

Design and Constructional Estimate of a 1000-Capacity Fish Pond Towards Diversification of the Nigerian Economy

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Abstract-The paper presents the design, materials and cost estimation for the construction of a 1000-capacity fish pond based on a standard size of 3m by 2.5m by 1.4m, in length, breadth and depth, respectively. The fish pond is for the provision of space for the stocking and rearing of one thousand cat fish. A total number of 210 - 450mm x 225mm x 225mm-sandcrete (hollow) blocks are estimated for the construction, using 14 bags of Portland cement and waterseal respectively. About 36 numbers of 25-litres jerry cans of water was estimated to be utilised while an in-let and out-let plumbing system was incorporated in the construction of the fish pond. In all, a total sum of one hundred and thirty thousand, eight hundred and nine naira, (₦130,809), was estimated for the construction of the sandcrete (hollow) block fish pond.

Keywords: Fishpond, Sandcrete Block, Fish Rearing And Income Generation.

I. INTRODUCTION

Fish pond is an enclosure (earthen, concrete or block) built to retain water for the purpose of growing fish to table-size for house hold consumption and for sale to generate income. Culturing of fish in ponds from where they can rarely escape, allows feeding, breeding, growing, and harvesting of the fish in a well monitored manner. Fish pond can be constructed, directly on soil as earthen fish pond, with concrete as concrete pond, with sandcrete blocks as sandcrete block fish pond, etc. Fish pond constructed, and managed in a proper way with good control gives the highest possible fish production, (Fish pond site selection and construction, extension Bulletin No. 96, 1988). Fish pond can be constructed on either small scale or large scale basis with respect to the size of the pond or reservoir. The small scale fish rearing can be carried out in a suitable house back-yard (Home Stead) or fish culture may be on a large area of land, (Abolagba and Omorodion, 2003). In addition, there are other types of enclosures used as fish ponds, which include tanks, concrete, blocks, fibre glass, plastic, cages, pens, reservoirs, etc.

II. BACKGROUND

Water retaining structures, ponds or reservoirs refer to the structures that are constructed for the purpose of confining or retaining water in specific position, (Mosley, Bungay and Hulse, 1999). Such structures include fish ponds, reservoirs, storage tanks, lakes and other underground construction where it is conducive for growing fish. These can be constructed in the form of earthen, concrete or block type.

This project work is based on the design and estimation of the materials and cost for the construction of a 1000-capacity sandcrete (hollow) block fish pond.

Estimation is a judgment or opinion that can be made without having exact details or figures about the size, amount, cost, etc of something. It is to form an idea of the cost, size, value, etc of something but without calculating it exactly (Oxford Advance Learner's Dictionary). Fish farming is a secret lucrative venture which very many people are unaware of. There are many methods being adopted in engaging in it, like the use of earthen pond, concrete pond, sandcrete block pond, fibre glass pond, plastic pond, etc. However adopting the most viable, effective, durable and economical type yields the most beneficial desirable results. The study is geared towards producing a standard viable adaptable sandcrete (hollow) block fish pond. The materials and cost implication knowledge of constructing a sandcrete (hollow) block fish pond for producing a specific quantity of cat fish specie is meant to serve as an incentive and a challenge to all and sundry in considering undertaking a positive drive in fish farming for both academic and economic benefit. Men have been building ponds for over 3000 years ago. These pond are used for dozens of purposes including sediments retention, water supply, livestock watering, aesthetics, aquaculture, heating and cooling building and of course recreational fishing. Land is a major factor of production. Fish ponds are built on land either by excavating the soil for earthen ponds, or by building embankment structure, concrete or sandcrete block ponds. A prospective fish farmer should therefore ensure that the land to be used is legally acquired, since a fish pond structure can be maintained for as long as 10-15 years or more in production circle. Soil at the site to be chosen must be tested for its capacity to retain water or structure built on it (Abolagba and Omordion, 2003).

A typical standard dimension of a concrete fish pond habitable by one thousand cat fishes used by the Kingsway Agro Services is 3m by 2.5m by 1.4m, in length, breadth and depth, respectively (Martinslibrary.blogspot.com).

The objective of this project work is centred on the use of sandcrete (hollow) blocks in the construction of fish pond due to the ready availability, ease of acquirement, rapidity and ease of application and early readiness for use, relative strength, durability and cheapness. Hence much attention will be focused on the commodity.

Sandcrete blocks comprise of natural sand, water and binder. Abdullahi, (2005) reported that sandcrete blocks are widely used in Nigeria, and other countries like Ghana, as walling units. The blocks are composed of cement, sand, and water, molded into a variety of shapes and sizes.

Hollow sandcrete blocks have been in use in many nations of the world including Nigeria, playing a major role in the building industry (Dashan and Kamang, 1999; Al-Khalaf and Yousif, 1984; Morenikeji et al., 2015). In Nigeria, 95% of walling materials in buildings are made of sandcrete blocks. Anwar et al., (2000) put forward that Sandcrete block walls have adequate strength and stability, provide good resistance to weather and ground moisture, durable and easy to maintain.

Nunnally, (2007) suggested that sandcrete blocks, usually hollow, are manufactured with the use of a vibrating machine for large scale production and hand mold for small scale production. Baiden and Tuuli, (2004) added that the type of hollow sandcrete blocks commonly produced and used for construction of buildings in Nigeria are made of a standard mix proportion of 1: 6 cement-sand ratio; that is, one part by volume of cement to six parts by volume of sharp sand.

Sandcrete blocks are molded using mainly metal molds: There are two main types of blocks molded in Nigeria. They are solid and hollow blocks. The sizes in length x breath x height include:

- (i). 450mm x 225mm x 225mm (hollow)
- (ii). 450mm x 150mm x 225mm (hollow)
- (iii). 450mm x 225mm x 225mm (solid)
- (iv). 450mm x 150mm x 225mm (solid)
- (v). 450mm x 100mm x 225mm (solid)

This study finds that block producers in Nigeria can be categorized into private and commercial purpose producers. Private-use Producers: They are those who produce blocks strictly for private use. Commercial Producers: They include both small and large scale producers.

III. MATERIALS AND METHOD

A. Materials

1. SANDCRETE (HOLLOW) BLOCKS

The 450mm by 225mm by 225mm (9 inches, as it is popularly called) sandcrete (hollow) blocks of good quality are usually obtainable at Madu block industry, Lokuwa, Mubi and Elephant block industry, Maiha road, Mubi for purchase and supply to any destination in Mubi metropolis for use. This is however depending on whether the prospective user adopts the commercial producers as his source of acquiring the materials; otherwise the private use producers are also readily available in Mubi.

2. FINE AGGREGATES

The fine aggregates are the sharp or pit sand free from dirt and passing through 4.70mm test sieve. It is of two types. That meant for bonding blocks and flooring the floor of the pond and that for the plastering of the pond walls which is smallish fines. These aggregates are readily got through supply from the tipper drivers.

3. CEMENT

The cement widely used is the ordinary Portland cement (OPC) and the Dangote brand of Portland, which is

commonly available in the many commercial cement stores in Mubi are used.

4. WATER SEAL

A one 1kg-bag of waterseal would be mixed with one 50kg-bag of cement during working. The waterseal is the most modern water proofing compound used in the construction of all concrete and cement mortal based structures which need to be waterproofed in Nigeria, currently. It is presented in a 1kilogram pack and obtainable in local commercial building materials stores in Mubi.

5. WATER

Clean and portable water is usually bought from water tankers delivered to the site of the pond. However the easiest and fastest way of obtaining water is through the "carry-go" riders, who supply water in 25-litre jerry cans to the site. The provision for storing water on the site of fish pond is always provided.

6. PLUMBING

The plumbing involved here are the inlet and outlet piping. While the inlet pipe carries water from a source, say directly from the bore hole, over head water tank, etc, the outlet pipe conveys water away from the pond for disposal when the need arises. It also includes pvc gum used for making joints firmly glued together.

B. Method Of Estimation

The method adopted was to itemise all the types of materials and estimate the quantity based on the size of the pond, which is 3m by 2.5m by 1.4m, in length, breath and depth respectively. Based on the material quantities, market survey was used to determine the cost of materials to obtain the total cost of constructing the sandcrete (hollow) fish pond for stocking and rearing one thousand cat fishes.

1. SANDCRETE (HOLLOW) BLOCKS

Size of fish pond: 3m x 2.5m x 1.4m (l x b x d).

Size of sandcrete (hollow) blocks: 450mm x 225mm x 225mm (l x b x d).

(i) No of blocks on the length course = Length of pond/length of block = 3000mm/450mm
= 6.7 = 7 blocks

But considering double length: = 7 x 2 = 14 blocks.

(ii) No of blocks on the width course = width of pond/length of block = 2500mm/ 450mm = 5.5 = 6 blocks

But considering double width = 6 x 2 = 12 blocks.

No of blocks on the perimeter of the fish pond = 14 + 12
= 26 blocks.

(iii) No of courses in the depth direction = depth of pond/depth of block = 1400mm/225mm
= 6.2 = 6 courses.

Total No of blocks (ground surface) = Perimeter x No of courses = 26 blocks x 6 courses = 156 blocks.

(iv) Two courses of block-work under ground = 26 blocks x 2 courses = 52 blocks.

∴ Total No of blocks = 156 + 52 = 208

Adding 2 blocks for factor of safety = 208 + 2 = 210 blocks.

The stretcher bond method would be adopted for the bonding of the hollow (sandcrete) block wall of the fish pond.

2) FINE AGGREGATES

(i) For bonding blocks and flooring the bottom/floor: 1 tipper of sharp sand.

(ii) For the plastering of walls: 2 “carry-go tri-cycles ($\frac{1}{4}$ of tipper) of smallish smooth fine sand are required. The estimation was based on work experience.

3) CEMENT

Note: One bag of cement would be used to build 30 blocks without filling of the hollows of the blocks and one bag of cement would be used to build 21 blocks with filling of the hollows of the blocks.

(i) No of cement bags for building and filling = 210 blocks/21 = 10 bags.

(ii) No of cement bags for flooring = 2 bags. (Estimation based on experience).

(iii) No of cement bags for plastering = 2 bags.

(As in (ii) above).

∴ Total No of cement bags = 10 + 2 + 2 = 14 bags.

4) WATER SEAL

Waterseal and Portland cement are used in ratio 1:1. Based on this, a total of 14 bags of waterseal were estimated for use.

5) WATER

Total numbers of 36 numbers of 25-litre jerry cans (3 drums) of water were estimated be utilised based on work experience.

6) PLUMBING

The plumbings mainly involve the inlet and outlet piping and the use of pvc gum.

(a) The inlet piping consists of the use of:

(i) 51mm pipe: 2 numbers

(ii) 51mm elbows: 3 numbers

(iii) 51mm stopcock: 1 number

(b) Outlet piping consists of:

(i) 76 mm pipe: 1 number

(ii) 76 mm sinking: 1 number

(iii) 76 mm stopcock: 1 number

(c) PVC gum

(i) Bigger size of pvc gum: 2 tins

IV. RESULT AND DISCUSSION

A. Result

Highlighted below with the use of a table is the result of the estimated materials and cost of constructing the sandcrete (hollow) block fish pond used for stocking and rearing 1000 cat fishes from fingerlings to table sizes.

TABLE 1 MATERIAL TYPES, QUANTITY AND COST ESTIMATE

S/n	Item	Quantity	Unit	Rate ₦ k	Amount ₦ k
1	Sandcrete (hollow) block	21	m	1,300:00	27,300:00
2	Fine aggregate sharp sand plastering sand	3.5. 0.875	m ² m ²	2,000:00 3,428:57	7,000:00 3,000:00
3	Cement	14	Bag	2,650:00	37,100:00
4	Waterseal	14	Bag	1,000:00	14,000:00
5	Water	900	Liter	1: 00	1,080:00
6	Plumbing 51mm pipe 51mm elbow 51mm stopcock 76mm pipe 76mm sinking 76mm stopcock pvc gum (big size)	2 3 No 1 1 1 1	No No No No No No No	800:00 250:00 1,200:00 950:00 700:00 2,500:00 1,200:00	1,600:00 750:00 1,200:00 950:00 700:00 2,500:00 2,400:00
7	Workmanship				25,000:00
	Total cost				124,580:00
8	Miscellaneous	5% of total expenditure			6,229:00
	Grand total cost				130,809:00

.Discussion

The sandcrete (hollow) block fish pond is 3m long, 2.5m wide and 1.4m deep and covering an area of 7.5m². It would be constructed or built using 210 numbers of 450mm by 225mm by 225mm (9 inches) sandcrete hollow blocks. A total number of 14 bags of Dangote Portland cement are needed for bonding, filling, flooring and plastering work, while 1¼ tippers of fine aggregates will be used; such that 1 tipper of sharp sand is for bonding, filling and flooring and ¼ tipper is used for plastering the pond walls. Since the fish pond is a water retaining structure, 14 bags of waterseal will be used by (thoroughly) mixing one bag of waterseal with one bag of Portland cement. Plumbing facilities are provided and 36 numbers of 25-litres jerry cans of water would be expended for the construction work. The cost of constructing the fish pond was estimated to be a total of one hundred and thirty thousand, eight hundred and nine naira, (₦130,809) only.

V. CONCLUSION

The campaign of economic diversification to agriculture by the Nigerian government in recent times due to the drastic falls in oil price; the Nigeria main source of internal revenue generation, is loudly obvious. It is a clarion call for all and sundry to rise up to the challenge, since everyone, government, institutions, individuals, are all affected by the economic recession.

Fish which is a major source of affordable animal protein whose demand has been on high increase recently, is an obscure secret source of potential personal empowerment, institutions latent secure means of internal revenue generation and cooperative body's EL Dorado.

The exposition of the materials and financial cost of constructing a relatively cheaper type of a fish pond: sandcrete (hollow) fish pond should therefore serve as a stimulant to all and sundry to respond to the prodding of the nerves' readiness and yearning, to go into action.

Above all, based on the project report, it can be simply concluded that:

- (1) The materials for constructing a sandcrete (hollow) block fish pond: sandcrete (hollow) blocks, cement, fine aggregates, waterseal, water, plumbing materials are readily available and cheap.
- (2) The expertise and labour required to effect construction are relatively not too technical, available and cheap.
- (3) The construction of a fish pond using sandcrete (hollow) block materials is fast in completion and early in availability for use.
- (4) The cost of constructing a sandcrete (hollow) block fish pond is relatively cheap, strong and durable.

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