural food organism. The recommended dosage for base manure application in grow-out ponds = 7500kg/ha; the manure should be spread evenly in the pond bottom after pond clearing. It should then be exposed for seven to ten days before the pond is filled with water. This improves the fertility of the water. Additional manure is applied after the pond has been stocked with fish. The dosage should not exceed 825kg-900kg/ha/day in wet weight or 100-200kg/ha/day in dry wt. Table 1 shows the rate of base manure application in ponds.

Table1 Rate of base manure application

Type of pond	Quantity of manure
Nursery pond	2250-4500kg/ha
Fingerling pond	3000-6000kg/ha
Grow-out pond	7500-15000kg/ha.

(1) FISH-CUM-POULTRY (CHICKEN) INTEGRATION.

Poultry is raised principally for egg and meat. For a poultry farmer to be successful he must practice good management, which require good knowledge of breeds and breeding, feed and feeding, disease control measures and there should be availability of market for the product.

A poultry house can be built over the pond, on the dyke, or near the fishpond.

Poultry built on dyke.

- sufficient light get to total surface area of the pond
- reduces problem of getting manure to the pond
- regulated amount and time of manure application
- battery cages to facilitate collection of droppings
- maximum utilization of space.
- In-deep litter system, 3-4 chickens per/m^2 of poultry house is required. For battery cages 3 birds/cage.

Poultry built over pond.

- Droppings are released directly into the pond.
- Maximum utilization of space
- Problem of shading
- Unregulated amount of droppings, which can be solved by estimating the number of chickens, required for production.

POULTRY PRODUCTION ON SMALL SCALE

For the purpose of this workshop a small-scale successful poultry keeping would be considered as follows:

Purpose of Keeping:

Poultry keeping is classified into:

(a.) Raising of cockerel from day old to grower i.e. 8 weeks

(b) Broiler production from day old to about 12 weeks

(c) Egg production from day old to laying stage or from point of lay to end of lay.

For a and b above you will require a building where the birds are kept from draught, good ventilation and concrete floor.

(a) Cockerel Production

At day old, the price ranges from N10.00 to N15.00 each. Make sure you obtain them from reputable hatchery to avoid diseases inherited chicks. The day old chicks are kept in the building where enough heat would be provided to keep the baby birds warm since the parent are not there to keep them under her wing coverage (brooding). Provide good water in water fountains. Also provide chicks mash of not less than 20% C.P. (available in poultry feed stores). Good quality feed is necessary to prevent diseases associated with poor feed especially in the first five weeks of life. Each bird require about 3 watt of heat i.e. one 60 watts bulb will brood only 20 chicks.

NB: **CHICK MASH** Is the starter diet for day old bird (cockerel, pullets etc.) for 8 weeks of life.

VACCINATION

Vaccinate birds against Newcastle disease

- intraocular first 10 days of life.
- Gumboro disease vaccine (First 10 day of life and the fifth week)
- Lassota 4-5 Week of age
- Mareks Disease Vaccine 1- 10 Days of life
- Mareks disease vaccine to be repeated at 5week.
- Provide coccidiostat in feed or water as preventive measure against protozoan diseases or other supha drugs
- Provide anti biotics/vitamin supplements in water at interval.
- At about 5 7 weeks old vaccinate against fowl pox disease via the wing web.
- At the age of 8 weeks you can sell out your cockerels to people who wish to keep them on free range..

INPUT: COCKEREL PRODUCTION (UP TO 8 WEEKS).

1.	Building and equipment	20,000.00
2.	1,000 day old chicks at N15.00 each	15,000.00
3.	Feed at 1kg per bird (1,000kg) at N40.00	40,000.00
4.	Vaccines (assorted) at N10.00 each	10,000.00
5.	Drugs at N5.00 each	5,000.00
6.	Contingency	5,000.00
	Total	**95,000.00**

Output:

1,000 birds Less 10% mortality in 5 weeks remaining 990 at N100.00 each 99,000.00

This can be raised twelve times in a year and the output = 99,000.00 x 12 1,188,000.00

While input stand at N75,000.00 x 12 = 900,000.00 (Less capital Input)

The profit is now N1,188,000.00 900,000.00 = 288,000.00

The manure of either of the poultry above can be mixed in the ratio of one part of the manure to three parts of conventional tilapia feed.

PRECAUTIONS:

- Feed all birds with balanced diet to expect good returns.
- For good hygiene, prevent people from entering poultry houses.
- Don't allow other birds to enter your poultry house
- Avoid damp litters, avoid noise making in the poultry house
- Observe every vaccination and medication programmes.
- Purchase chicks from disease free record farmers
- Feed birds regularly, avoid over feeding to minimize wastage
- Provide enough good quality water.

(b) Broiler production

The management is not different from the above but they differ in that broilers are special birds bred to grow fast within a short time for quick meat. They are expensive at day old (about N100-N120). The feed for a start to 5 week is broiler starter mash, 6-12 weeks broiler starter and finisher, which contain about 24% C.P. and 22% respectively. At the end of 5 weeks remove the source of heat but provide the source of light to feed the birds at night. When broilers are well fed with adequate management, at this time their weight will be between 1.8-2kg each. Tables 2 5 shows the financial analysis for broiler cum fish

Table 2: Depreciation – Poultry Broiler Cum fish.

S/no	Items	Purchase price	Life span	Salvage value C - 10%	**Annual Depreciated Value**				
					Year 1	Year 2	Year 3	Year 4	Year 5
1	Poultry house	15,000	15	15,000	900	900	900	900	900
2	Fish pond	50,000	25	50,000	1,800	1,800	1,800	1,800	1,800
3	Canoe	5,000	5	5,000	900	900	900	900	900
4	Paddle	1,000	7	1,000	129	129	129	129	129
5	Beach Seine Net	20,000	5	20,000	3,600	3,600	3,600	3,600	3,600
6	Water pump	30,000	5	30,000	5,400	5,400	5,400	5,400	5,400
7	Poultry equipment	5,000	3	5,000	1,500	1,500	1,500	1,500	1,500
	TOTAL ANNUAL DEP.				**14,229**	**14,229**	**14,229**	**14,229**	**14,229**

Table 3: Cash Flow – Poultry Broiler Cum Fish

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Cash Receipts from Sales of Broilers (100x4)x130 400broilers in 1yrx130 Sales of Fish (900 Catfish of 1kg each x N300) (Tilapia 200 of 400g at N100)	252,000 278,000	252,000 278,000	252,000 278,000	252,000 278,000	252,000 278,000
Total Cash Receipts	**530,000**	**530,000**	**530,000**	**530,000**	**530,000**
B. Fixed Capital					
1. Poultry House	15,000	-	-	-	-
2. Fish Pond (10mx10mx2m)	50,000	-	-	-	-
3. Canoe	5,000	-	-	-	-
4. Paddle	1,000	-	-	-	-
5. Beach Seine Net	20,000	-	-	-	-
6. Water Pump	30,000	-	-	-	-
7. Poultry Equipment	5,000	-	-	-	-
Sub-total	**126,000**	-	-	-	-
C. Operating Costs					
1. Broiler birds (400 at N130/bird)	52,000	52,000	52,000	52,000	52,000
2. Poultry feed	80,000	80,000	80,000	80,000	80,000
3. Drugs and medication (Poultry)	2,000	2,000	2,000	2,000	2,000
4. Fish feed (¼)	15,000	15,000	15,000	15,000	15,000
5. Catfish fingerlings (1000 at N10) each	10,000	10,000	10,000	10,000	10,000
6. Tilapia (500 at N5) each	2,500	2,500	2,500	2,500	2,500
7. Liming and fertilization	10,000	10,000	10,000	10,000	10,000
7. Labour hands (2 at 3,500	84,000	84,000	84,000	84,000	84,000
Sub-total	**255,500**	**255,500**	**255,500**	**255,500**	**255,500**
D. Total Cash outflow (B+C)	381,500	255,500	255,500	255,500	255,500
E. Total Cash Inflow (A -D)	148,500	254,970	254,970	254,970	254,970

Table 4: Projected Profit and Loss Account – Poultry Broiler Cum fish..

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Income from Sales of Broiler Birds(400 less1%(360av.2kgeach)x350	252,000	252,000	252,000	252,000	252,000
Sales of fish (900 Catfish of 1kg each x N300) (Tilapia 200 of 400g at N100)	278,000	278,000	278,000	278,000	278,000
Total Income	530,000	530,000	530,000	530,000	530,000
Less Operating Costs.	255,500	255,500	255,500	255,500	255,500
Operating profit	254,970	254,970	254,970	254,970	254,970
Less Depreciation	14,229	14,229	14,229	14,229	14,229
Net profit	240,741	240,741	240,741	240,741	240,741
%age of Net Profit to Total Annual Investment	63.1%				
%age of Net profit to Equity capital	63.1%				
Benefit Cash ratio (yearly operation)	1:0.63	1:0.94	1:0.94	1:0.94	1:0.94

Table 5: Economic Viability Indicators – Poultry Broiler-Cum-fish

Year	Actual	Discounted value at 35%	Actual	Discounted value at 35%	Actual	Discounted value at 35%
0	-	-	381,500	-381,500	-381,500	-381,500
1	530,000	392,571	255,500	189,248.85	240,741	+203,322.15
2	530,000	290,652	255,500	140,116.02	240,741	+150,535.08
3	530,000	215,392	255,500	103,835.02	240,741	+111,556.08
4	530,000	159,583	255,500	76,931.05	240,741	+82,651.95
5	530,000	11,81.90	255,500	56,976.05	240,741	+61,213.05

Net present Value (NRV) = 127,780 (positive)

Internal Rate of return (IRR) 63.1% (Higher than the lending rate of 35%)

(c) **Laying birds**: The management of the laying birds (pullets) from day old to point of lay differ from the above as follows:

- Provide heat up to end of 8 weeks
- Vaccination continues up to point of lay. (Fowl typhoid, fowl cholera, NDV komorov vaccines must be applied completely to produce healthy layers). The use of antibiotics, antiprotozoa, anti-helmenthis and vitamin supplement drugs must continue but at interval of every 4-6 weeks.

Feeding day old to 8 weeks chicks mash (20% C.P) 9-18 weeks grower's mash (14-15% C.P.) 19 weeks to end of lay layers mash (about 15% C.P.).

Spacing: A car park of about 10x15sq.ft would accommodate 110 layers from point of lay to end of lay.

- Brood 1000 chicks to 5 weeks
- Rear 120 broilers from day old to 12 weeks.

Table 6 9 shows the financial analysis of layer cum-fish production using 110 birds

Table 6: Depreciation – Layer Cum fish.

S/no	Items	Purchase price	Life span	Salvage value C - 10%	**Annual Depreciated Value**				
					Year 1	Year 2	Year 3	Year 4	Year 5
1	Poultry house	15,000	15	15,000	900	900	900	900	900
2	Fish pond	50,000	25	50,000	1,800	1,800	1,800	1,800	1,800
3	Canoe	5,000	5	5,000	900	900	900	900	900
4	Paddle	1,000	7	1,000	129	129	129	129	129
5	Beach Seine Net	20,000	5	20,000	3,600	3,600	3,600	3,600	3,600
6	Water pump	30,000	5	30,000	5,400	5,400	5,400	5,400	5,400
7	Poultry equipment	5,000	3	5,000	1,500	1,500	1,500	1,500	1,500
	TOTAL ANNUAL DEP.				**14,229**	**14,229**	**14,229**	**14,229**	**14,229**

Table 7: Cash Flow – Poultry Layer Cum Fish.

Particulars	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Cash Receipts from sales of :					
Eggs (896 crates at N350.00)	313,600	313,600	313,600	313,600	313,600
Fish (900 Catfish of 1kg each x N300)	35,000	35,000	35,000	35,000	35,000
(Tilapia 200 of 400g at N100)	278,000	278,000	278,000	278,000	278,000
Total Cash Receipts	**626,600**	**626,600**	**626,600**	**626,600**	**626,600**
B. Fixed Capital Equity					
1. Poultry House	15,000	-	-	-	-
2. Fish Pond (10x10x2m)	50,000	-	-	-	-
3. Canoe	5,000	-	-	-	-
4. Paddle	1,000	-	-	-	-
5. Beach Seine Net	20,000	-	-	-	-
6. Water Pump	30,000	-	-	-	-
7. Poultry Equipment	5,000	-	-	-	-
Sub-total	**126,000**	-	-	-	-
C. Operating Costs					
1. Poultry feed	182,500	182,500	182,500	182,500	182,500
2. 110 birds	44,000	44,000	44,000	44,000	44,000
3. Drugs and medication (ig)	2,000	2,000	2,000	2,000	2,000
4. Catfish (1000 at N10/each)	10,000	10,000	10,000	10,000	10,000
5. Tillapia (500 at N5/ each)	2,500	2,500	2,500	2,500	2,500
6. Fish Feed 30% C.P.	30,000	30,000	30,000	30,000	30,000
7. Labour hands 2 at 3,500/ each	84,000	84,000	84,000	84,000	84,000
8. Liming and fertilization	10,000	10,000	10,000	10,000	10,000
Tub-total	**365,000**	**365,000**	**365,000**	**365,000**	**365,000**
D. Total Cash outflow (B+C)	491,000	365,000	365,000	365,000	365,000
E. Total Cash Inflow (A-D)	135,600	261,600	261,600	261,600	261,600

Table 8: Projected Profit and Loss Account – Poultry Layer Cum fish..

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Income from sales of					
Egg (896 crates at N350.00/crate)	313,600	313,600	313,600	313,600	313,600
Old layer (100 at N350.00 each)	35,000	35,000	35,000	35,000	35,000
Fish (900 Catfish of 1kg at N300/kg)	278,000	278,000	278,000	278,000	278,000
(Tilapia 200 of 400g each at N100/kg)					
Total Income	626,600	626,600	626,600	626,600	626,600
Less Operating Costs.	365,000	365,000	365,000	365,000	365,000
Operating profit	261,600	261,600	261,600	261,600	261,600
Less Depreciation	14,229	14,229	14,229	14,229	14,229
Net profit	247,371	247,371	247,371	247,371	247,371
%age o f Net Profit to Total Annual Investment	50.38%				
%age of Net profit to Equity capital	50.38%				
Benefit Cash ratio (yearly operation)	1:0.50	1:0.68	1:0.68	1:0.68	1:0.68

Table 9: Economic Viability Indicators – Poultry Layer Cum fish

Year	Actual	Discounted value at 35%	Actual	Discounted value at 35%	Actual	Discounted value at 35%
0	-	-	491,000	-491,000	-491,000	-491,000
1	626,600	464,122.62	365,000	270,355.5	247,371	+193767.12
2	626,600	343,627.44	365,000	200166.0	247,371	+143461.44
3	626,600	250,650.24	365,000	148336.0	247,371	+102314.24
4	626,600	188,669.26	365,000	109901.5	247,371	+78767.76
5	626,600	139,731.8	365,000	81395.0	247,371	+58336.8

Net present Value (NRV) = 85467.36 (positive)

Internal Rate of return (IRR) 50.38% (>35%)

(2) FISH-CUM-PIG INTEGRATION

The pig pen could be constructed on a wide dyke and the manure from the pig channel could flow directly into the pond. On the other hand, the pig house could be built on a centralized position and the manure collected in storage tanks. The manure in the tank may be treated, with line and diluted. Only the required quantity of manure is transported to the fishpond. With this pattern the control of pig manure entering the pond can easily be achieved.

PIG PRODUCTION

GESTATION PERIOD

Gestation period for pig is 3 months, 3 weeks and 3 days pcpularly referred to as "tripple 3", the approximate number of days is 114 days.

PIGSTY.

Area occupied by pig: 1-1.2m^2/pig (fattening pen) 2m^2/pig (breeding pen)

WEIGHT AND AGE FOR BREEDING.

Sex	Age	Weight
Male	9-10	50-60kg
Female	8-9	40-50kg

NURSERY REARING.

(i) **FEED.**

The piglet should suck milk from the sow till they are one week old at which time good quality feed should be introduced into the diet. Iron should be supplied to the piglet either in concentrate or injection to prevent anemia. This can be administered at birth and then 7-15 days later. The dosage for iron injection is 1ml/piglet.

(ii) **ABLACTATION:**

The piglet should be weaned 25-30 days after birth to enable the sow to recover and commence reproduction again.

(Iii) **GENERAL CARE:**

To prevent pneumonia in young piglet, a warm environment should be provided. A small crib or box with an electric bulb fitting can supply the required warmth.

(I) **WEANERS/PORKERS.**

The weaners are transferred to a separate pen and fed with kitchen waste, compounded feeds, processed chicken manure etc. till they attain a market size of 60-80kg. Elephant grass and centrosema may also be used in supplementing the diet

HEALTH PROBLEMS

- Dewarm pig regularly whether in confinement or extensive farming system e.g. Bemesol or Bemith administered on a monthly basis after weaning. In-sow may be dewarmed before they are transferred to the farrowing house.
- ECTOPARASITE (e.g. midges and lice) can be treated externally using ectoror
- The piggry should be cleaned very well and washed every other day or everyday.

Nutrient Requirement of Pigs.

Age	Energy	C.P.	Lysine	Methionine
(5-10kg) starter (young weaners)	33kcal/kg	22%	0.8%	0.6%
Weaners (10-20kg)	32 Kcal/kg	20%	0.8%	0.6%
Growers (20-45kg)	3Kcal/kg	18%	0.7%	0.5%
Finishers (45-100kg)	30kca/kg	14-16%	0.6%	0.4%

	Average daily wt gain	Standard feeding rates (daily)
Weaners	**0.4-0.5kg**	**0.5-1kg**
Growers	**0.5-0.6kg**	**1.0-1.5kg**
Finishers	**0.6-0.8 or 0.9kg**	**2-2.5kg**

Tables 10 13 indicate the financial analysis of Piggery cum fish production

Table 10: Depreciation – Piggery Cum fish.

S/no	Items	Purchase price	Life span	Salvage value C - 10%	**Annual Depreciated Value**				
					Year 1	Year 2	Year 3	Year 4	Year 5
1	**Building and enclosure**	17,000	15	17,000	1,020	1,020	1,020	1,020	1,020
2	Equipment	5,000	3	5,000	1,500	1,500	1,500	1,500	1,500
3	Water pump	30,000	5	30,000	5,400	5,400	5,400	5,400	5,400
4	Fish pond	50,000	25	50,000	1,800	1,800	1,800	1,800	1,800
5	Canoe	5,000	5	5,000	900	900	900	900	900
6	Paddle	1,000	7	1,000	129	129	129	129	129
7	Net	20,000	5	20,000	3,600	3,600	3,600	3,600	3,600
	TOTAL ANNUAL DEP.				**14,349**	**14,349**	**14,349**	**14,349**	**14,349**

Table 11: Cash Flow – Piggery- Cum -Fish.

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
A. Cash Receipts					
1. Receipts from sale					
Pig 40pgx60kgx N150	360,000	360,000	360,000	360,000	360,000
Fish (900 Catfish of 1kg at N300/kg)	278,000	278,000	278,000	278,000	278,000
(Tilapia 200 of 400g each at N100/kg)					
Total Cash Receipts	**638,000**	**638,000**	**638,000**	**638,000**	**638,000**
B. Fixed capital					
1. Building (Piggery house and enclosure)	17,000	-	-	-	-
2. Equipment (feeders and drinkers)	5,000	-	-	-	-
3. Water pump	30,000	-	-	-	-
4. Fish Pond (10mx10mx2m)	50,000	-	-	-	-
5. Canoe	5,000	-	-	-	-
6. Paddle	1,000	-	-	-	-
7. Net	20,000	-	-	-	-
Sub-total	**128,000**	-	-	-	-
C. Operating Costs					
1. Young Piglet (40 No) at N1,000/piglet	40,000	40,000	40,000	40,000	40,000
2. Catfish fingerling (1000 at N10)	10,000	10,000	10,000	10,000	10,000
3. Drugs and medication (pig)	6,000	6,000	6,000	6,000	6,000
4. Tilapia fingerling (500 at N5)	2,500	2,500	2,500	2,500	2,500
5. Feed for pig to fatten	100,000	100,000	100,000	100,000	100,000
6. Fish Feed 30% C.P. (.25ton)	15,000	15,000	15,000	15,000	15,000
7. Labour hands 3 at 3,500	126,000	126,000	126,000	126,000	126,000
Tub-total	**299,500**	**299,500**	**299,500**	**299,500**	**299,500**
D. Total Cash outflow (B+C)	427,500	299,500	299,500	299,500	299,500
E. Total Cash Inflow (A-D)	210,500	338,000	338,000	338,000	338,000

Table 12: Projected Profit and Loss Account Piggery-Cum- Fish.

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Income from sales of					
Pig (40pigsx60kg each 2400kg at N150)	360,000	360,000	360,000	360,000	360,000
Fish (900kg Catfish at N300	278,000	278,000	278,000	278,000	278,000
Tilapia (200x400g) at N100)					
Total Income	638,000	638,000	638,000	638,000	638,000
Less Operating Costs.	299,500	299,500	299,500	299,500	299,500
Operating profit	338,000	338,000	338,000	338,000	338,000
Less Depreciation	14,349	14,349	14,349	14,349	14,349
Net profit	324,151	324,151	324,151	324,151	324,151
%age of Net Profit to Total Annual Investment	75.8	10.8	10.8	10.8	10.8
%age of Net profit to Equity capital	75.8	75.8	75.8	75.8	75.8
Benefit Cash ratio (yearly operation)	1:0.76	1:1.08	1:1.08	1:1.08	1:1.08

Table 13: Economic Viability Indicators – Piggery Cum fish

Year	Actual	Discounted value at 35%	Actual	Discounted value at 35%	Actual	Discounted value at 35%
0	-	-	427,500	-427,500	-427,500	-427,500
1	638,000	472,566.6	299,500	221,839.65	338,500	+250,726.95
2	638,000	349,879.2	299,500	164,245.8	338,500	+185,633.4
3	638,000	259,283.2	299,500	121,716.8	338,500	+137,566.4
4	638,000	192,101.8	299,500	90,179.45	338,500	+101,922.35
5	638,000	142,274.0	299,500	66,788.5	338,500	+75,485.5

Net present Value (NRV) = 323,834.6 (positive)

Internal Rate of return (IRR) = 75.8% (Higher than the lending rate of 35%

3) RABBIT PRODUCTION

Rabbit breeds quickly and healthy doe produces 6 litters of approx. 6 rabbits yearly i.e. 36kg of meat annually. Cooked rabbit meat tastes like chicken and a good source of protein.

BREEDING

Buck and does should be kept in clean, dry safe hatches before they begin breeding. Put the Doe in a cage with the buck early in the morning or in the evening. Mating takes 2 or 3 minutes. Transfer the Doe back to her cage after mating has taken place. The litter is born 31 days post mating. 3 days before the baby rabbit is due, provide the mother with a rest box containing a small amount of soft dried grass which the mother will mix with her own fur.

LITTER SITE: USUALLY 6-10 KIDS ARE PRODUCED IN ONE LITTER

CARE:

Newborn rabbit do not open their eyes until they are 2 weeks old.

- Do not touch any of them till they are seven days old. If touched, the small baby rabbit will change and the mother will refuse to nurse them. However, to avoid this, rub your hand on the mother rabbit first before handling the baby rabbit. The baby rabbit can be weaned at 2 months of age after which the Doe can begin breeding again. The rabbit attain a table size of 2kg in 4 months.

FEEDING:

Rabbit can be fed with grass or weeds, which must be dried to avoid infection, particularly diarrhoea. Supplementary feed such as kitchen waste, sweet potato rice, porrage, bread crumps, carrot tops, maize plant, banana leaves, ray dried grass etc.

NOTE: Potato tops are poisonous to rabbit and other animals. Hang forage from the top or side of the cage so that it does not touch the floor and get contaminated. For kitchen waste, put in a rack or bowl attached to the wall to avoid it being knocked over. Provide clean water in a clean container daily. Provide small pieces of wood for rabbit to sharpen their teeth. The wood should be cleaned without oil or paint.

MONITORING.

- Check rabbit morning, evening and while feeding.
- Clean rabbit are healthy rabbit. If diarrhea occurs administer chicken antibiotics in their drinking water.
- Cull and eat any injured rabbit
- Record keeping is important.

HANDLING

Never pick up rabbit by their ears. Hold them by the loose skin or scrub on their shoulders. Support an adult with one hand under the legs.

STOCKING DENSITY

1500-2000/Ha of Pond Area.

Tables 14-17 show the financial analysis of a Rabbitry cum fish production

Table 14: Depreciation – Rabbitry Cum fish.

S/no	Items	Purchase price	Life span	Salvage value C - 10%	**Annual Depreciated Value**				
					Year 1	Year 2	Year 3	Year 4	Year 5
1	Building	5,000	15	500	300	300	300	300	300
2.	Hatches (No No)	10,000	7	1,000	1,286	1,286	1,286	1,286	1,286
3	Equipment	5,000	3	500	1,500	1,500	1,500	1,500	1,500
4	Fish pond	50,000	25	5,000	1,800	1,800	1,800	1,800	1,800
5	Beach seine net	20,000	5	2,000	3,600	3,600	3,600	3,600	3,600
6	Water pump	30,000	5	3,000	5,400	5,400	5,400	5,400	5,400
7	Canoe	5,000	5	5,000	900	900	900	900	900
8	Paddle	1,000	7	100	129	129	129	129	129
	TOTAL ANNUAL DEP.				**14,915**	**14,915**	**14,915**	**14,915**	**14,915**

Table 15: Cash Flow – Rabbitry Cum Fish.

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
A Cash Receipts from sales of :					
Sales of Does 6x6=36x10=360 x4xN 200	288,000	288,000	288,000	288,000	288,000
Sales of Parents 12 parents(48kgx200)	9,600	9,600	9,600	9,600	9,600
Sale of Fish 900kg Catfish at N300	278,000	278,000	278,000	278,000	278,000
Tilapia(200x400g)xN100/kg					
Total Cash Receipts	**575,600**	**575,600**	**575,600**	**575,600**	**575,600**
B. Fixed Capital Equity					
1. Building	5,000	-	-	-	-
2. Hutches (10 No)	10,000	-	-	-	-
3. Equipment	5,000	-	-	-	-
4. Fish Pond	50,000	-	-	-	-
5. Canoe	5,000	-	-	-	-
6. Paddle	1,000	-	-	-	-
7. Water pump	30,000	-	-	-	-
8. Beach seine Net	20,000				
Sub-total	**126,000**	-	-	-	-
C. Operating Costs					
1. Cat fish fingerlings (1000 at N10)	10,000	10,000	10,000	10,000	10,000
2. Tilapia fingerings (500 at N5)	2,250	2,250	2,250	2,250	2,250
3. Fish feed 30% C.P	15,000	15,000	15,000	15,000	15,000
4. Rabbit Suppl. Feeding	60,000	60,000	60,000	60,000	60,000
5. Medication	6,000	6,000	6,000	6,000	6,000
6. Labour (1 at 3,500/mth/year)	42,000	42,000	42,000	42,000	42,000
7. Does and 2 bucks	12,000	12,000	12,000	12,000	12,000
Tub-total	**147,500**	**147,500**	**147,500**	**147,500**	**147,500**
D. Total Cash outflow (B+C)	273,500	147,500	147,500	147,500	147,500
E. Total Cash Inflow (A-D)	302,100	428,100	428,100	428,100	428,100

Table 16: Projected Profit and Loss Account – Rabbitry Cum fish.

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Income from sales of					
Sales of Does	288,000	288,000	288,000	288,000	288,000
Sales of Parents	9,600	9,600	9,600	9,600	9,600
Sale of Fish	278,000	278,000	278,000	278,000	278,000
Total Income	575,600	575,600	575,600	575,600	575,600
Less Operating Costs.	147,500	147,500	147,500	147,500	147,500
Operating profit	428,100	428,100	428,100	428,100	428,100
Less Depreciation	14,915	14,915	14,915	14,915	14,915
Net profit	413,185	413,185	413,185	413,185	413,185
%age of Net Profit to Total Annual Investment	151.1%				
%age of Net profit to Equity capital	151.1%				
Benefit Cash ratio (yearly operation)	1:1.51	1:2.8	1:2.8	1:2.8	1:2.8

Table 17: Economic Viability Indicators – Rabbitry-Cum- fish

Year	Actual	Discounted value at 35%	Actual	Discounted value at 35%	Actual	Discounted value at 35%
0	-	-	273,500	-273,500	-273,500	-273,500
1	575,600	426,346.92	147,500	109,253.25	428,100	+207,840.42
2	575,600	315,659.04	147,500	80,889.00	428,100	+234,770.04
3	575,600	233,923.84	147,500	59,944.00	428,100	+173,979.84
4	575,600	173,313.16	147,500	44,412.25	428,100	128,900.90
5	575,600	128,358.80	147,500	32,892.5	428,100	95,466.30

Net present Value (NRV) = 567,457.05 (positive)

Internal Rate of return (IRR) 156.5%

(4) FISH CUM DUCK

Ducks can feed on juvenile frogs and toads, tadpoles, dragonfly larvae, aquatic snails thus eradicating some predators of fish fry and fingerlings. Furthermore, these food organisms provide a protein source for ducks. Therefore duck raising in fishponds reduces demand for protein in duck feeds. Ducks release their dropping directly into the ponds providing calcium, nitrogen and phosphorous which stimulates the growth of phytoplankton. This direct fertilization of the pond has two advantages:

There is continuous supply of manure

Direct fertilization is more homogenous and avoid any heaping of duck droppings.

- Ducks loose 10-20% (33-30g/day) of their feeds to the ecosystem. Fish can directly consume these feeds.
- Fish-cum-duck integration also promotes the recycling of nutrients in the pond

ecosystem. In shallow areas, ducks deep their heads into the water and reaches to the bottom and turns the silt to search for benthos. By virtue of this digging action, nutritional elements deposited in the pond humus will be released.

- Duck also acts as pond aerators: Their swimming playing and chasing habit stirs the water and thus aerates the pond water.
- The only disadvantage of duck integration is the fact that duck eat fish. However, ducks will feed on only slow swimming fishes, e.g. sick fish and small sized fish of 4cm total length. Therefore, fish-cum-duck integration is only ideal in grow-out ponds. The dyke of a grow-out pond is partly fenced to form a dry-run and part of the water area or a corner of the pond is fenced with reeds or used nets to form a wet run. The net fence should be about 0.8m high. In making the fence, 40cm of the net should be above the water while 40cm remains below the water surface. The net should not reach the pond bottom so that fish can enter the wet run in search of food. The duck should not be able to escape under the net.

STOCKING DENSITY OF DUCKS

- Duck pen: 4-5 individuals/m2
- Dry run: 4-5 individuals/m2
- Wet run: 3-4 individuals/m2

The duck pen size should be equal to the dry run size while the wet run size should be a little larger.

The number of ducks to be raised in pond depends on the quantity of excreta produced by duck, which in turn depends on the species of duck, the quantity of feeds applied and the method of raising. The stocking of duck also depends on climatic condition and the stocking ratio and density of the various fish species in the pond. However, the recommended number/ha of pond area is 900-1100 individual/ha.

(5) FISH CUM CATTLE INTEGRATION.

Among all livestock manure, cattle dung is the most abundant. A 460kg cattle produces 13,600kg of faeces and 9000kg of urine annually. Cattle are ruminants and because of the repeated grinding and digesting, decomposition by the several microorganisms in the rumen, Cattle manure is fine.

Cattle keeping

Cattle shed should be built close to the fishpond to simplify the handling of Cattle manure. Cattle need both the shed and the playground. This will occupy more areas than pigpens on pond dykes. Therefore the shed should be built near the fishponds for easy transportation of the wastes to the pond but not on the dykes. The cattle shed can be connected to a manuring ditch or septic tank to collect the faeces and urine. By so doing the mixture can be flushed directly into the fishponds. A hosepipe with a spray nozzle gives the best result. The number of cattle allocated to an area of fish pond depends on many factors including the amount of cattle manure and wasted foods, the species ratio and target output of fish, the sediments of the pond, the quality and quantity of pond humus and feeds applied.

(6) MULTILEVEL COMPREHENSIVE UTILIZATION OF WASTE SYSTEM.

CONCEPT:

This involves the integration of the various forms of waste. For example chicken manure can be used in feeding pigs after treatment. With this system of integration, the farmer makes best use of available resources in different ways and at different rates. It is a complex system of integration.

MODEL 1.

(A) CHICKEN MANURE AS FEED.

Chicken manure should be disinfected or treated before use. It then becomes a good feed for pigs supplying 25-50% of daily diet to the pigs.

PROCEDURE.

- UV LIGHT: Spread the chicken manure on a cement slab and expose it to sunlight till it dries up usually for 48-72 hours. Ammonia will be released from the manure on exposure to sunlight. In addition some parasite that thrive in the manure will be destroyed.

  OR
- Half dry the manure in direct sunlight, then mix with wheat bran or rice bran. Add some yeast to the mixture for fermentation. Brewers yeast or normal yeast may be used. Indicator of complete fermentation is that no bad odour emanates from the manure.

  OR
- Bake the manure in a hot oven. Yeast could be added before baking. This produces rice smelling manure.

MAGGOT PRODUCTION FROM WASTE AND UTILIZATION FOR FISH PRODUCTION

Maggot (the larval stage of the housefly) can be produced most commonly from chicken manure, cow dung, or pig manure and other moist, rotting plant and animal remains including human faeces.

- 1kg of chicken manure can produce 920 maggots;
- 1kg of pig manure can produce 810 maggots
- 1 kg of cow dung can produce 530 maggots.
- 10-15kg of maggots/m2 can be produced daily
- Protein content of maggot is about 50-60%. Therefore maggot feeds produce good effect on fish culture.
- Maggot can be used in place of fish meal in fish feed composition and can be produced at high rate at very minimal cost.
- When used in the production of feed pellets the maggots should first of all be killed in boiling water.
- Maggots can serve as 10% of ingredient in compound feeds.

Maggots can be produced by various methods the essential factor is to provide the substrate for the growth of the maggot..

(i) The "sack method".

- Pour about 5kg chicken manure into a fertilizer bag. (Enough sacks of manure can be prepared and at various time intervals to ensure a regular supply of maggots)
- Soak the bag with water and tie with string.
- Keep outside for 3-4 days on a shade to allow maggot to develop.
- Maggots would start appearing on the second day with a peak on the fourth/fifty day.
- Harvest from the residual manure by washing and sieving out through a wire screen of 3mm-mesh size some of the escaped maggots from the sac are collected as well.

(II) Using concrete tank

PROCEDURE:

- Place fresh chicken manure in a tank
- Add some bran (if available) to increase nutrient for maggots
- Add some ammonia water (Pig manure)
- Place the cover over the tank
- Harvest maggot after 3-4 days and feed the fish.

Note that maggot is a high protein feed

suitable for common carp, Clarias, Heterobranchus etc.

(8) BIOGAS PRODUCTION FROM AGRICLTURAL WASTE

Most of the energy needs of Nigerians for household and industrial use are petroleum-based namely petrol, diesel, kerosene and natural gas. While most households in urban areas use kerosene and gas extensively, the rural dwellers, which form 70-80% of the population, depend almost exclusively on fuel wood for household use. This high dependence on fuel wood for domestic and commercial purposes is a matter of public concern as it is the major cause of deforestation in many parts of the country. Since the rate of regeneration of wood is not commensurate with the high rate of consumption, there is an increasingly high rate of desert encroachment, soil erosion and loss of soil fertility in places with high rate of deforestation. Thus complete reliance on fuel wood to meet the domestic energy needs of rural communities enhances environmental degradation - a situation which is very difficult to reverse.

One of the ways of saving the environment from further deterioration and also supplement the energy needs of rural dwellers are by the production of biogas.

The technology of biogas production is not new. The development and construction of biogas digester started in the 1920s and has spread to several developing countries such as India, Taiwan etc. In these countries biogas technology has supplemented a large proportion of energy requirements of the rural majority. The availability of raw materials coupled with the ever-increasing prices of fossil fuel has made this technology attractive.

In India for example biogas-generating plants using cow manure have been in operation for years. In Taiwan more than 7,500, methane-generating devices utilizing pig manure have been in construction. The technology of biogas production is therefore advantageous in that it can be used to provide energy for households and rural communities without tampering with fuel wood.

Composition of Biogas

Biogas is a mixture of methane, carbon dioxide, small amounts of carbon monoxide, hydrogen, nitrogen, oxygen, hydrogen-sulphide and hydrocarbon gas. The actual percentage of each gas varies with raw materials, ratio of input materials, temperature and fermentation stages. Typically the composition of biogas is as follows.

Methane	54 -70%	Carbon monoxide	0.1%
Carondioxide	27-45%	Oxygen	0.1%
Nitrogen	0.5-3%	Hydrogen sulphide	Trace
Hydrogen	1-10%.		

Methane is the major combustible component of biogas. Others usually in small quantity are carbon dioxide, hydrogen and hydrogen sulphide. Table 18 shows the composition of biogas from treated cow-dung at room temperature.

Biogas production.

Biogas is produced from waste materials such as crop residues, animal wastes and urban waste including night soil. The quality of biogas to be generated should depend on the rate of utilization. This will also depend on the size of digester, which is usually of small, medium and large capacities. Figure 1 shows the fixed done type biogas plant.

Small digester.

This range from 4m3 to 20m3. The size of the plant depends on the number of people in the household. On the average an individual require about 0.3% of biogas for cooking, heating and lighting in a day. Table 19 shows the cost of constructing 4m3 fixed done digester.

Medium digester

This has capacity ranging between 50m3 and 500 m3. These are community based biogas digester. Biogases are supplied to the users via pipelines from one or more coupled digester.

Large-scale digester

This is usually for industrial production of agro based residues and other waste products that are organic in nature. This requires building digester of 5000m3 capacity or more.

Application of Biogas:

Biogas can be used in the house hold, community farm or industry for

(i) Heating, cooking and lighting using domestic biogas stoves and lamps.

- Electricity generation in rural areas using internal combustion engines, which can be used for irrigation, lifting and pumping portable water, threshing, feed processing etc.
- Agricultural production such as drying of crops, hatching eggs, grain storage, production of bio-manure, which can be used as fertilizers in farms and ponds etc.

(iv) Commercial purpose: Smoking or drying of fish by fish processors using the Kainji Gas kiln.

Table 18: Composition of biogas produced from anaerobic fermentation at room temperature.

S/no	Raw Material	Gas composition after 21 days (%)		
		CH	H2S	CO2
1	Cow dung +	60.0	1.1	34.4
2	Cow dung + 0.4% cane sugar	57.6	2.1	38.4
3	Cow dung + 1% ashes	60.4	2.9	34.4
4	Cow dung +2.4% fresh leguminous leaves	61.6	4.0	32.0
5	Cow dung + 0.4% casein	64.0	2.4	32.0
6	Cow dung + 1% cane sugar + 1 urea	68	-	30.6
7	Cow dung + 1% cane sugar + !% CaCO3	70.0	-	28.0
8	Cow dung + urine (20ml/100g dung)	67.0	-	32.0
9	Cow dung + 0.4% charcoal	65.6	-	32.0

Source: Garba (2000)

Table 19: Materials and labour for the Construction of $4m^3$ fixed-Dome digester.

S/No	Materials	Quality	Unit cost	Total cost.
1	46x22x12cm cement blocks	150	35	5,250.00
2	25x12x6cm Burnt bricks	200	25	5,000.00
3	Cement (50kg)	20	600	12,000.00
4	Sand $3.5m^3$ tipper	2	1200	2,400.00
5	Gravel 4m3 tipper	1	2000	2,000.00
6	PVC or Asbestos pipe (for inlet and outlet) full length % 20cm	2	3000	6,000.00
7	Steel rod (8mm diameter 9mm length)	2	700	1,400.00
8	¾" G.I. Pipe-full length	1	600	600.00
9	½" G.I. Pipe full length	1	500	500.00
10	Gas control valve	2	1850	3,700.00
11	Rubber hose for gas piping	-	1400	1,400.00
12	6" Paint brush	2	200	400.00
13	4" paint brush	2	150	300.00
14	Wire gauze for sieving sand	3	200	600.00
15	2" x 12" x 12" wooden plank.	4	400	1,600.00
16	3" nails	1kg	50	50.00
17	Hacksaw blade	2	100	200.00
18	6" G.I. socket and plug	1	700	700.00
19	¾" Socket	3	35	105.00
20	Biogas burner (2 way type)	1	5000	5,000.00
A	**Sub-total for materials**			**49,375.00**
21	Site clearing and pits excavation	4 labourers working for 30 days from 8 a.m – 5 p.m. i.e 300 x 3 x 4	300 per day per person	4,800.00
22	Plant body construction	2 masons for 7 days	500 per mason per day i.e. 500x2x7	7,000.00
23	Plant body construction	2 labourers x 7	200x2x7	2,800.00
B	**Sub-total**			**14,600.00**
C	Total for labour A & B			78,305.00
	5% contingency			3,915.25
D	Grand total for materials Labour and variation			82,220.25
E. SUBSISTENCE for supervisors				
S/No	Category of staff days	Number of days	Rate	Amount
1	2 Senior Staff	14 days from the date work commence	2,500 per day x 2x7	70,000.00
2	1 Junior Staff	14 days from the date work commence	1,500 per day x 2x7	42,000.00
				112,000.00
F	Transportation	(2 trips)		40,000.00
G	Honorarium of Consultancy charges			50,000.00
	Grand total D+E+F+G			**₦244,220.25**

CONCLUSION

Integration of fish with livestock would reduce operational cost of the fish farm and increase the profit margin for the fish farmer from sales of products such as eggs, meat and fish. The livestock manure is a good source of organic fertilizer for the pond and can be used for biogas production and use by rural communities. With the present high cost of pelleted fish feeds integrated fish farming will help to reduce cost of fish feeds and at the same time yield high economic returns for the fish farmer

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