LARGE-SCALE TILAPIA CAGE CULTURE IN LAKE MALAWI

This project document has been developed by a group of participants to whom the credit and technical responsibility go. Dr. Abdel Rahman El Gamal supervised the group projects activity which was a part of the 3-month training course: "Fish Culture Development – Africa". This course is annually organized by EICA, JICA and EFTCA. The names and pictures of the team members who developed this project are shown in a subsequent slide.

2019

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PROJECT SUMMARY

- **Project name:** LARGE-SCALE TILAPIA CAGE CULTURE IN LAKE MALAWI
- **Location:** SOUTH-EAST OF LAKE MALAWI
- **Funding:** Equity and Loan
- **Total Investment costs:** 1,736,102.47 US$
- **Revenue:** 1,360,800 US$
- **Production rate:** 21kg/m^3
- **Farm size water:** Open waters
- **Annual total fish production:** 500 tons

INTRODUCTION

Background

- Fish is a very important commodity in Malawi and beyond
- The fisheries sector contributes about 4% to the total GDP.
- Combating food and nutritional insecurity
- Good source of animal protein
- Fish is also a source of income to both fish farmers and fishermen
- It is also a source of employment to people who are directly and directly involved in fish related activities.

Background..

Fish Species

- *Oreochromis shiranus*
- Popular species for aquaculture in Malawi
- Can spawn easily in captivity
- Policy does not allowed to culture exotic species like Nile tilapia

Background..

Cages

- Cage culture, also known as net-pen culture, consists of a net suspended in the water column with a flotation system around its perimeter.
- The cages are either moored in close proximity or physically connected to form a large array.
- The system is characterized by an intensive farming running-water culture with high yields and great efficiency.

Advantages and disadvantages of cage system

Advantages

- Flexibility of management of the cage since all of the water parameters are regulated naturally
- Ease and low of harvesting
- Close observation of fish feeding response and health
- Ease and economical treatment of parasites and diseases

Disadvantages

- Risk of loss from poaching or damage to cages from predators or storms
- Less tolerance of fish to poor water quality
- Complete dependence on nutritionally diets
- Greater risk of disease outbreaks

Rationale

- Increasing fish demand primarily from population growth
- Decline in commercially valuable fish species, especially the Chambo (*Oreochromis shiranus*) in Lake Malawi
- There is low per capita consumption of fish in Malawi which stands at 7kg/capital/person

Objectives

Main objective

- To increase aquaculture fish production through cage culture from the current 7,500 tones to 10,000 tons.

Specific objectives

- To supply fresh tilapia to local population a source of low cost fish protein.
- To provide of livelihood (income and employment) through commercial aquaculture
- To reduce importation of fish
- To increase the per capita consumption of fish in Malawi

PROJECT DESCRIPTION

Project area

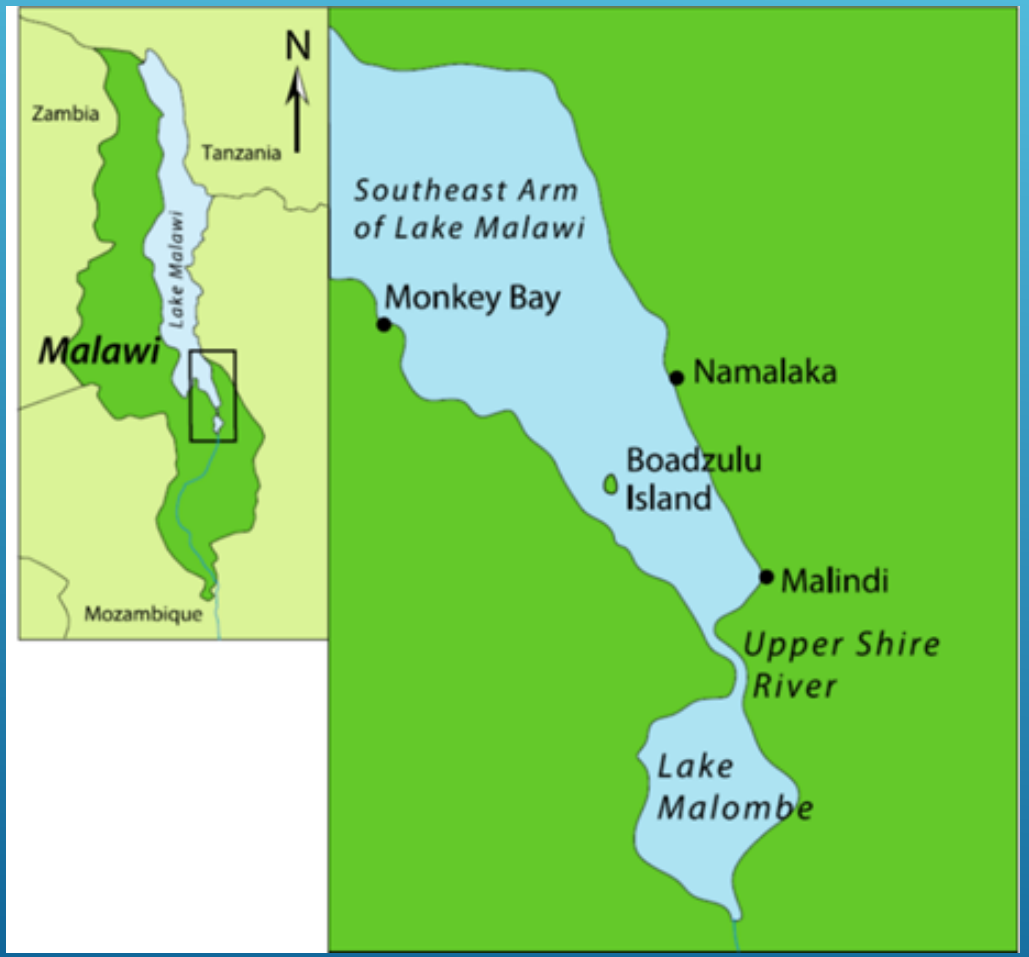


Figure 1: Map of Lake Malawi showing the project area

- The project will be carried out in the Southeast arm (SEA) of Lake Malawi (Fig 1)
- This is located in Mangochi District in the southern region of the country.
- Mangochi is also more suitable for aquaculture because of relatively higher temperature than most parts of the country (25 – 37) °C
- The SEA is relatively shallow with an average depth of 50 m.
- This site has good water quality regarding:
  - Temperature
  - Salinity
  - Dissolved oxygen (DO)
  - Optimum current to ensure adequate water exchange
  - Free from industrial pollution

Culture types

- Fingering production
- Fingerlings will be produced from the fish hatchery of the farm using fiber glass tanks
- Monosex tilapia fingerlings(*Oreochromis shiranus*) will be stocked in cages at 20g
- The system of production will be an intensive system which will involve stocking of 84,000 fingerlings per cage (70 fish/m^3).
- This is characterized by high yields and great efficiency.
- The project will produce table size tilapia of 300g in one cycle of seven months each every year.

Water Quality

Table 1: Water quality Parameters

Physico-chemical Parameters	Value/Range
Minimum water depth	2 m
Water Current	10 – 20 cm/sec
Turbidity	<5mg/l
Temperature (oC)	28 – 30
pH	7 – 7.5
Dissolved Oxygen (ppm)	5 – 7
CO2 (mg/l)	Less than 20
Free Ammonia (ppm)	0 – 0.5
Nitrite (mg/l)	Less than 0.3
Nitrate (ppm)	Less than 300
Salinity	Less importance in freshwater culture.

CAGE LAYOUT

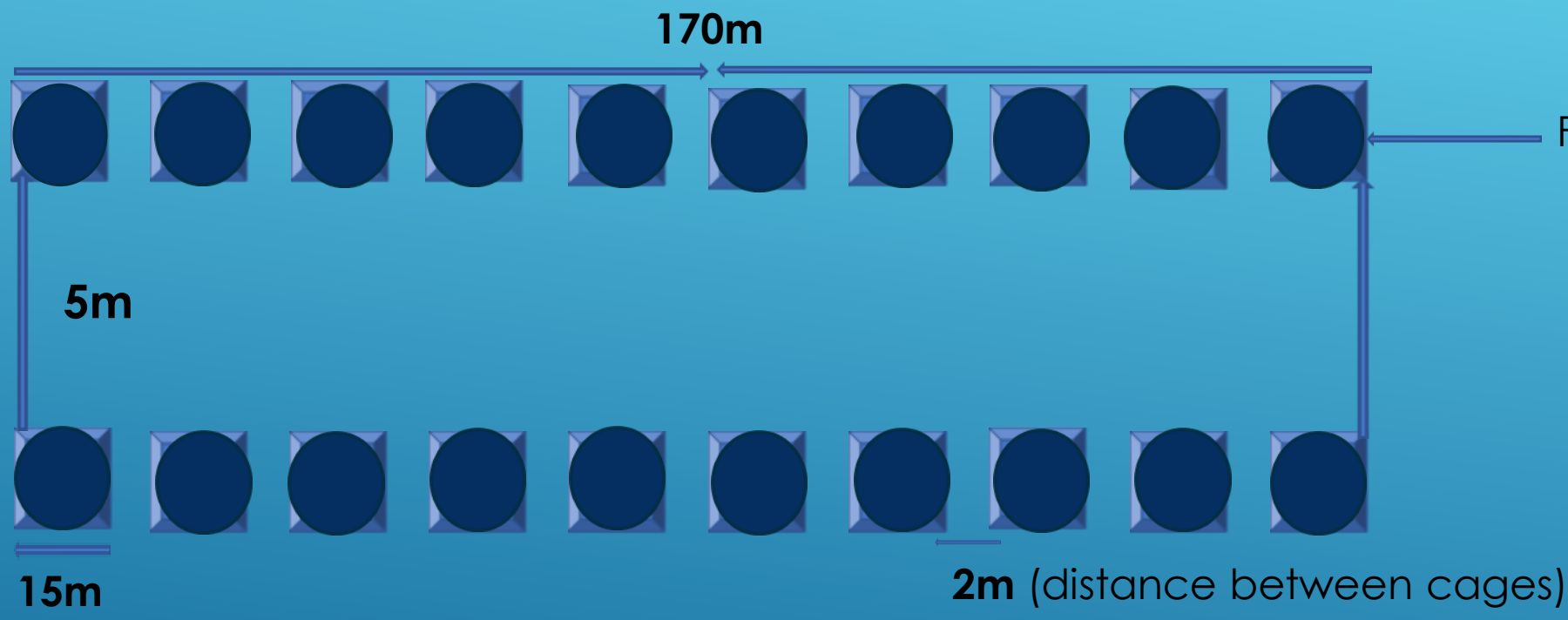


Figure 2: Layout of the cages in the water

Cage layout cont..

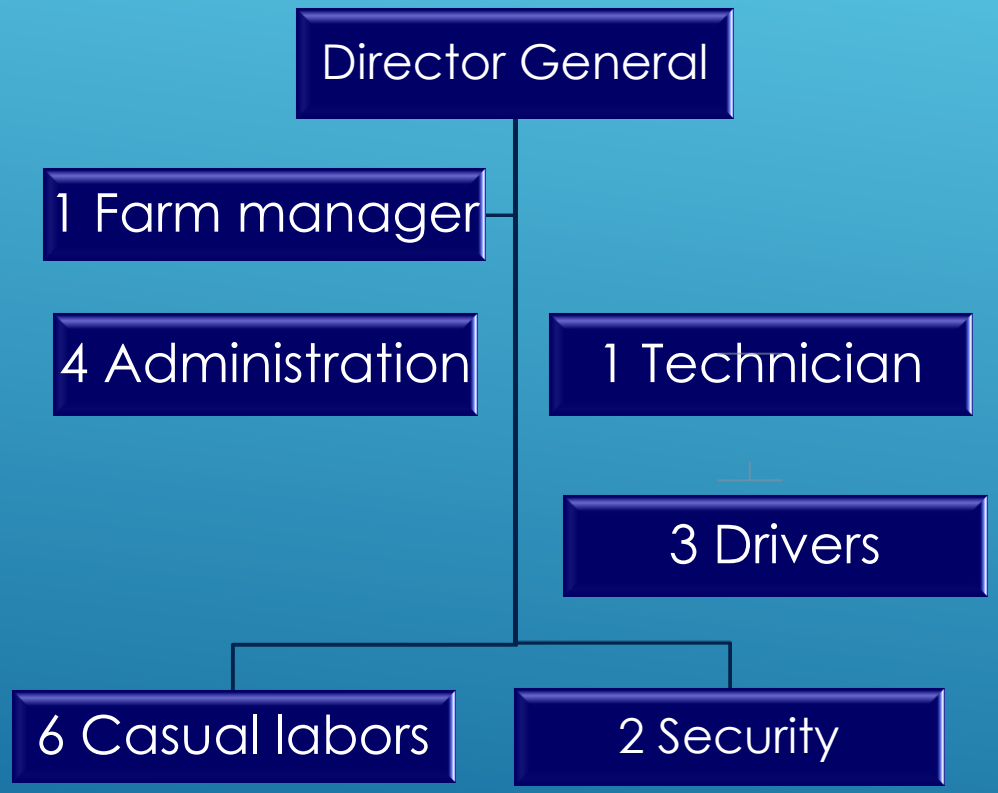
- Cages will be sited 200 meters offshore of the lake.
- 20 cages with a total volume of 1200 cubic meters each
- The cages will be arranged in two rows with 10 cages on each row
- The distance between cages in a row will be 2m.
- The between the two rows will be 5 m.
- The 5 m distance between the rows will allow easy movement of the boat during feeding.
- Therefore, the total area of 6,800m2 will be required for the cages.

Feed and feeding regime

Table 2: Fish feeding regime

Time of culture	Feed type	Feeding rate (% BW)	Protein percent	Feeding frequency (times/day	# of feeding days
1	Special fry feed	5	38	5	30
2	Fry feed	3	38	3	30
3	Starter	2	32	2	120
4	Finisher	2	32	2	30

LABOUR AND ADMINISTRATION



Total of 17 workers on both permanent and temporary basis as diagram shows:

PROJECT FINANCE

- **Source of funding**
  - The source of funds for the project will be:
    - Loan amount: **604213.0** (**40%**)
    - Equity: **1131889.5** (**60%**)
  - The estimated annual interest rate for the loan is **30%**
  - The loan will be paid within a period of **10 years**

FINANCIAL ANALYSIS

Total Capital Investments

Table 3: Total Capital Investments

Items	Cost ($)
Total Fixed Assets	**885 000**
Pre-operational Costs	
Expenses during construction	204 353.9
Interest during construction	181 263.9
Total Pre-operational Costs	**385 617.8**
Working Capital	
Inventory	258 598.7
Cash liquidity	93 486.0
Debt accounts	113 400.0
Total Working Capital	**465 484.7**
Total of Investment Costs	**1 736 102.5**

Table 4: Fixed costs and depreciation

Fixed Assets			
ITEM	VALUE ($)	ANNUAL DEPRECIATION RATE (%)	ANNUAL MAINTENANCE RATE (%)
Land	10,000.00	-	-
Buildings and civil works	150,000.00	2.5.00	1.30
Hatchery and rearing tanks	25,000.00	10.00	5.00
Out board engine Boat (2)	150,000.00	10.00	5.00
Air distributors	10,000.00	10.00	5.00
Cold room	20,000.00	10.00	5.00
Office furniture	15,000.00	10.00	5.00
Drainage tanks	10,000.00	10.00	5.00
CAGES	260,000.00	10.00	5.00
Water pumps	40,000.00	10.00	5.00
Air pumps& drainage pumps	25,000.00	10.00	5.00
Refrigerated Truck	75,000.00	10.00	5.00
Hatchery equipment	10,000.00	10.00	5.00
Electric Generators	30,000.00	10.00	5.00
Lab. Equipment	10,000.00	10.00	5.00
Equipment for fish rearing	5,000.00	10.00	5.00
Vehicles and motorbikes	40,000.00	10.00	5.00
TOTAL FIXED ASSETS	885,000.00		

Operating Costs

Table 5: Operation costs

Operating costs	
ITEM	VALUE ($)
Medicines	6 921.4
Parent stock / Fingerlings	7 500
Utilities (Energy)	17 040
Wages and Salaries	66 150.0
Feeds	503 354.5
Total	600 965.9

Loan Repayment

Table 6: Annual loan repayment to the bank

Year	Loan Amount ($)	Interest Amount ($)	Annual Installment ($)
0	604 213.0	181 263.9	
1	604 213.0		195 440.8
2			195 440.8
3			195 440.8
4			195 440.8
5			195 440.8
6			195 440.8
7			195 440.8
8			195 440.8
9			195 440.8
10			195 440.8

Economic parameters

Table 7: Standard economic parameters with and without loan

WITHOUT loan		WITH loan	
IRR	47.5%	IRR	64.2%
PBP	2.11	PBP	1.56
NPV	$497,828	NPV	$497,827.81
NPVb	$3,266,287	NPVb	$3,731,065.93
NPVc	$2,768,459	NPVc	$3,233,238.12
B/C RATIO	1.18	B/C RATIO	1.15

Loan interest rate scenario analysis

Table 8: Loan interest rate scenario analysis

SENSIVITY OF INTEREST RATE (BANK) ON NPV				
BASE				*NPV* ($)
Annual Revenue ($)	1,360,800.00	*VARIATION OF INTEREST RATE (BANK)*	20%	972,464.60
Rate	30%		30%	497,827.81
NPV ($)	497,827.81		35%	354,453.11

Scenario analysis based on fish price

Table 9a: Price Scenario prior information

SENSIVITY OF FISH PRICE ON ANNUAL REVENUE	
BASE	
Total production (kg)	504,000
Production of efficiency	90%
Price of fish/kg ($)	3.00
Annual revenue ($)	1,360,800.00

Table 9b: Scenario analysis based on fish price

		VARIATION OF PRICE ($)				
		90%	95%	100%	105%	110%
		2.00	2.85	3.00	3.15	3.30
PRODUCTION	95%	957,600.00	1,364,580	1,436,400	1,508,220	1,580,040
EFFICIENCY	90%	907,200.00	1,292,760	1,360,800	1,428,840	1,496,880

MARKETING PLAN

- At the moment, the fish will be sold fresh at a price of US$3/kg.
- Future plans, the fish will further be processed into fillets
- Fillets will be packed in polyethene bags with the company's name printed on them
- The fillets will be packed in 1kg, 5kg, 10kg packages.
- The filleted fish will be supplied to supermarkets, hotels, restaurants
- The waste products will be sold to feed processing industries to produce fish meal.
- The project will have a marketer to help advertise our product.
- We could advertise our products through the media: television, radio and social media.

Table 10: SWOT ANALYSIS

Strengths	Weaknesses
• Production of high-quality fish for food and nutrition security • Provision of employment to the people within the rural communities of the project site • Availability of freshwater which is relatively unpolluted for cage culture production • Good government support in terms of policy governing cage aquaculture in the lake • Availability of technical expertise on cage aquaculture • Good environment and climate • High market demand for fish	• High cost of input such as feed • Lack of enabling infrastructure like feed mill facility • Lack of local capacity for capital investment on high cost cage aquaculture ventures. • Inadequate processing and marketing infrastructure. • Environmental degradation through pollution to the lake environment as a result of feeding in cages • High level of risk from natural events such as storms and floods
Opportunities	**Threats**
• Availability of pollution free areas suitable for cage culture, which has up to now not been explored for enterprise. • To provide employment opportunities in the aquaculture sector. • Improved product quality • Increasing demand for fish	• Theft of fish from cages by the surrounding communities • Conflict between cage operation and fishing operations • Increased cost of production • Market price due to competition • Disease introductions in the lake due to intensive system in cages.

ENVIRONMENTAL IMPACT ASSESSMENT

- EIA will be done to check or address the following:
  - Hydrology and water quality of the lake and its surroundings,
  - Occupational safety and health of workers,
  - The health status of the lake; free of disease, lice, predators, mortalities
  - Correct dose of chemicals, medicines and hormones for the project to avoid pollution.
  - Exotic species will not be used so as not to endanger the local species
  - The project will be assessed that it is free of conflicts among the communities when in use

PROJECT OUTPUT

Table 11: Total Revenues

Annual quantities and values of production	
Operating efficiency (90%)	
Quantities	Value ($)
Quantities Produced and sold (in KG)	504000
Fresh Tilapias (100%)	453600
Fresh Tilapias at $3 per Kg	1360800
Total Revenues ($)	1360800

PROJECT MONITORING AND REVIEW

- The project will be reviewed annually in order to assess its performance against its objectives
- Monitoring is a continuous process which will be carried to ensure proper implementation of the project.

PROJECT CALENDER

Table 12: Calendar of project activities

No.	Activity	Months											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Land acquisition												
2	Construction of the offices and storage												
3	Cage acquisition												
4	Acquisition of fish feed, medication												
5	Fingerling Production												
6	Stocking of fish in cages												
7	Feeding the fish												
8	Harvesting and marketing, distribution												
9	Evaluation of the first cycle												

SUSTAINABILITY OF THE PROJECT

The sustainability in any aquaculture project involves three pillars which include:

- **Environmental**
  - Use floating fish feed and not sinking feed to avoid water pollution
  - The cultivation of local species and not wipe them out by exotic species.
  - Optimal stocking densities of fish in the cages in order to prevent disease outbreaks
  - Proper use of sex hormones in the hatchery to avoid threat to the environment and the consumers
- **Social equity**
  - Employment- benefit from cheap labour around the area of the project
- **Economics**
  - Demand for fish is high due to high population

CONCLUSION

- Based on the economic parameters, the project is feasible
- Fish production in Malawi will be increased, hence per capita consumption
- The nutrition status of the people will be improved

RECOMMENDATIONS

- The government of Malawi should propose the reduction of interest rate on loans from 30% to at least 15%
- Government should waive tax on any importation of aquaculture inputs until the critical mass point is reached

ACKNOWLEDGEMENTS

- Our sincere gratitude to almighty GOD for giving as good health and strength to accomplish this project
- Thanks JICA, EICA and WorldFish Centre for funding

  for training and Logistics
- Special thanks to Fish farmers in Egypt for sharing their experiences with us on fish farming, hatchery management etc.
- Several lectures from different Egyptian Institutions
- Course coordinators and Prof Abdel El Gamal
- Last but not least our fellow trainees.

Thank you for your attention