Development of African Catfish, (Clarias gariepinus) hatchery in the Nyanza Province, Republic of Kenya

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This project is the outcome of a group efforts to whom credit and technical responsibility goes. This project is based on an assignment which was given to course participants and supervised by Dr. Abdel Rahman El Gamal as a part of “Warm Water Fish Production Training course”. This annual course is organized by the Egyptian International Centre for Agriculture - Egypt (EICA) and Japan International Cooperation Agency (JICA). Names of the team members are shown above

2007

CONTENTS

INTRODUCTION

- Clarias gariepinus, or African catfish, is widely distributed throughout Africa and has long been considered as one of the most suitable species for culture in Africa The African cat fish having a high growth rate and being very resistant to handling and stress, Gamal El Naggar, 2007)
- The bronchial organs allow it to use atmospheric oxygen. It can survive and grow in very poor environmental conditions.
- Although *C. gariepinus* is widely cultured in Africa, it has not emerged as an important aquaculture species in many other countries because of inadequate supply of fingerlings.
- Clarias does not reproduce in captivity
- Attempts have been made to develop simple techniques for natural spawning *C. gariepinus* that do not depend on hormone.
- Research work done by the World Fish Centre has shown that it is possible to produce *C. gariepinus* fingerlings by subjecting the brood fish to a physical stress of reduced water depth and/or increased temperature.

PROJECT AIM

The aim of the project is to establish a sustainable hatchery project for the Kenyan fish farmers for the production of catfish fingerlings as there is no such a hatchery in region. The hatchery will also be for demonstration of fingerling production by using the Abbassa technique of World Fish Center.

PROJECT OBJECTIVES

- The project has the following immediate objectives:
- The establishment of a hatchery for catfish culture (C. gariepinus) at the Nyanza province situated in western of the republic of Kenya.
- The adaptation and optimization of the technology for the semi-intensive culture of (C. gariepinus) under the prevailing conditions in Kenya.
- The establishment of a action plan for the distribution of (C. gariepinus) fingerlings to the private fish farmers and awareness to farmers on how to culture Clarias gariepinus.
- The training of the local staff in these technologies for natural propagation of (C. gariepinus) and its perspectives for fish culture development

PROJECT JUSTIFICATION

4.1 Location

The Hatchery project will be located at Nyanza province on the western part of Kenya. The province have around 1000 farmers with an average of 300 m^2 each. The project will be located at this area due to the following reasons:

- Lack of reliable supply of the fingerlings brought the need of having a Hatchery project which will be of much help to fish farmers of region
- Temperature in Kenya is conducive for catfish growth
- People in Kenya prefer catfish.

PROJECT JUSTIFICATION cont'd

Species

- To a large extent the poor performance of this freshwater fish species in Africa has been due to the absence of reliable production techniques for the reproduction and rearing of the species under practical farming conditions, as Clarias does not reproduce in captivity.
- The main problem of fingerling production in ponds was the low survival rate which although varied, in most cases only 10% of fry survived.

MAP OF KENYA


SUDAN
ETHIOPIA
UGANDA
SOMALIA
TANZANIA
INDIAN OCEAN
Lake Victoria
Lake Rudolf (Lake Turkana)
Lake Natron
RIFT VALLEY
EASTERN
NORTH EASTERN
WESTERN
NYANZA
CENTRAL
COAST
NAIROBI AREA
Administrative Boundary
Kapoeta
Kelem
Negele
Lokichokio
Kaabong
Lodwar
Moyale
Ramu
Garbahaarrey
Dolo Ado
Marsabit
Moroto
Soroti
Wajir
Mbale
Kitale
Tororo
Eldoret
Mado Gashi
Butere
Kakamega
Nyahururu Falls
Nanyuki
Isiolo
Bilis Qooqaani
Kisumu
Mount Kenya
Kericho
Nakuru
Nyeri
Garissa
Embu
Kindaruma dams
Thika
Narok
Nairobi
Musoma
Magadi
Lamu
Pate Island
Garsen
Kilimanjaro
Arusha
Moshi
Voi
Malindi
Nyumba ya Mungu dam
Mombasa
Pemba Island
Tanga
Kenya
International boundary
Province boundary
National capital
Province capital
Railroad
Road
0 50 100 Kilometers
0 50 100 Miles
Boundary representation is not necessarily authoritative.
Base 801062 (B00446) 1-88

SITE SELECTION, DESIGNING, LAYOUTING AND POND CONSTRUCTION

Site selection

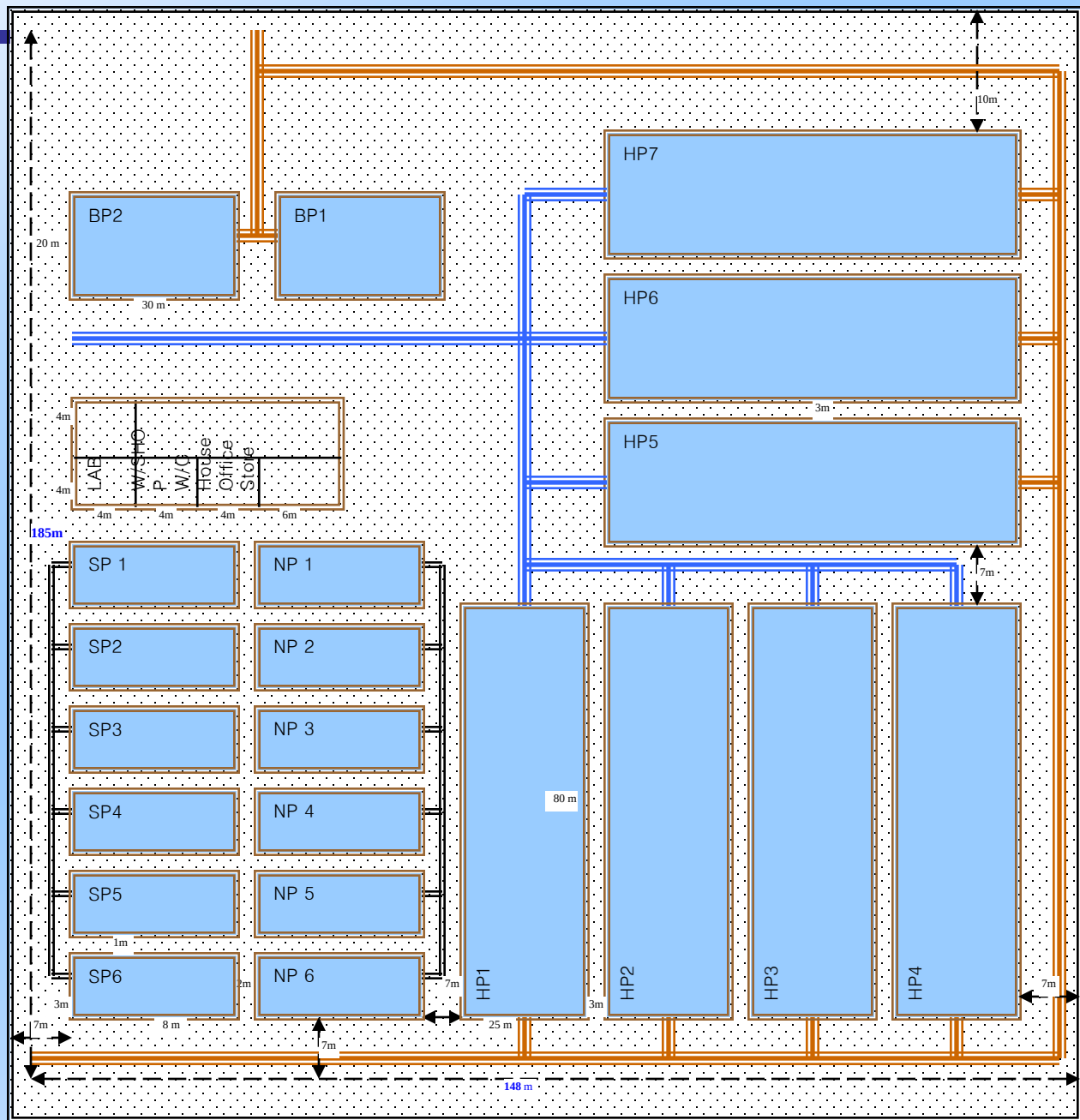
- A suitable site has been selected for the construction of the hatchery in consideration of the following factors:
- Availability of permanent source of water in terms of quantity and quality from River Nyando in Nyanza province
- Good soil type (with high water retention) loamy clay soils.
- A good gentle slope to enhance filling and draining of ponds by gravity as well as avoiding ponds wash away due to runoff water.
- Accessibility of the area to ensure conscious management and security against predators.
- Availability of management and skilled labour

Design and Lay outing

The farm will consist of four types of ponds namely:

- Brood stock ponds
- Spawning ponds
- Nursery ponds
- Holding ponds

Design and Layouting



Construction

- The project will construct the ponds, A building comprised of an office, store, caretaker house, a workshop and a laboratory areas using manual labour.

Water supply system

- The source of water into the ponds and the drainage system will by gravity. Pond filling will be by a network of pipes (3-inch PVC) which will suck water from the source, River Nyando to the concrete ponds (spawning and nursery) and subsequently be drained by drainage pipes (3-inch PVC). Another pipe (4-inch PVC) will be used to bring water to the hatchery for the earthern holding tanks whereby water will ne supplied by using inlet canals.

6. HATCHERY OPERATIONS

6.1 Recruitment of the broodstock

- Broodstock will be acquired from nature and will be kept in earthen ponds at a stocking density of 0.5-1/m^2. Egg development will take place and about 3 months after a female has been reproduced it can be used again.

6.2 Feeding of the broodstock

- A feeding level of 3% of the body weight should be used when the broodfish reaches 300 g or more. The food should contain a crude protein level between 30 and 55% and a high energy content.

6.3 Conditioning the broodstock

- The broodstock will be conditioned for one month before the spawning period which is between march and August. There will be a higher water supply during the conditioning month to prevent accumulation of uneaten food particles in the tank

6.4 Selection of the broodstock

- Reproduction starts with the selection of females and males from broodstock ponds after which they are transferred to the spawning tank within a hatchery. Ideally, broodfish weigh between **300-800 grams**, and the selected broodstock will have an average weight of 700g.

Selection of the broodstock cont'd

In general mature females are selected according to the following criteria:

* A well distended, swollen abdomen from which ripe eggs can be obtained by slightly pressing the abdomen toward the genital papilla. Ripe eggs are generally uniform in size and an experienced hatchery operator can see the nucleus as a small dark point in the centre of the egg

* A swollen, sometimes reddish or rose coloured genital papilla

Checking the female brooder

6.4 Spawning process

- Catfish spawn for the 3 months during the spawning season (March to August in Kenya).
- The number of fry to be produced in year which is 2,000,000 will be produced within the 3 months with the average of 677,160 fry per month.
- 136 brooders will be used to produce the number of fry in a month with the average of 25,000 fry per brooder (70,000 eggs per brooder with the spawning success of 60%). The selected 136 brooders will be put in the 17 hapas which will be haboured in 3 different ponds.
- The hapas should be top-covered. After 24 hours the larvae will be seen in the pond and egg shells in the hapas. The brooders will be taken out after the 24 hours.

Spawning process cont'd

Covered hapas to avoid jumping of the brooders

Spawning process cont'd

- The fry will be left in the spawning pond for 3-4 days for yolk sack period to be completed.
- After 3–4 days, when about two-thirds of the yolk sac has been absorbed, the larvae (weighing about 2–3 mg) become early fry. This major turning point in catfish life occurs when the larvae begin vigorously swimming in a fish-like manner and searching for exogenous food items.
- The early fry are then transferred into the nursery ponds

6.5 Nursing of catfish fry

- Once the yolk sac is fully absorbed, the fry must find adequate food to ensure proper development; failure will weaken them beyond recovery and will stimulate cannibalism.
- After the yolk suck period the fry will be fed on fish meal 10% body weight and 40% protein. The temperature should be maintained at 25°C to 26°C.
- During the early fry stage the development of the main organs will be completed after 10–18 days when the accessory air-breathing organ has developed. Catfish fry (now weighing about 30–50 mg) frequently rise to the surface to breath air. They become then advanced fry.

Nursing of catfish fry cont'd

- The 600,000 fry will be stocked in the nursery ponds of the same size as spawning ponds. The fry will be nursed for 5 to 6 weeks whereby they will attain a weight of 3 g each. Afterwards, grading will be done every 10 days.

The number of fingerlings produced will be calculated based on the following:

Survival rate of fry (45%) = 0.45 x 4,515,840	2,032,128	fingerlings
Survival rate of larvae (80%) = 0.8 x 5,644,800	4,515,840	No. of fry
Hatching percentage (80%) = 0.8 x 7,056,000	5,644,800	No. of larvae
Fertilization percentage (80%) = 0.8 x 8,820,000	7,056,000	No. of eggs
Spawning percentage (60%) = 0.6 x 14,700,000	8,820,000	No. of eggs
Maximum number of eggs/g (600) 122.5g x 200=24,500	14,700,000	No. of eggs
Number of fish broodstock (700 g average)	168	females

6.6 Selling and holding of the fry

- The fry will be sold after about six weeks when they are in the fingerling stage.
- The rest of the stock will be held in earthern rectangular ponds of 25 × 80 m in order to facilitate seining. These ponds will have a water depth of 100 cm. Greater depths are avoided in order to conserve energy as Clarias fry often swimming to the surface to breathe air.

6.6.2 Liming

- Liming is an important part of nursery pond maintenance, increasing the natural productivity of the ponds and having a favorable effect on the health of the fry. Some of the beneficial effects of liming can be summarized as follows:
- Disinfection of the pond bottom (using quick lime).
- Increases the pH of the water and pond bottom to an optimum level (pH 7-9) for plankton and fish production.
- Increases the alkalinity of the water; adequate alkalinity required so as to ensure pH stability and neutralize the harmful effects of magnesium, sodium and potassium salts.
- Increases pond productivity through increased biological activity and availability of minerals in the pond bottom and water column.

The most commonly used liming compounds are quicklime CaO, caustic lime, also called slaked lime or hydrated lime $Ca(OH)_2$, and agricultural lime

6.6.3 Fertilization

- The most critical factor for the successful nursing of African catfish larvae is the ready availability of zooplankton during the first week after stocking. A good zooplankton bloom can only be obtained if the ponds are well fertilized.
- Catfish nursing ponds will be fertilized with dry chicken manure at a rate of 50 kg/100 m^2 two weeks prior to stocking.
- In regard to chemical fertilization, the main fertilizers used are: superphosphate (containing about 20% P_2O_5), triple superphosphate (containing about 45% P_2O_5), urea (containing about 45% N) and NPK 15:15:15 (15% N, 15% P_2O_5, 15% K_2O).

6.6.5 Protection against Predators

- The rearing pond will be protected against predators such as juvenile fish, frogs, toads and their eggs. Therefore, the pond will be fenced by a fine mesh netting or roofing sheets if this is cheaper. The fence, having a height of 1–1.5 m, should be embedded for about 10 cm. The inflowing water should be filtered through a screened box placed on the inlet pipe.
- The appropriate moment for stocking fry is about 15 days after fertilization, when a good standing crop of zooplankton has been established.

Pond will be fenced by a fine mesh netting

OVERALL DEVELOPMENT PLAN OF HATCHERY PROJECT

NO	Task Name	SEP'08				OCT'08				NOV'08				DEC'08				JAN'09				FEB'09				MAR'09			
		W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
1	Site Selection																												
2	Clearing																												
3	Designing																												
4	Layouting																												
5	Construction																												
6	Recruitment of Brood Stock																												
7	Conditioning of The Brooders																												

OVERALL DEVELOPMENT PLAN OF HATCHERY PROJECT cont'd

NO	TASK NAME	APR'09				MAY'09				JUNE'09				JULY'09				AUG'09				SEPT'09				FEB'09			
		W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
8	Selections of Brooders and Spawning & Early Nursing of Larvae																												
9	Nursing of Larvae to Fry & Grading of Fry																												
10	Transfer to Holding Ponds & Selling																												
11	Evaluation																												

Economic Indicators

Cost of the production of 2 million catfish fingerlings (Kenyan shillings)			Revenue (Kenyan shillings)	
Operation costs			Product	Revenue
Feed (broodstock, fry and fingerlings)	2,414,164		Two million 3-4 g catfish fingerlings	10,000,000
Labour	392,000			
Materials and consumables & contingencies	349,800		Profit (above operation costs & depreciation)	5,993,056
Sundry expenses	14,000			
Operation & maintenance	36,380			
Depreciation of fixed assets	800,600			
Total	4,006,944			

This Table has been extracted by the supervisor from the text document of this project.
Notes:
Operation costs above does not include the interest rate related to credit
Depreciation applies to fixed assets excluding the land used to establish fish ponds

Thank You