

**CONSTRUCTION AND ENVIRONMENTAL
CONTROL OF A SMALL- SCALE FISH TANK
FOR BREEDING AND PRODUCING
FRESHWATER FISH**

**BY
SAFAA ELSAYED GHARIB MOHAMED**

A thesis submitted in partial fulfillment

of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Science
(Agricultural Engineering)

**Department of Agricultural Engineering
Faculty of Agriculture
Zagazig University**

2016

CONTENTS

	No.
1. INTRODUCTION.....	1
2. REVIEW OF LITERATURE.....	3
2.1. Culture tank engineering	3
2.2. Fish tanks conditioning requirements.....	5
2.2.1 Temperature.....	5
2.2.2 Aeration.....	7
2.2.3 Water quality.....	8
2.3 Aerators Devices	9
2.3.1 Gravity aeration	11
2.3.2 Diffuser aerators.....	11
2.3.3 Paddle wheel aerators	13
2.3.4 Turbine aerators.....	15
2.3.5 Propeller-aspirator pump aerators.....	16
2.3.6 Vertical pump aerators.....	16
2.4 Dissolved oxygen (DO) required for fish.....	17
2.5 Factors affecting the amount of dissolved oxygen in water.....	21
2.6 Effect of stocking density on tilapia Fish production.....	22
2.6.1. growth performance.....	23
2.6.2. Survival rate.....	28
2.6.3. feed utilization.....	29
2.6.4. water quality parameters	31

3. MATERIALS AND METHODS.....	33
3.1. Materials.....	33
3.1.1. Nile Tilapia fish	33
3.1.2. Fish diet.....	33
3.1.3. Water quality.....	34
3.1.4. The constructed tanks.....	34
3.2. Methods.....	39
3.2.1. Experimental conditions.....	39
3.2.2. Measurements and determinations	40
4. RESULTS AND DISCUSSION.....	44
4.1. Effect of aeration regime on round and square fish tanks performance under different stocking densities.....	44
4.1.1. Ammonia concentration.....	44
4.1.2. Efficiency of biological filter	46
4.1.3. Dissolved oxygen	48
4.1.4. Biomass of Nile tilapia	55
4.1.5. Dead fish of Nile tilapia	57
4.1.6. Body weight gain of Nile tilapia	59
4.1.7. Specific growth rate of Nile tilapia	61
4.1.8. Relative growth rate of Nile tilapia	63
4.2. Effect of aeration regime on required power	65
4.3. Net profit of Nile tilapia for round and square tanks under different stocking densities.....	67

5. SUMMARY AND CONCLUSIONS.....	69
6. REFERENCES.....	74
7. APPENDIX.....	87
ARABIC SUMMARY	

LIST TABLES

No.	Title	Page
1	Standard specifications of the used water.....	34
2	Types of bacteria that are present in one gram of biological cotton at the beginning of the Experiment.....	39
3	The changes occurred in body weight under aeration regime A1 (aeration by air compressor with inter-holes distance of 150 mm) in round tank.....	87
4	The changes occurred in body weight under aeration regime A2 (aeration by air compressor with inter-holes distance of 200 mm) in round tank.....	88
5	The changes occurred in body weight under aeration regime A3 (aeration by air compressor with inter-holes distance of 250 mm) in round tank.....	89
6	The changes occurred in body weight under aeration regime A1 (aeration by air compressor with inter-holes distance of 150 mm) in square tank.....	90
7	The changes occurred in body weight under aeration regime A2 (aeration by air compressor with inter-holes distance of 200 mm) in square tank.....	91
8	The changes occurred in body weight under aeration regime A3 (aeration by air compressor with inter-holes distance of 250 mm) in square tank.....	92
9	Number of dead fish in round tank.....	93
10	Number of dead fish in square tank.....	93

No.	Title	Page
11	Effect of aeration regime on biomass of Nile tilapia in round tank.....	93
12	Effect of aeration regime on biomass of Nile tilapia in square tank.....	94
13	Effect of aeration regime on specific growth ratio with using round tank and different densities.....	94
14	Effect of aeration regime on specific growth ratio in square tank with using different densities.....	94
15	Effect of aeration regime on relative growth ratio (RGR %) in round tank with different densities...	95
16	Effect of aeration regime on relative growth ratio (RGR %) in square tank with different densities...	95
17	The dissolved oxygen without fish in round tank under different aeration regimes.....	96
18	The dissolved oxygen without fish in square tank under different aeration regimes.....	97
19	Effect of stocking density of Nile tilapia on the dissolved oxygen under aeration regime A2 in round tank.....	98
20	Effect of stocking density of Nile tilapia on the dissolved oxygen under aeration regime A3 in round tank.....	99
21	Effect of stocking density of Nile tilapia on the dissolved oxygen under aeration regime A1 in round tank.....	100

No.	Title	Page
22	Effect of stocking density of Nile tilapia on the dissolved oxygen under aeration regime A1 in square tank.....	101
23	Effect of stocking density of Nile tilapia on the dissolved oxygen under aeration regime A2 in square tank.....	102
24	Effect of stocking density of Nile tilapia on the dissolved oxygen under aeration regime A3 in square tank.....	103
25	Net profit of Nile tilapia as affected by using different stocking densities in round tank.....	104
26	Net profit of Nile tilapia as affected by fish stocking densities under different aeration regime in square tank.....	105

LIST OF FIGURES

No.	Title	Page
1	pH meter.....	34
2	Round tank.....	35
3	Square tank.....	35
4	Elevation view of Round tank.....	35
5	Elevation view of square tank.....	36
6	Manometer.....	37
7	Section elevation of Biological Filter.....	38
8	Dissolved oxygen meter.....	41
9	Effect of aeration regime on ammonia concentration with and without biological filter in Square and round tanks under different Nile	
10	Tilapia stocking densities.....	45
	Effect of aeration regime on efficiency of biological filter in Square and round tanks under different Nile tilapia stocking densities	47
11	Effect of aeration regimes on dissolved oxygen without fish for round and square tanks.....	47
12	Effect of aeration regimes on dissolved oxygen for round and square tanks using different stocking densities in first month.....	49
13	Effect of aeration regimes on dissolved oxygen for round and square tanks using different stocking densities in second month.....	51

No.	Title	Page
14	Effect of aeration regimes on dissolved oxygen for round and square tanks using different stocking densities in third month.....	52
15	Effect of aeration regimes on biomass of Nile tilapia in round and square tanks using different stocking densities.....	54
16	Effect of aeration regime on dead fish of Nile tilapia in round and square tanks using different stocking densities.....	58
17	Effect of aeration regime on body weight gain of tilapia in round and square tanks under different stocking densities.....	60
18	Effect of aeration regimes on specific growth ratio of tilapia in round and square tanks under different stocking densities.....	62
19	Effect of aeration regimes on relative growth ratio of tilapia in round and square tanks under different stocking densities.....	64
20	Effect of aeration regime on required power.....	66
21	Net profit of Nile tilapia in round and square tanks under different stocking densities.....	68

ABSTRACT

Experiments were carried out through two years from 2014 to 2015 at a private farm, Sharkia Governorate, Egypt to study the effect of some different parameters on the performance of two designed aquaculture tanks (round and square) during aquaculture of Nile tilapia (*Oreochromis niloticus*).

The main objective of the present research is to construct and control environment of a small-scale fish tank for breeding and producing freshwater fish.

To achieve the main objective, the sub main objectives of this investigation are to:

- 1- Evaluate some different parameters (tank shape, fish stocking density, with and without biological filter, and aeration regime) affecting Nile tilapia production.
- 2- Evaluate the constructed fish tank from the economic point of view.

Two small-scale designed fish tanks (round and square) were constructed for breeding and producing freshwater fish. To control environment, experiments were carried out to study the effect of some different parameters on the performance of the two designed tanks during aquaculture of Nile tilapia (*Oreochromis niloticus*). Performance was experimentally investigated as a function of change in tank shape, fish stocking density, with and without biological filter, and aeration regime in terms of ammonia concentration, dissolved oxygen, biomass, dead fish, body weight gain, specific growth ratio, relative growth ratio and required power.

The experimental results reveal that the highest biomass of (13.53 kg/m³) while dead fish (3 fish/m³) was acceptable under the following conditions: use of the round fish tank, use of air compressor with inter-holes distance of 150 mm as an aeration regime and adjust stocking density at 200 fish/m³.