

# WATER RECIRCULATORY SYSTEM TECHNOLOGY AS A MAJOR TOOL FOR INCREASED FISH PRODUCTION BY PRIVATE FISH FARMERS.

By B. Ezenwa and P.E. Anyanwu

*Nigerian Institute for Oceanography and Marine Research,  
P.M.B. 80108, Victoria Island, Lagos.*

## INTRODUCTION

---

In recent times (1994/2001) the country has witnessed an unprecedented interests by entrepreneurs in fish farming. This is largely due to scarcity of fish in the local markets in addition to the huge export potentials of our local fin and shellfish species in international markets. The use of high technology in catfish farming is the latest in Aquaculture culture system that has attracted numerous investors due to its tremendous success in areas that initiated the system in recent times. First introduced in Nigeria in 1978/79 by Nigerian Farms Ltd. in Patani, Delta State by German Entrepreneurs and local partner, its success was very limited in terms of fingerling and table sized fish production of *Tilapia* spp, Catfish and Common Carp due to poor management skill after departure of German Experts. Others followed as from 1996 e.g. Chi farms Nigeria Limited Lagos, Zartech (Ibadan), Durante (Ibadan), Ocean Fisheries Nigeria Limited etc.

Nigeria requires approximately 1.5 million tonnes annually to meet fish demand, whereas domestic supply is estimated at about 0.5 tonnes including massive importation of frozen fish, which gulps over N20 billion annually. Nigeria is the largest importer of frozen fish in the whole world. Furthermore, the major source of fish supply in Nigeria (capture fisheries) are presently on the decline arising from an over exploitation. Similarly, Livestock production the other major contributor to protein foods is also constrained by desert encroachment, rinderpest attack and others. This has placed fish culture on the spotlight as the viable option for food security and fish production increase, which has to be large-scale to impact.

Unfortunately however, aquaculture in Nigeria contributes only 25,000 30,000 tonnes annually despite its potential estimated at over half a million tonnes. There are now concerted efforts to develop intensive aquaculture production to increase fish production. Consequently research was initiated on intensive catfish production using water recirculation system. Water Recirculation System (WRS) can be adapted to all the ecological zones of Nigeria and is especially recommended for areas where pond culture is not so feasible due to low rainfall, high water evaporation rates, loose soil types and poor water retention characteristics.

With WRS, it is possible to produce fish all the year round. It is a type of cultivation system in which effluents or used water from fish rearing units is partially or completely recirculated to them after water treatment and reconditioning. This system rears fish at high densities with reduction in water usage. This is achieved by employing a water treatment unit, which includes mechanical filtration, biological filtration solid waste removal, water sterilization and aeration. WRS conserve both water and land and maximize production in a relatively small area of land, use a relatively small volume of water for example 50 tonnes of fish can be produced in 60m<sup>3</sup> building annually. This is in contrast to outdoor earth ponds. The WRS system is very effective in the control of poaching prevalent in Nigerian agricultural investment profiles.

Water Recirculation System could be outdoor systems offer better environmental control for

maximum fish growth and survival. The system requires continuous supply of water at a temperature an content that is optimum for growth of the cultured fish. In addition, a filtering (bio filter) system is required to purify the water and remove or detoxify harmful water products and uncaten food. The fish is fed a nutritionally

complete feed on a daily basis. WRS are particularly useful in areas where land and water are not readily available or expensive. They are very suitable in climatic condition, which prevent year-round production e.g. cold (winter) or extremely dry (desert) condition.

### **POTENTIAL ROLE OF WRS IN SHELL AND FIN FISH PRODUCTION IN NIGERIA**

Presently in Nigeria, three fish farms operating the WRS Technology are producing a total of 500 tonnes annually. If 1000 fish farmers or families adopt this technology 200,000 tonnes of fish will be produced annually at 200 tonnes per family, thereby raising total fish production from Aquaculture to over 250,000 tonnes/year.

If the WRS Technology is domesticated through use of local raw material to reduce production costs, more farmers will be attracted to adopt the technology ad more fish will be produced in Nigeria. This will ensure fish self-sufficiency ad food security as well as creation of employment opportunities thereby alleviating poverty.

Mass adoption of this technology will be greatly advantageous to aquaculture investors and food fish security in Nigeria. It will enhance rural employment, alleviate poverty, and increase fish production and fish protein intake leading to general well being of Nigerian citizens. Below is a brief summary of fingerlings and table size fish production using WRS.

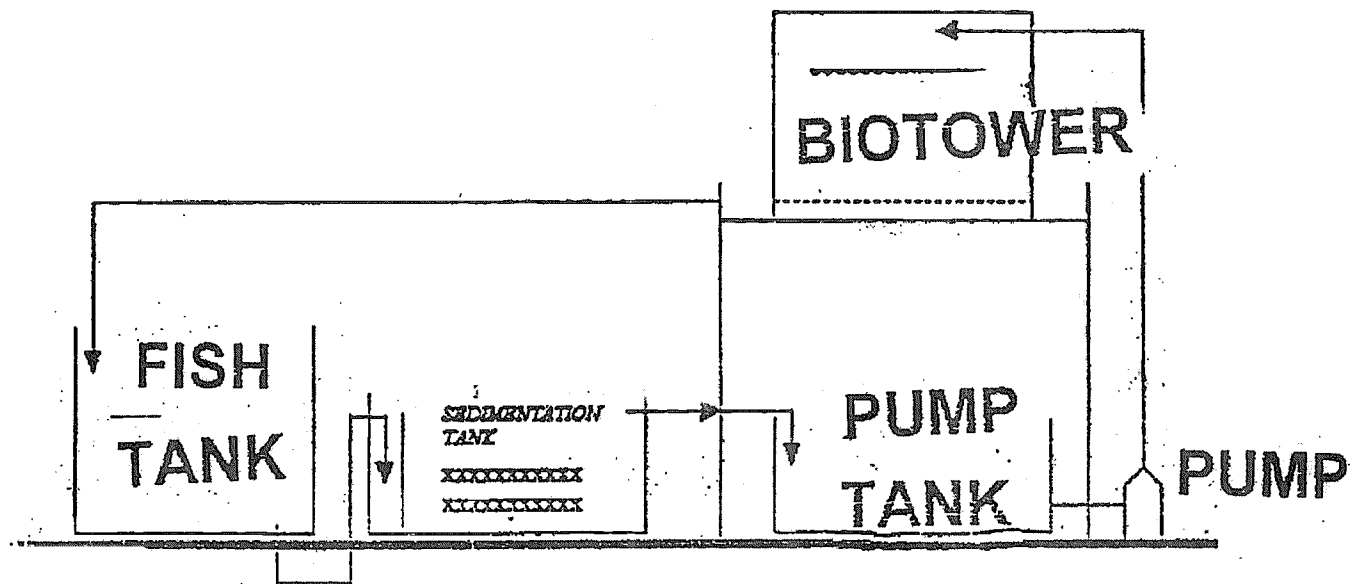
**Table I: Table size fish production.**

S/No.	Capacity of WRS	Total number of investors per geopolitical zone.	Fish production using WRS
1	100 tons	1000	100,000 tons of fish per zone
2	50 tons	1000	50,000
3	20 tons	1000	20,000
Total per zone			170,000 m.t
Total for 6 zones			1,020,000

i.e. 1.02 million m.t. of fish per annum in Nigeria.

**Table II: Table size fish production.**

S/No.	Capacity of WRS	Total number of investors per geopolitical zone	Total number of fingerlings.
1	100 tons	1000	5,000,000
2	50 tons	1000	2,500,000
3	20 tons	1000	1,000,000
Total number of fingerlings per zone			8,500,000
Total number of fingerlings for six zones			51,000,000



### Re-circulation of the flow (skech)

#### COST ESTIMATES FOR PRODUCTION:

- (a) 100,000 fingerlings
- (b) 20 tonnes of table fish and
- (c) 500 broodstock of *C. gariepinus* annually.

WRS Building (10m x 20m)	500,000.00
Water supply + piping	200,000.00
Electricity supply + installation	250,000.00
Fish tank (14)	330,000.00
Biofilters (9)	200,000.00
Aeration device	40,000.00
Water Sterilization/solid waste removal	130,000.00
Water pumps (10)	180,000.00
Fish feed + Artemia	200,000.00
Broodstock	30,000.00
Water analysis kit	100,000.00
Lab. Equipment (balance, etc)	150,000.00
Total	₦2,410,000.00

## Details of items.

Broodstock Unit	2 fibre glass tanks (500L)
	2 fibre glass tanks (1000L)
	1 complete set of biological filtration
	1 complete set of sedimentation/pump tank (1200L)
	UV Light
	1 Water pump
	Piping and fittings
Incubation Unit	2 Fibre glass tanks (500L)
	2 complete set of biological filtration
	2 complete set of sedimentation/pump tank (1200L)
	UV Light
	2 water pump
	Piping and fittings
Advanced fry Unit	2 fibre glass tanks (500L)
	2 complete set of biological filtration
	2 complete set of sedimentation/pump tank (1200L).
	UV Light
	2 water pump
	Piping and fittings
Fingerlings Unit	4 fibre glass tanks (500L)
	2 complete set of biological filtration
	2 complete set of sedimentation/pump tank (1200L).
	UV Light
	2 water pump
	Piping and fittings
Table fish Unit	4 fibre glass tanks (500L)
	2 complete set of biological filtration
	2 complete set of sedimentation/pump tank (1200L).
	UV Light
	2 water pump
	Piping and fittings

## TREATMENT OF WASTE MATERIALS FROM THE WRS SYSTEM

During operations, the major inputs are feeds and oxygen while wastes from the fish in the form of faeces, are given out, in addition to ammonia, carbon dioxide and heat.

- ❖ Drum filter
- ❖ Materialisation

### Ammonia:

- ❖ Nitrifying bacteria in the bio-tower

### Treatment of wastes.

#### Faeces

Treatment is based on removing or breaking down the waste of the fish faeces:

- ❖ Settling/sedimentation filter

#### Carbon dioxide:

Diffusion of air in and out of the system

## INFRASTRUCTURE REQUIRED FOR WRS SYSTEM

### i) Space/building

20 tonnes production/year	100m <sup>2</sup>
50 tonnes production/year	150m <sup>2</sup>
100 tonnes production/year	300m <sup>2</sup>

### ii) Energy required

20 tonnes production/year	2KW/24 hours/day
50 tonnes production/year	4KW/24 hours/day
100 tonnes production/year	7KW/24 hours/day

### iii) Water quantity?

20 tonnes production/year	11m <sup>3</sup> water/day
50 tonnes production/year	27.5m <sup>3</sup> water/day
100 tonnes production/year	55m <sup>3</sup> water/day

i) Fish raised in WRS system depends entirely (100%) on properly formulated feed diets that enhance rapid growth. Feed therefore is the major input in cost of production at an estimated level of N95/feed producing one kg of fish.

### ii) Feed should be based on the following characteristics:

- ❖ Full meal diet; containing all the necessary

ingredients, premix and so on

- ❖ High digestibility
- ❖ Water stable
- ❖ Uniform size
- ❖ No dusk smell attractive to the fish (blood-meal/fish oil)
- ❖ Stored well in A/C environment.

### iii) Feeding Methods:-

In Intensive farming: it is appropriate and advisable to use demand or self feeders with either floating or sinking feed, unlike floating feed in pond farming that enables better control over fish growth and health.

Young fish should get: 5 times a day

Big fish should get: 3 times a day.

### iv) Feed is imported as fish concentrate:

FC = 1.0

- ❖ 20 tonnes production/year 1.2 container, 20 feet
- ❖ 50 tonnes production/year 3 container, 20 feet
- ❖ 100 tonnes production/year 6 container, 20 feet

