ICLARM mcc p.o. box 1501, makati, metro manila, philippines

CONTRACT NO.: 492-1406

SPECIFICATIONS FOR CARP AND MULLET HATCHERIES, NURSERIES AND COLLECTING STATIONS

Prepared by

Ziad H. Shehadeh, Ph.D.

USAID-EGYPT Aquaculture

Design Team

28 April 1978

12-4-78

S C H E D U L E

ARTICLE I - SCOPE OF WORK

A. Statement of Work to be Performed

The Contractor, as a member of an Aquaculture Project Design Team and under the direction of the team leader, will:

1. Assess hatching requirements for the project generally.

2. Assess requirements for obtaining mullet fry specifically.

3. Determine, in collaboration with the Construction Engineer and Aquaculturist, the location and physical requirements for propagation, rearing and distribution of the several species of fish fry or fingerlings for the polyculture type of project planned.

4. Determine types of feed for any other special inputs required for various fry and fish in production generally and for mullet specifically.

B. Reports

The Contractor shall assist in the preparation of a draft project paper summarizing the findings, including assessments, determinations and evaluations, etc. of the component parts for the project design, to be submitted to USAID/Cairo/Government of Egypt (GOE) for discussion prior to the Contractor's departure from Cairo.

ARTICLE II - PERIOD OF SERVICES OVERSEAS

This Contract is effective during the period indicated on the Cover Page.

TABLE OF CONTENTS

A. Production of Carp Fry and Fingerlings

Carp fingerlings of 40 g/each will be produced in two stages: (1) from 3 day old hatchlings to 2 - 2.5 g fry and (2) from 2 - 2.5 g fry to 40 g fingerlings. Fry ponds will have an individual area of 1 - 2 feddans (4,200 - 8,400 m^2); alternatively, a greater number of nursery ponds of 500 m^2 area each can be used (see Section A.4.B.). Fingerling ponds will have an individual area of 2.4 - 4.8 feddans (10,080 - 20,160 m^2).

Total fry production is designed to provide adequate stocking material (fry of 2 - 2.5 g) for 5000 feddans of production ponds (including the Center) in two crops.

1. Production of Carp Fry (2 g)

a. Nursery ponds:

(i) Recommended area of individual nursery pond

= 1 - 2 feddans (4,200 - 8,400 m^2) or

= 0.12 feddans (500 m^2)

(ii) Recommended Dimensions:

21 m width x 200 m length x 1.5 m depth; or

40 x 210 x 1.5 m for ponds of 1 - 2 feddan area

or 10 x 50 x 1.5 m for ponds of 0.12 feddan area

(iii) Fry Catch Basin

Nursery ponds should be equipped with an outlet to permit ready drainage and collection of fry with minimum handling. Figures 1 and 2, and related table of dimensions, provide specifications for a concrete drain-catch basin suitable for various pond areas. If nursery ponds of 500 m^2 are used, fry catch basins will not be required since the

small ponds can be harvested easily by means of a fine-mesh seine. The device also can be constructed of wood planks if these are available at reasonable cost. The water holding capacity of the catch basin (2 m^3) is adequate for the weight of fish fry to be harvested (200 kg). If the fish biomass is to be increased significantly, the depth of the basin should be increased and/or water pumped or siphoned from the supply canal into the basin to provide oxygen and wash away mud during the harvesting operation. (Running water should be used during harvesting operations in any case).

An alternate arrangement for harvesting would be to construct a larger catch basin, provided with pumped water, in a suitable place in the main drainage canal(s). Such a basin could be used to harvest a number of ponds; fewer basins would be required with significant savings in construction and material costs.

b. Source of newly hatched fry:

Abbasa Center hatchery

c. Nursing period:

30 - 40 days/crop beginning April or May according to the timing of the carp breeding season at Abbasa. According to the stocking rate, recommended management and

expected mortality (see below), about 100,000 - 125,000 fry of 2 g each will be harvested from each nursery pond of one feddan area every 30 - 40 day nursing periqd. If ponds of 500 m^2 are used, higher stocking densities would yield 62,500 fry per 30 - 40 days per pond.

The number of crops that can be produced from each nursery pond will depend on the timing and duration of the breeding season. About two to three crops are anticipated; one each in May, June and July.

d. Stocking:

Stocking rate of newly hatched carp fry has been established by trial and error. The rate varies with water management methods, water temperature; use of fertilizers, manure and supplemental feed. In general, 1 - 5 million hatchlings are stocked per hectare (2.4 feddans) when organic and inorganic fertilizers are used together with supplementary feeds. In the present case, since available supplementary feeds are low grade (grain bran and cottonseed cake), a stocking rate of 1.2 million per hectare (500,000/feddan) is recommended initially. This stocking rate should be increased gradually to 5 million/ha as nursery management techniques are adapted to conditions in Egypt. Utilization of smaller (500 m^2) nursery ponds would permit better management and

utilization of feed. In this case initial stocking rates can be maximized to 250,000 fry/pond (or about 5 million fry/ha).

e. Fry Mortality:

A mortality rate of 75% is expected during the nursing period. A total of 125,000 fry of 2 g will be harvested per feddan from an initial number of 500,000; or 62,500 fry from an initial number of 250,000 in the case of small (500 m^2) ponds.

f. Nursery Management:

(i) Pond preparation

Soaked chicken manure is applied to the dry pond bottom at the rate of 500 - 1000 kg/feddan, 4 weeks before stocking. Water is let in to a depth of 25 cm two weeks after manure application and kept at that level for 1 - 2 weeks. Water depth is then increased to 50 cm immediately before stocking. About 20 kg superphosphate (15%) and 50 kg of manure per feddan are applied at that time.

(ii) Stocking

Fry are stocked early in the morning to avoid warm weather. Care should be taken to avoid temperature shock in transferring fry from the hatchery to the nursery. If the water temperature difference is $5^{o}C$ or more, the fry container should be floated on the pond for 2 hours to equilibrate

temperatures before release of fry. Shade should be provided during the process.

(iii) Fertilization

After the initial fertilization during pond preparation and at stocking time, chicken manure (air-dried) is applied at the rate of 50 kg/feddan/biweekly and superphosphate at the rate of 20 kg/feddan biweekly for the duration of the nursing period.

(iv) Supplemental feeding

Supplemental feed made up of 3 parts cottonseed cake and one part rice bran is offered during the entire nursing period. Table 1 provides a recommended feeding schedule when stocking rate is 500,000 fry/feddan. The feed is prepared as a fine powder after gross fibrous material is removed from the cottonseed cake. Cobalt chloride is mixed with the feed at the rate of 0.01 mg/fry/day, or 5 g/feddan/day. This trace element has been proven to improve fry survival rate by 10 - 25% and enhance the growth rate. Feed is offered three times a day - morning, noon and late afternoon.

In the case of small (500 m^2) nursery ponds, half the supplemental feed given in Table 1 should be provided per pond according to the schedule. The

amount of cobalt chloride given per day should also be halfed.

(v) Control of Pests and Predators

It is imperative that special precautions be taken to avoid adventitious entry of fish and proliferation of carnivorous insects in the nursery ponds. Preventing entry of tilapia into the ponds is expected to be problematical. The best solution to the problem is to (a) fill the ponds through a pipe inlet rather than a sluice gate, (b) place a large fine screen on the pipe outlet and (c) allow the water to fall into a square box (wood, concrete, or plastic) packed with gravel and provided with holes at the bottom. The box should be square (60 cm x 60 cm) and the height should be such that the top protrudes 60 cms above the water level. The box should be 2/3 full of gravel. Alternatively a gravel filter can be installed at some point in the main supply canal itself provided this does not impede water flow drastically.

Aquatic insects as well as large zooplankton (copepods), which prey on fish fry, can be controlled with Dipterex or similar pesticides. Tests should be conducted starting with solutions of 2 - 3 ppm sprayed over the water surface 3 days before stocking and 7 days subsequent to stocking.

(vi) Harvesting

Fry will be harvested from the catch basin by draining the pond. Clean water should be pumped or siphoned into the catch basin during harvesting. Fry should be scooped with plastic cups having perforated bottoms and placed in plastic bags for transportation. Transportation in bags is discussed in a subsequent section.

If small (500 m^2) nursery ponds are used, harvesting can be accomplished by means of fine-mesh seine without draining the pond.

g. Fry production inputs and cost[1]/crop[2]/pond

ITEM	KG 1 feddan pond	KG 500 m^2 pond	Unit Price LE/t	TOTAL COST (LE)$_2$ 1 feddan pond	TOTAL COST (LE)$_2$ 500 m^2 pond	COST/1000 FRY(LE)$_2$ 1 feddan pond	COST/1000 FRY(LE)$_2$ 500 m^2 pond
Chicken manure	625	75	10	6.25	0.75	0.11	0.05
Superphosphate (15%)	50	6	60	3.00	0.36		
Feed	150	75	30	4.50	2.25		
Total				13.75	3.36		

1/ Land, water, labor and hatchery costs not included in production cost.

2/ One crop = 125,000 fry of 2 g each produced in about 35 days in ponds of one feddan area with low stocking density.

= 62,500 fry of 2 g each produced in the same period in 500 m^2 ponds with high stocking density.

2. Production of Carp Fingerlings

a. Ponds:

(i) Recommended pond area

2.4 - 4.8 feddan each (1 - 2 hectare)

(ii) Dimensions

To conform with ponds for production of market fish and general farm layout.

Elongated form is desirable.

b. Assumptions for Production Scheme:

(i) Fish productivity of ponds (fish carrying capacity: Pond water depth - 1.25 - 1.50 m

- natural capacity (no fertilizers or feed) =

0.9 kg/feddan/day

200 kg/feddan/240 days

- capacity with fertilizers

- - single species (carp) culture =

1.7 kg/feddan/day

310 kg/feddan/180 days

360 kg/feddan/210 days

(ii) Growing period for fingerlings: (180 - 210 days)

If fry are ready for stocking in May, the growing period will be 210 days; if they are stocked in June it will be 180 days.

c. Fingerling Production:

Table 2 provides comparative data on fry stocking rates and fingerling retrieval with nursing periods of 180

and 210 days. Comparable data is also given for the same nursing periods but using both fertilizers and supplemental feed to augment pond productivity (total fish biomass that can be supported). For comparative purposes, the feeding rate used is that recommended by the FAO/World Bank Mission (1977).

Production cost/1000 fingerlings with different growing periods (180 and 210 days) and management methods - (a) fertilizer only and (b) feed + fertilizer is given in Table 3. Cost accounting at this stage is restricted to cost of feed and fertilizer only; land, water, labor and hatchery costs are not considered.

It is apparent from Table 3 that, at least on the basis of purchased inputs, the use of supplementary feed increases the cost per 1000 fingerlings by 19 and 30% with growing periods of 180 and 210 days respectively; fingerling production is increased 44 and 33% respectively. The use of supplemental feed in fingerling production should be assessed on the basis of production tests that would define related savings in land and water utilization (which are not considered here in fingerling cost assessment).

d. Pond Management:

(i) Pond preparation

The same procedure is followed as in the case of fry ponds (see section 1.f.(i)). In the case of fingerling ponds, however, water level is raised gradually from 0.50 m at stocking time to 1.25 m by 70 days after stocking.

(ii) Fertilization

Initial fertilization up to stocking time is the same as for fry ponds. Thereafter, chicken manure (air-dried) is applied at the rate of 50 kg/feddan biweekly for the duration of the growing period. Superphosphate (15%) is applied at the rate of 20 kg/feddan biweekly.

(iii) Harvesting and overwintering

At the end of the growing period (December), pond water level is raised to the maximum possible (1.5 m) and the fingerlings left in the production ponds for the duration of the winter season. Fingerlings are harvested for stocking in production pond (for market fish) when water temperatures reach at least 15°C (March - April).

Harvesting can be done (a) by seine net after pond-water level is dropped, (b) from a catch

basin inside each pond, or a larger basin in the drainage canal which can service a number of ponds, or (c) by drawing pond water down to a depression designed in the deeper end of the pond (near the drain) and removing fish with dip nets.

3. Summary of Carp Stocking - Retrieval Scheme

Table 4 provides a summary of the stocking-retrieval scheme for carp fry and fingerlings.

Table 1. FEEDING SCHEDULE FOR CARP HATCHLINGS 1/

(stocking rate = 500,000/feddan)

Period (Days)	Daily Feeding Rate % of Initial Body Wt.	Kg/feddan/day	Total (Kg/feddan/week)
1 → 7	100	1.0	7.0
8 → 14	80	2.4	17.0
15 → 21	60	5.0	35.0
22 → 28	30	6.0	42.0
29 → 35	15	7	49.0
35 days			150.0 Kg

- - - - - - - - - - -

1/ In the case of nursery ponds of 500 m^2 area, half the amount of feed indicated under Kg/feddan/day should be given daily.

Table 2. Fingerling (40 g) Production with different Growth Periods and Management Methods

Treatment	Growth Period (days)	Pond Productivity (Kg/feddan)	Expected Mortality (%)	Stocking rate (No./feddan)	Weight Stocked (Kg)	Number Retrieved (No./feddan)	Average Individual Weight (g)	Total Weight (Kg/feddan)
Fertilizer 1/	180	310	20	9,700	19	7,760	40	310
	210	360	20	11,250	23	9,000	40	360
Fertilizers 1/ + supplemental feed*	180	450	20	14,000	28	11,200	40	448
	210	480	20	15,000	30	12,000	40	480

- - - - - - - - - -

1/ Superphosphate (15%) at 20 Kg/feddan + 50 Kg/feddan of chicken manure applied biweekly.

* 25 Kg/feddan/week of cottonseed cake and rice bran in a 3:1 mixture.

Table 3. Production cost/1000 fingerlings for methods and growth periods given in Table 2.

Treatment	Growth Period	1. Manure Kg/feddan	1. Manure Cost (L.E.)	2. Fertilizer Kg/feddan	2. Fertilizer Cost (L.E.)	3. Feed Kg/feddan	3. Feed Cost (L.E.)	Total Cost (L.E.)	Fingerlings Number/ feddan	Fingerlings Cost/ 1000 (LE)
Fertilizers only	180	1,150	11.50	260	15.60	- -	- -	27.1	7,760	3.48
	210	1,250	12.50	300	18.00	- -	- -	30.5	9,000	3.39
Fertilizers + supplemental feed	180	1,150	11.50	260	15.60	640	19.2	46.3	11,200	4.13
	210	1,250	12.50	300	18.00	750	22.5	53.0	12,000	4.42

1. Manure = 10 L.E./t
2. Superphosphate (15%) = 60 L.E./t
3. Cottonseed cake and Rice bran = 30 L.E./t

Table 4. Summary of Carp Stocking - Retrieval Scheme

Production Stage	Growth Period (days)	Initial Stocking (No.)	Average Individual Weight (g)	Total Weight (Kg)	No. Recovered	Average Individual Weight (g)	Total Weight (Kg)
1. Fry Nursery							
a. 1-feddan pond	35	500,000	0.0025	1.25	125,000	2	240
b. 500 m^2 pond	35	250,000	0.0025	0.63	62,500	2	125
2. Fingerling Nursery (1-feddan pond) 1/	180	9,700	2	19.40	7,700	40	308

- - - - - - - - - -

1/ No supplemental feed given.

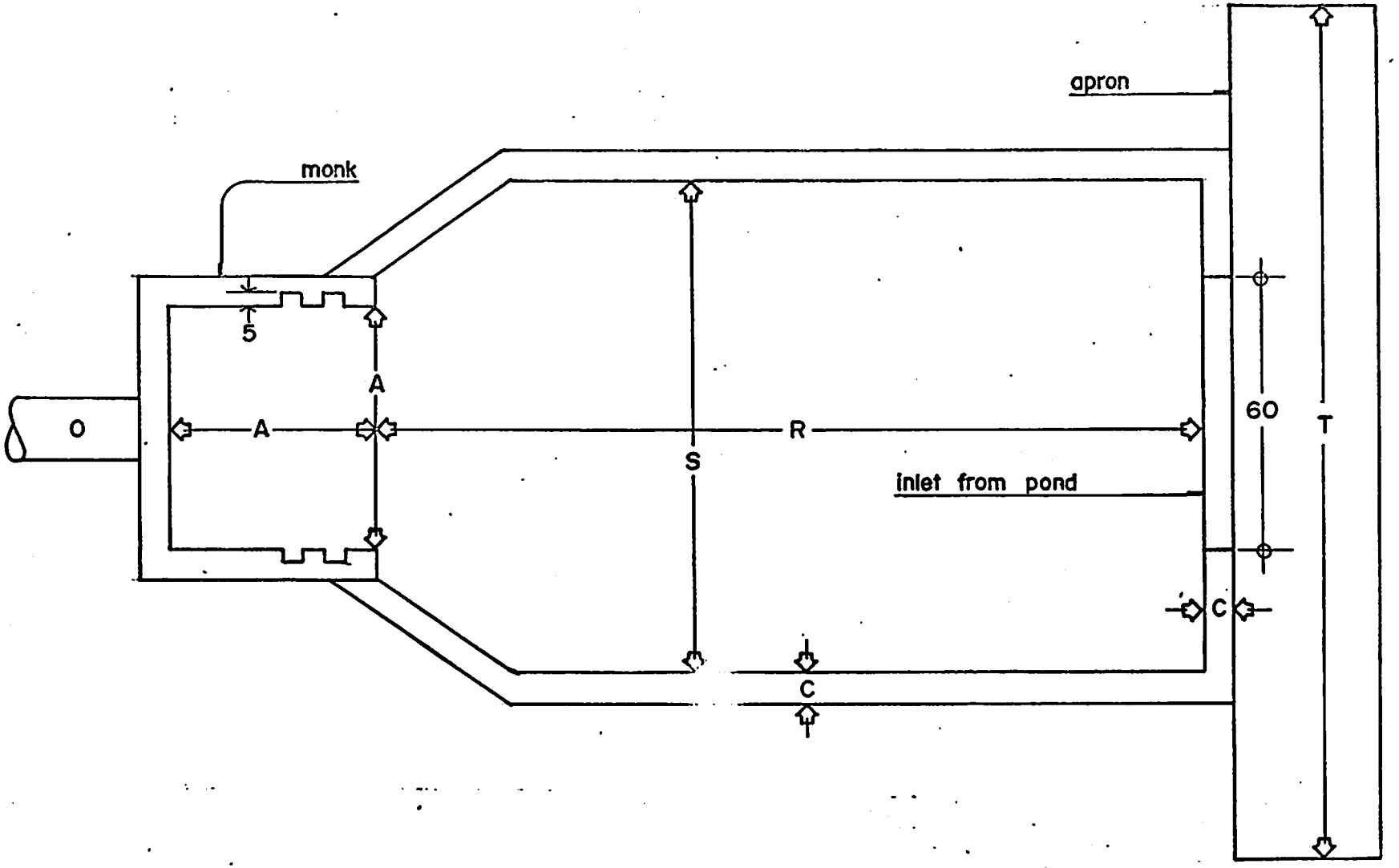

FIGURE I. CATCH BASIN
P L A N

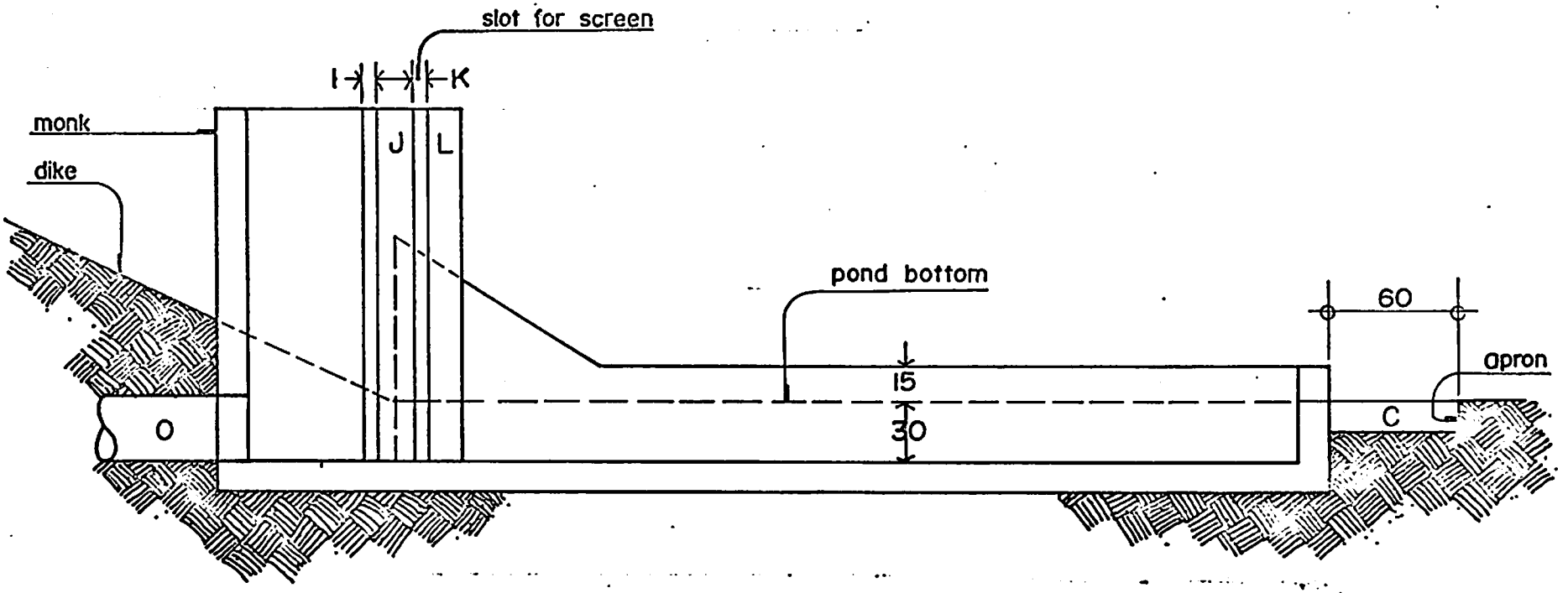

FIGURE 2. CATCH BASIN
CENTER LINE SECTION

Catch Basin Dimensions (cm) According to Pond Area

Pond Area (feddans)	A	C	I	J	K	L	O	S	T
¼ or less	76.2	15.2	3.8	15.2	3.8	15.2	305	182	242
½ - 1½	91.4	15.2	3.8	15.2	3.8	20.3	366	182	242
2 - 3	106.7	15.2	5.1	15.2	5.1	25.4	425	244	364
4 - 8	121.9	20.3	6.4	15.2	6.4	30.5	488	244	364
10 - 15	137.2	20.3	7.6	15.2	7.6	38.1	550	305	425

4.A. Total Carp Nursery Area Required at the Abbasa Center

a. Stocking rate of fry (0.0025 g/each) in Nursery ponds: 500,000/feddan

b. Retrieval rate of 2 g fry: 125,000/feddan

c. Production area to be stocked: 5,000 feddans

d. Stocking rate in production ponds: 1,200/feddan[1/]

e. Total fry (2 g) requirements - 1,200 x 5000 = 6 million

f. Total nursery area needed = $\frac{6,000,000}{125,000}$

= 48 feddans

A total of 48 feddans is required if the entire quantity of fry (6 million) is produced simultaneously. It is planned, however, to produce the fry in at least two crops, each crop requiring 30 - 40 days of nursing. Accordingly half the above nursery area will be required

= 24 feddans

Recommended unit area of nursery

= 1 - 2 feddan/pond

=12 -24 nursery ponds

g. Total number of hatchlings (0.0025 g/each) required to produce 6 million fry (2 g/each) assuming 75% mortality in the nursery

= $\frac{6,000,000}{0.25}$ = 24 million

- - - - - - - - - -

1/ Rate recommended by previous USAID Aquaculture Mission (See Egyptian Aquaculture Feasibility Report, 1977; p. 36, Table 2)

h. Nursery ponds should be as close to the hatchery as possible.

4.B. Alternative Abbasa Carp Nursery Design for Producing Six (6) Million Fry (in three crops)

1. Total Nursery Area: 500 m^2 per pond x 32 ponds = 16,000 m^2 = 4 feddans

2. Stocking Rate of Hatched Fry = 250,000 per 500 m^2 pond

3. Fry Retrieval Rate = 25% = 62,500/pond

4. Construction Specifications:

a. Excavated ponds of 1.5 m depth.

b. Retaining dike for entire nursery area should be vertical and lined with brick and mortar; separation of ponds to be accomplished with brick and mortar walls with adequate thickness to withstand pressure from one meter depth of water.

c. Ponds are to be filled by pumped water; the delivery pipe will pour water into a brick gravel box with dimensions of 60x60x125 cm (LxWxD). If the pumped water is filtered before it is delivered to the nursery ponds, the gravel box (which is meant to act as a filter) can be dispensed with.

d. Each nursery pond will be drained by means of a monk. A depressed area, about 35 cm below pond level, should be provided around the monk for harvesting purposes.

e. The bottom of each pond should slope toward the drain; the slope should be approximately 1/1000.

This nursery arrangement is preferred to that described

in the earlier section because it (1) permits easier and better production management, (2) facilitates harvesting of fry and (3) saves land and water. The construction cost for the entire nursery, however, will be the same as for the earthen ponds (about 96,000 LE).

5. Hatchery Pond Requirements at Abbasa:

a. Assumptions:

- Carp breeders should weigh 3 Kg/each
- One female of 3 Kg will produce: 450,000 eggs
- Egg hatching rate = 90%
- Hatchling survival rate = 90%
- Number of females needed to produce 24 million hatchlings for stocking:

$$= \frac{24,000,000}{365,000} = 66 \text{ females}$$

Allowing 50% safety margin = about 100 females

- Number of males needed = 100 x 2 = 200 males

b. Broodstock - holding pond:

One pond of 2.4 feddan (1 ha) area will be sufficient to hold 300 breeders of 3 Kg each (900 Kg of fish) using fertilizers only for fish food production. Fertilization rates will be the same as in nursery ponds.

About 30% of the broodstock needs to be culled and replaced annually -- about 33 new breeders of 3 Kg

each will have to be supplied every year.

The broodstock holding pond should be as close to the hatchery as possible.

c. Donor fish pond:

- About 4 pituitary glands are required to breed one pair of fish; total number of about 265 glands will be needed per year. The glands either have to be purchased from outside the country or the hatchery will have to grow 265 fish of 2.5 - 3 Kg each every year for gland extraction.
- The donor fish and the replacement breeders can be grown to an individual weight of 2.5 - 3 Kg in two years.
- One pond of 2.4 feddan (1 ha) area will be sufficient for this purpose. The same applies for growing the initial broodstock of 300 fish.

If the Center hatchery grows its own broodstock, it will need to rely on the Serow Farm for fry supply for the first 2 years of operation.

A total of 250,000 - 500,000 fry will be needed to stock 200 feddans at the Center alone.

A more practical alternative would be to purchase breeders of 3 Kg each at prime prices, if this is possible. Carp pituitary glands should also be

purchased from outside Egypt in one lot of 1000. This will be adequate for 3 breeding seasons.

d. Broodstock Segregation and Recuperation Ponds:

- Male and female breeders selected from the holding pond for spawning will be separated by sex immediately before the onset of the breeding season to prevent breeding in ponds.
- After spawning, spent breeders should be segregated in a special pond to recover.
- Two ponds of 2500 m^2 area/each will be sufficient for these purposes.

6. Summary of Nursery and Hatchery Pond Requirements (Abbasa) to Produce 6 Million Carp Fry (of 2 g/each)

Purpose	Number of Ponds	Area/Pond (Feddan)	Total Area (Feddan)
1. Nursery Ponds	12 - 24	1 - 2	24.0 1/
2. Broodstock Holding Ponds	1	2.4	2.4
3. Donor and Brood Replacement Ponds	1	2.4	2.4
4. Broodstock Segregation Ponds	1	0.6 (2500 m^2)	0.6
5. Broodstock Recovery Ponds	1	0.6 (2500 m^2)	0.6
Total			30.0

- - - - - - - - - -

1/ Alternate nursery design (see section 4.B.) requires 4 feddan nursery only.

B. Carp Hatchery Specifications (Abbasa)

1. Hatchery Space Requirements

	Area(m^2)	Recommended Dimension(m)
a. Breeding Laboratory		
- This is a wet lab. and should be supplied with floor drains and water and air supply lines.	150	15 x 10
- It will contain:		
-- 12 tanks of 2 x 1 m (L x W) each		
-- Work bench of 4 x 0.75 m (L x W) with a large sink		
b. Egg-incubation and Fry-holding Lab.	216	16 x 13.5
- This is a wet lab. and should be equipped as in (a.)		
- It will contain:		
-- 6 fry troughs of 5 x 0.8 m (L x W) each		
-- 4 sets of Zuger jars of 2.5 x 1 m (L x W) per set		
-- Work bench of 4 x 0.75 m (L x W) equipped with large sink.		
- Should be located next to breeding laboratory and on the periphery of the building to afford immediate access to outdoors.		

		Area(m^2)	Dimmension(m)
c.	Experimental Wet Laboratory:		
	- Floor drains + water and air supply lines	110	10 x 11
	- Will contain:		
	-- 12 aquaria of 1 x 0.5 m (L x W) each (40 gallons)		
	-- 4 circular tanks of 1.5 m diameter each		
	-- 2 troughs of 3 x 0.6 m (L x W) each		
	-- Work bench 4 x 0.75 m (L x W)		
d.	Dry Laboratory:	22.5	5 x 4.5
e.	Feed Preparation Laboratory:	16	4 x 4
f.	Offices:	24	2 (3 x 4)
g.	Toilets:	12.5	2 (2.5 x 5)
h.	Storage room:	12	3 x 4
i.	Outdoor Fry "hardening" area:	182	13 x 14
	- Supplied with water and air lines and a water drainage system		
	- Will contain: 10 tanks of 4 x 1.5 m (L x W) each.		
	- Will have a porch roofing (overhead cover)		
	- Should be within easy access of live transport trucks for loading and unloading.		

j. Garage & Maintenance Shed:	96	8 x 12
Total Area:	841 m^2	

2. Specifications and Water Flow Requirements of Hatchery Tanks (Abbasa)

Item	No.	Unit Dimension or Capacity (LxWxD) or Liters	Water Flow Requirements (l/min) per unit	Total
A. Water-holding Equipment: 1. Breeding tanks (fiberglass)	12	2 x 1 x 1 m (inside dimensions) or equivalent volume in circular tank	10	120
2. Zuger (Hatching) Jars	48 (4 sets of 12)	6 - 8 liter/jar	2	96
3. Fry Troughs (figerblass)	6	5 x 0.8 x 0.5 m	15	90
4. Fry Mesh Baskets (0.3-0.4 mm mesh)	36	0.75 x 0.60 x 0.5 m (See Figure 3)	--	--
5. Fry "hardening" Troughs (fiberglass)	10	4 x 1.5 x 1 m (inside dimensions)	25	250
6. Glass Aquaria (with covers)	12	150 l/each	1.25 l	15
7. Fiberglass Troughs with covers - height of trough stand = 0.3 m	2	3 x 0.6 x 0.19 m (inside dimensions of trough)	2	4
8. Circular tanks (fiberglass, with inside standpipe drain)	4	1.5 m diameter and 0.75 m depth	5	20

Total Flow Requirements = 600 l/min.

a. Breeding tanks:

- Fiberglass construction; green color; with covers
- Bottom sloping towards outlet on one end of tank
- External standpipe drain that can be swivelled to adjust water level
- Should be supplied with compressed air outlets for emergency use.

b. Zuger Jars and assembly:

- These are not manufactured in the U.S.A. and may have to be purchased from West Germany.

c. Fry troughs: (see Figure 3)

- To hold yolk-sac fry for 3 - 5 days.
- Fiberglass construction; bottom of trough sloping towards the drain.
- Water should drain from the bottom rather than the upper part of the trough.
- The water supply lines for the troughs should be centered 50 cm over the median line of each trough.

  Water should spray into the trough from 6 shower heads attached to the overhead water line at 75 cm intervals. It is recommended that a second water line, also equipped with showerheads, be installed in the bottom of the trough to improve water circulation in the fry baskets. Showerheads should be provided with valves to control the strength of the spray.

- All fry troughs should be supplied with compressed air outlets for emergency use.

d. Fry baskets:

- These sit within the fry troughs and hold the newly hatched yolk-sac fry (see Figure 3). Each basket can hold fry hatched from one Zuger jar. Baskets should be made of 0.3 - 0.4 mm inert synthetic mesh, and extend 10 - 15 cm above the water level in the holding trough. Each basket should have bottom supports (corner legs) to keep the bottom screen about 10 cm above the bottom of the trough.

e. Fry "hardening" troughs:

- To be used for holding 2 g - fry (mullets and carp), harvested before shipping to farmers. In the off-season, they can be used to hold market fish or for various experimental purposes.
- As in the case of the fry troughs, water should be delivered from showerheads, or jets, from a water supply pipe positioned 50 - 100 cm above the median line of each trough. The jets should cover the entire surface of the trough and be provided with valves for water control.
- The troughs should drain from the bottom and the bottom should slope towards the drain.
- Troughs should be provided with compressed air outlets.
- The troughs should be located immediately outside the

the hatchery and provided with a porch roof. The open sides of the area could be screened, if necessary, provided screens are movable to permit transport trucks easy access to the troughs.

f. Hatchery water and air supply:

- Water temperature should be no less than 18°C and no more than 28°C during the breeding season.
- Fine filters should be installed in the main water lines to remove fine particulate matter. If this is difficult, "aqua-pure" water filters of 100 u and 50 u porosity should be installed in series on water lines supplying the Zuger jars and fry holding and hardening troughs.
- A minimum water head of 2 - 2.5 m is required to operate the Zuger jars. The water head may have to be increased to counteract loss of pressure to water filters.
- Water lines should be of PVC or galvanized iron; water valves should be of PVC or brass.
- Oil traps should be installed in all air lines if needed.
- All water holding tanks, troughs, aquaria, etc. should be provided with running water and compressed air.
- Source of water

  The cheapest method of obtaining water would be to pump from irrigation canals through a series of coarse and fine filters.

However, this is not recommended since the pesticide content of the water is unknown (and probably varies from time to time). Pesticides against the bilharzia snail host are also applied to irrigation and drainage water and the chemicals would probably cause mass mortalities of eggs and fry in the hatchery.

It is therefore recommended that hatchery water be obtained from a well at the center, provided that the water is not saline.

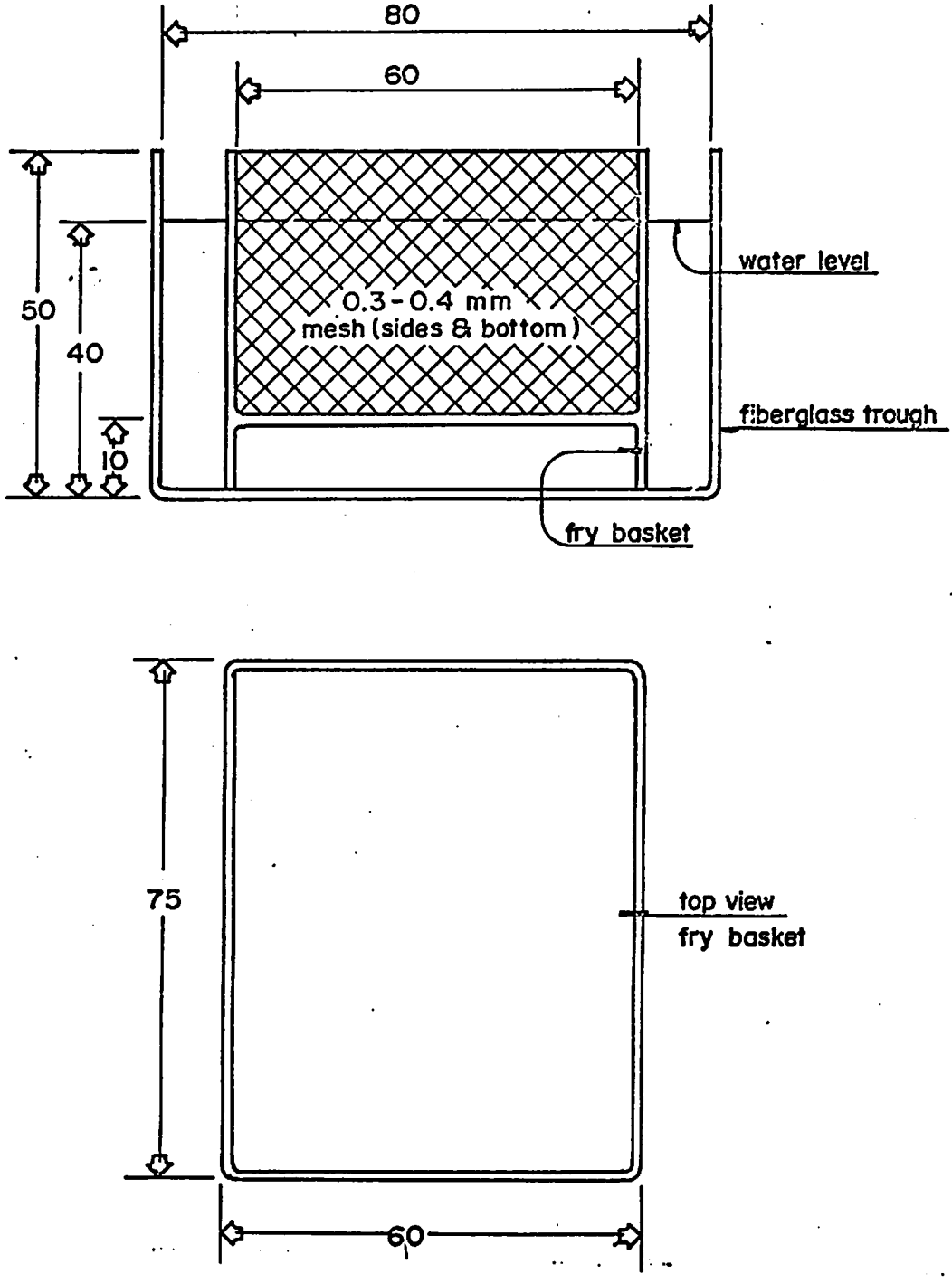

FIGURE 3. FRY TROUGHS & BASKETS

3. Hatchery Equipment and Cost (Abbasa)

Item	Number	Estimated (F.O.B.) Cost $US	
		Per Unit	Total
1. Breeding tanks	12	1,400	16,800
2. Zuger Jars	48	2,100/12	8,400
3. Fry Troughs	6	1,000	6,000
4. Fry Baskets	36	100	3,600
5. Fry "hardening" troughs	10	2,500	25,000
6. Glass Aquaria	12	300	3,600
7. Fiberglass troughs	2	700	1,400
8. Circular Tanks	4	1,200	4,800
9. Water Pump (1,200 l/min)	2	2,000	4,000
10. Air Compressor	2	1,000	2,000
11. Generator	1	3,000	3,000
12. Portable gasoline pumps	2	1,000	2,000
13. Truck	1	6,000	6,000
14. Truck + live-transport tanks (2)	1	8,000	8,000
15. Jeep	1	6,000	6,000

Continuation - Hatchery Equipment and Cost (Abbasa)

Item	Number	Estimated (F.O.B.) Cost $US Per Unit	Total
16. Feed Grinder (Table model)	1	3,000	3,000
17. Feed Mixer (Table model)	1	2,000	2,000
18. Refrigerator (20 cubic ft.)	2	1,200	2,400
19. Deep Freezer	1	1,200	1,200
20. Compound Microscope	2	1,200	2,400
21. Dissecting scope	2	250	500
22. Plastic air lines and air stones	--	--	600
23. Aqua-Pure filters (100 m and 50 m)	30	100	3,000
24. Cartridges for filters (100 m and 50 m)	600	3	1,800
25. Small plankton nets	6	200	1,200
26. Fishing nets (seines, of sundry lengths and widths)	--	--	8,000
27. Dip nets (of sundry sizes and depths)	--	--	1,000

Continuation - Hatchery Equipment and Cost (Abbasa)

Item	Number	Estimated (F.O.B.) Cost $US Per Unit	Total
28. Portable air pumps (battery operated)	12	50	600
29. Syringes (1 - 10 cc) and needles (16 - 20 gauge) all disposable	--	--	500
30. Pharmaceutical funnels, plastic, 1 - 3 liters	12	10	120
31. Plastic Buckets, basins, etc.	--	--	250
32. Sundry glassware	--	--	1,500
Total			US$132,000

C. National Carp Fry Requirements and Sources of Supply

a. Carp fry requirements:

Fry requirements, based on known Government development plans are estimated below:

		Fry Requirements (Millions)
(i)	Current fry production at El Serow (distributed to Government and private farms)	1.5
(ii)	GOE/FAO Al Zawiya Farm	6.0 (0.2 g fry)
(iii)	GOE/USAID Project	6.0 (2 g fry)
(iv)	GOE/World Bank Project	63.0 (0.2 g fry)
	Total	74.1 million

b. Carp fry sources:

		Fry (millions) 0.2 g fry	2.0 g fry
(i)	Planned GOE/USAID Hatchery (Abbasa)	9 - 15	6 - 10
(ii)	Planned GOE Hatchery (Al Zawiya)	15	-
(iii)	El Serow Nursery (if a hatchery is built and nursery management improved)	15 - 25	10 - 17
	Total	39 - 55	16 - 27

c. Recommendations:

In view of the magnitude of the expected demand for carp fry and the inadequate facilities for fry production,

it is recommended that a second carp hatchery, of the same capacity as that designed for Abbasa Center, be constructed at El Serow to augment carp fry production as indicated in the above table.

D. Production of Mullet Fry

1. Collection and Nursing

Mullet fry (0.15 g/each) will be collected and transported from El-Mex Station or from the proposed new stations in late February (Mugil capito) and late July (M. cephalus).

Each species will be nursed for a period of 100 days to an individual weight of 2 - 5 g and then distributed to farmers.

The timing of the nursing periods will be as follows:

a. M. capito: Early March - early June

b. M. cephalus: Early August - end November

2. Nursery Management

The same procedure will be followed as for carp nurseries except that (a) no feed will be offered and (b) water level in the ponds will be raised to 1.25 m immediately before stocking.

Fry of M. cephalus to be used at the Center will be over-wintered in the same nursery ponds with water depth at 1.5 m, and grown to 250 - 500 g each during the following year.

Fry of M. capito will be ready for stocking into production ponds in June. The fry can either be grown to 200 g by November and marketed, or to 50 - 100 g (at higher stocking rates) and over-wintered to be grown to 350 - 500 g the following year.

3. Stocking Rates in Production Ponds

The stocking rate in production ponds adopted (1,700/feddan) for calculation of the required mullet nursery area, is that recommended by the earlier USAID Mission (see Egyptian Aquaculture Feasibility Report, 1977; Table 2, p. 36).

4. Nursery Area Required at the Abbasa Center

a. Total production area = 2000 feddan
(Center + adjoining 1500 feddans)

b. Stocking rate/feddan of production pond - 1,700

c. Total fry requirements = 1,700 x 2000 = 3.4 million

d. Total nursery area required to produce 3.4 million fry, assuming 50% mortality during the nursing period:

(i) stocking rate of 0.15 g fry in nursery
= 170,000/feddan

(ii) Fry (2 - 5 g) Recovery = 85,000/feddan

(iii) Total nursery area needed at Center =

$$\frac{3,400,000}{85,000} = 40 \text{ feddans}$$

(iv) No. of fry (0.15 g) needed from
El-Mex = 40 x 170,000 = 6.8 million

5. Area and Number of Mullet Nursery Ponds

Since the nursing period of the two mullet species do not overlap, and only M. cephalus needs to be over-wintered in nursery ponds, only half (20 feddans) the calculated nursery area (40 feddans) will be required and the 3.4 million fry will be raised in two crops using the same nursery area twice. If, in the future, fry requirements should increase beyond 3.4 million, the carp nursery, which is unused from August to May, can be used to grow additional fry of M. cephalus (provided these are available).

6. Fertilizer Needs and Cost of Fry

Fertilizer needs per feddan of mullet nursery, and cost per 1000 fry are given below:

Item	Kg/Feddan	Cost LE/t	Total Cost LE/feddan	Cost (LE) per 1000 fry
1. Chicken Manure	875	10	8.75	0.21
2. Super-phosphate	150	60	9.00	
Total			17.75	

E. Production of Tilapia Fry

No special facilities are planned for production of tilapia fry. Depending on the species, tilapia begin to breed at a length of 6 - 11 cm and continue to breed once every 30 - 45 days thereafter. Large quantities of fry can be

obtained initially by stocking one or two ponds of one feddan area each with tilapia of 30 g body weight or larger. Thereafter, fry from production ponds will be adequate for stocking purposes. Accordingly tilapia fry should not be distributed to farmers.

If it proves possible to preclude entry of wild tilapia into production ponds, the latter should be stocked with Tilapia nilotica fry. This species grows to a larger size before it begins to breed and, therefore, attains a larger market size during the growing period.

F. Summary of (1) Stocking - Retrieval Plan for Carp and Mullet Nurseries and (2) Fertilizer and Feed Requirements for Nursery and Hatchery Pond, at the Abbasa Center.

1. Summary of stocking-retrieval plan in nurseries.

Nursery	Area (feddan)	Total Fry (0.0025g) Stocked (Millions)	Fry (2g) retrieved (millions)
1. Carp	24 (used twice/yr)	24	6[1/]
		Fry (0.15 g) of both species	Fry (2 - 5 g)
2. Mullet (2 species grown separately)	20 (used twice/yr)	6.8	3.4

1/ Same number of fry can be recovered from 4 feddan nursery with alternate nursery design (Section 4.B.) in three crops.

2. Summary of Pond Fertilizer Requirements for Carp and Mullet Nurseries and Carp Hatchery

Nursery	Area (feddan)	Superphosphate (15%) Tons	Superphosphate (15%) Cost (LE)	Chicken Manure Tons	Chicken Manure Cost (LE)	Supplemental Feed Tons	Supplemental Feed Cost (LE)	Total Cost (LE)	Total No. Fry/yr (Millions)	Cost 1/ (Piasters) per 1000 Fry
1. Carp 2/	24 (used twice)	2.4	144	30	300	7.2	216	660	6	11.00
2. Mulet (2 species)	20 (used twice)	6.0	360	35	350	- -	- -	710	3.4	20.9
Total	44	8.4	504	65	650	7.2	216	1370		
1. Hatchery ponds for Carp brood-stock	6 (only 4.8 fertilized 240 days)	1.7	102	4.2	42	- -	- -	144		
Grand Total	50	10.1	606	69.2	692	7.2	216	1514		

1/ Includes only fertilizer and manure costs.

2/ If 500 m^2 nursery ponds are used to produce 6 million fry in 3 crops: nursery area = 4 feddans; superphosphate = 0.58t; manure = 7.2t; feed = 7.2t; cost/1000 fry = 5.4 piasters.

G. Fry Collection and Transport

For the purposes of the USAID project, 6 million carp fry of 2 g each and 3.4 million mullet fry of 2 - 5 g each will be transported to farmers every year. About 6.8 million mullet fry of 0.15 g each will also have to be transported from El-Mex Station to the Center every year.

The calculations below, based on the recommended stocking rate in fry plastic bags indicate that, for the size of fish to be transported, it would be much more economical to use live transport tanks, mounted on a truck and equipped with recirculating water and/or oxygen, than plastic bags.

Accordingly, it is recommended that a special consultant be retained to provide specifications for the size, type and number of live transport tanks and truck required.

It is recommended that the consultant be retained from the U. S. Sportfish and Wildlife Department, Division of Hatcheries; more specifically from the Department's Station at Sttutgart, Arkansas, where transport of minnows to Florida is carried on a large scale (Anderson Minnow Farms).

It is further recommended that the consultant be provided with data on: (a) number and size of fry to be transported, (b) transport time and (c) mean daily air temperatures during the transport period before arrival in Egypt. This will

allow the consultant to collect the necessary information on possible types and costs of live-transport equipment that could be used in Egypt while he is in the U. S.

1. Recommended Rate of Stocking (in Plastic bags) for transport periods of 20 hours or less, at 25°C air temperature

Fish	Weight/1000 fry (g)	Number fry/3 liter water and 6 liter oxygen 1/
a. Carp	50 - 200	1200 - 1500
	450	450 - 600
	800	240 - 360
	1500	150 - 240
	2000	135 - 195
b. Mullet	50 - 200	1200 - 1500
	350	810 - 1100

- - - - - - - - - - -

1/ Size of bags used currently at El-Mex Station; thickness of 0.7 mm.

2. Estimated Cost of Transport for Carp Fry Per Year using Plastic Bags [1/]

Fry	Size to be transported (g/1000 fry)	Total Number Fry (Millions)	Disposable Plastic Bags Needed		Cardboard Boxes Needed		Total Cost (L.E.)	Cost Per 1000 Fry (L.E.)	Cost/1000 Including Nursery Cost (L.E.)
			Number	Cost (L.E.)	Number	Cost (L.E.)			
Carp	2000	6	30,770	52.3	10,257	1539	1591	0.27	0.36

1/

Assumptions: (a) plastic bags are disposable; same size bags as used at El-Mex Station.

(b) fry are transported in three trips; therefore cardboard boxes used 3 times.

(c) cost of gasoline, oxygen and driver's salary not included.

(d) transport time = 20 hours or less.

It is clear from the above table that annual, recurring fry transport costs for carp alone (based on cost of bags and boxes only) will be relatively high (L.E. 1590/year). The use of permanent live-transport tanks would do away with the recurring cost of bags and boxes and permit mass transport of fry with less labor and handling.

3. Collection and Transport of Mullet Fry

a. The El-Mex Station is currently the only government facility for the collection of mullet fry. Although private operators collect fry from Lake Manzallah (illegally), there are no Government stations on the lake or any other location.

The El-Mex Station does not qualify as a real collecting station inasmuch as it is not equipped with any special facilities for the proper collection and holding of fry, nor live-transport tanks for efficient mass transport of fry to private and Government farms, and to artificially stocked lakes.

The station delivers fry to Government farms in plastic bags charged with oxygen. Private farmers provide their own transport. Fry are sold to private farmers at the rate of 0.30 L.E./1000, including the price of the plastic bag (0.07 L.E./each).

b. Present demand for mullet fry:

It is estimated (from records at El-Mex Station, and private interviews during field trips) that a minimum of about 30 - 40 million mullet fry (of both species) are presently being collected and used for the stocking of farms and Lake Qaroun. Records of fry collection are not available except from El-Mex station, which provides only 10 million of the total number of fry collected annually.

c. Future demand for mullet fry:

Demand for mullet fry during the next decade, based on known Government development plans, are estimated as follows:

		Fry Requirements (millions)
(i)	Government of Egypt (GOE)/USAID Center and related farms:	7.0
(ii)	GOE/FAO farm (Al Zawiya):	5.0
(iii)	GOE/World Bank Fish Farm Development Project:	108.0
(iv)	Minimum present fry requirements:	35.0
	Total:	155.0 million fry

In addition to this, fry will be needed to stock the new lake to be developed in Wadi el Ruwayan, southwest of Lake Qaroun. It is difficult to estimate accurately the number of fry required for this purpose but the figure will be at least 10 million/year.

d. Recommendations:

In view of the anticipated rapid increase in demand for mullet fry, and the inadequacy of existing facilities for the collection of fry, it is recommended that

(i) two well-equipped fry collecting stations be established and,

(ii) an experimental pilot production hatchery for mullet be constructed near the Al Gameel channel connecting Lake Manzallah to the Mediterranean Sea.

(i) Establishment of collecting stations:

Each station would include:

- Fixed traps for fry collection
- Concrete troughs to hold fry for periods of 24 hours, equipped with running water (preferably both fresh and sea water) and compressed air
- One vehicle equipped with live-transport tanks

Total expenditure per station is not expected to exceed $175,000 (L.E. 123,000).

Location of Collecting Stations:

In considering the location of the proposed stations, special attention was given to El-Mex. The station used to collect 20 million fry during the two mullet fry seasons. Presently, it collects only 10 million fry. This decline can be

attributed, at least in part, to increasing chemical and organic pollution in El-Mex waters and the coastal zone. A number of chemical industries (soap, vegetable oil, caustic soda, etc.), paper mill and oil storage tanks are located either at El-Mex or nearby. Effluents, including sewage from Alexandria, are discharged either below El-Mex or to the sea directly. In the absence of chemical analysis of water from El-Mex canal and nearby coastal waters, it is difficult to determine if the establishment of a collecting station at El-Mex would be advisable in the long term. It is therefore recommended that El-Mex be shelved as a possible site at least until the pollution question is resolved.

Two better sites for collecting stations were identified. One is at the Al Gameel Channel (currently under repair) which connects Lake Manzallah to the Mediterranean about six (6) kilometers west of Port Said. The other is at Al Girby on the Domyat (Damietta) branch of the Nile, about three (3) kilometers south of where the Nile joins the sea.

Both locations have access to good roads; distance to the southern-most point of fry distribution is about 200 Km or less. Land and freshwater are also available, although dechlorination of fresh water will probably be necessary at both locations. Total number of mullet fry (of both species) that can be collected at either location is

roughly estimated to be about 20 - 30 million per year.

(ii) Establishment of a mullet hatchery:

Techniques for the controlled breeding of the flat-head mullet (M. cephalus) and rearing of larvae to fry have been developed at the Oceanic Institute (Hawaii, U.S.A.). Survival rate of larvae to fry size varies from 10 - 20%. The technology has not been tested on a large production scale, mainly because of the lack of interest in this fish in the U.S. The technology developed in Hawaii is the most advanced anywhere in the world, and the Oceanic Institute currently receives research support from USAID - Washington, D.C.

The hatchery is recommended as an experimental pilot production facility to adapt U.S. techniques to Egyptian conditions and to apply it to both mullet species - M. cephalus and M. capito. The recommendation is based on the following rationale:

- Despite the large numbers of mullet fry that can be collected from natural waters, the supply is unpredictable. Peak fry availability can vary from year to year and, in case of delayed availability, the annual growing period in ponds is shortened with attendant financial losses. Environmental degradation can result in decreased fry availability. Stream and coastal

pollution have already drastically reduced availability of mullet (flat-head) fry in east Mediterranean countries with a resulting decrease in the number of mullets stocked in fish farms.

- There is extensive regional interest in the development of mullet hatcheries. Interested countries include Egypt, Tunisia, Italy, Yugoslavia, Greece, Turkey, Iran and some countries bordering the eastern Mediterranean. The recommended hatchery could serve as a regional research and training center.
- The hatchery would operate on a year-round basis as it would focus on two mullet species which breed at different times of the year. (In comparison, a carp hatchery in Egypt would be operational only 3 - 4 months per year.)
- The GOE is interested in developing brackish-water and marine aquaculture and mullets are the only available market fish which feed on plant and detritus material and can be reared in saline waters. Expansion of brackishwater farms would further increase the demand for fry. The recommended hatchery can produce <u>six (6) million fry</u> (both mullet species combined) per year. This would provide enough fry to stock 5000 feddans of ponds (at 1200 fry/feddan). The hatchery would attain its

production capacity in about three (3) years after construction if adequate external technical assistance is provided.

The best site for the hatchery is near one of the two Al Gameel Channels west of Port Said. (Accordingly the hatchery and one fry-collecting station could be combined at one location). Second preference is given to Ras Al Barr at the mouth of the Domyat (Damietta) branch of the Nile. Here again, the hatchery site would be only three (3) kilometers from the proposed second collecting station at Al Girby.

Lake Qaroun is not considered a suitable site for a mullet hatchery because:

- Minimum water temperature during mullet (M. cephalus) breeding season (July - August) is 29 - 30°C, which is well above the optimum egg incubation temperature of 20 - 22°C. High egg mortality is associated with temperatures above 25°C in the Pacific area. The effect of high temperature on egg hatching has not been studied in the Mediterranean area.
- Water salinity varies with the season (depending on evaporation, precipitation and the volume of drainage water which empties into the lake) and

increases from east to west in the lake. Water salinity at the present site of the Institute's laboratory is about 22 ppt compared to 36 ppt at the western extremity of the lake. Optimum salinity for incubation of mullet eggs and rearing of larvae varies from 32 - 35 ppt. However, the salt content of Lake Qaroun water is quite different from sea water especially as regards magnesium and sulphate concentrations, which are about three (3) times sea water levels. The effect on eggs and larvae of mullet (M. cephalus and M. capito) is unknown.

Lake salinity has been increasing at a rate of 0.24 ppt/year, with attendant increases in magnesium and sulfate concentrations. Future trends in lake salinity will depend on the balance between evaporation, precipitation and influx of drainage water.

- Neither M. cephalus nor M. capito have established breeding populations in the lake, which indicates unsuitable environmental conditions, possibly related to water chemistry and temperature.

The laboratory of the Institute of Fisheries and Oceanography at Alexandria is also unsuitable as a hatchery

site mainly because of lack of space and poor sea water quality. A deep-sea port may also be established nearby in the near future.

The cost of a mullet hatchery which can produce about six million fry of M. cephalus and M. capito per year is estimated to be about $ U.S. 1.25 million (L.E. 875,000). The hatchery would include about 1000 m^2 of laboratory space; 270 m^2 of shop, shed and warehouse space; and 1500 m^2 of outdoor tanks and raceways. The price quoted includes necessary equipment. About 2 - 3 external experts will be required to run the hatchery for 3 - 4 years. Training of Egyptian staff (at least two) should be conducted in Hawaii for a period of four (4) months beginning in December.

ANNEX I

TRAINING COMPONENT: HATCHERIES, NURSERIES AND FRY TRANSPORT (Over 5-year period)

Subject Matter	No.	Duration (months)	Total Cost (@ $1500/mm)	Suggested Training Location
I. Short-term Training				
1. Fry handling-transport	2	2	6,000	U. S. Fish & Wildlife Service Stuttgart, Arkansas
2. Monosex tilapia: fry production & culture	4	3	18,000	USAID-Auburn Freshwater Aquaculture Center, Brazil
3. Carp hatchery operation and culture				
a. Germany or Hungary	4	3	18,000	Hamburg Fisheries Institute
b. India	4	3	18,000	Central Inland Fisheries Institute, Barrackpore
4. Mullet breeding-rearing	2	3	9,000	Oceanic Institute, Hawaii
5. Plankton production	2	6	18,000	NMFS Station (Galveston or La Jolla)
Total	18	20	87,000	

		Duration (years)	Total Cost (@ $13,200/yr)	
II. Degree Training (Ph.D.)				
1. Fish reproduction and genetics	1	4	52,800	Univ. California, Davis, California
Total	1	4	52,800	

ANNEX II

MANPOWER REQUIREMENTS FOR HATCHERIES & NURSERIES

Specialization	Number	Contract Period (yrs)	Cost/5 yrs. (@ $100,000/man-year
1. Carp hatchery-nursery specialist (at Abbasa Center)	1	5	500,000
2. Mullet hatchery (at Al Gameel)			
a. Hatchery biologist 1/	1	5	500,000
b. Plankton production specialist	1	5	500,000
Total	3	15	1,500,000

- - - - - - - - - -

1/ Mullet-breeding and larval-rearing specialist; otherwise general specialization in breeding and rearing of marine fish.

ANNEX III

CONSULTANT MAN-MONTHS FOR HATCHERIES, NURSERIES AND COLLECTING STATIONS

(consultants are needed during first 2 years only)

Specialization	Duration (m/m)	Cost 1/ ($US)	YEAR I	YEAR II	YEAR III - V
1. Fry transport	2/visit; 2 visits	26,000	———	———	- - - -
2. Carp hatchery-nursery specialist	2/visit; 2 visits	26,000	———	———	- - - -
3. Mullet hatchery:					
a. Hatchery biologist	1/visit; 2 visits	15,000	———	———	- - - -
b. Hatchery engineer	1/visit; 1 visit	7,500	———		- - - -
Total	11 m/m	74,500			

1/ Cost figured on the basis of: daily per diem = $30; daily consulting fee = $150; roundtrip air travel = $2000/trip.

ANNEX IV

COST OF HATCHERIES, NURSERIES AND COLLECTING STATIONS

Item	Construction 1/ Cost (LE)	Equipment Cost (LE)	Total (LE)
1. Abbasa Carp Hatchery	125,600	91,000	216,600
2. Abbasa Carp Nursery	96,000	- - -	96,000
3. Serow Farm Carp Hatchery	125,600	91,000	216,600
4. Abbasa Mullet Nursery	80,000	- - -	80,000
5. Mullet Fry Collecting Stations			
a. Al Gameel	87,500	35,000	122,500
b. Al Girby	87,500	35,000	122,500
6. Mullet Hatchery (Al Gameel)	525,000	350,000	875,000
Total	1,127,200	602,000	1,729,200

1/ @ LE 8000/2 feddan pond.

ANNEX V

ESTIMATED MATERIAL INPUTS AND GROSS INCOME FROM A 20 - FEDDAN FISH FARM

I. Basic Assumptions:

A. Fish Stocking Rates and Cost of Fry:

1. Mullet : 1700 (2g)/feddan/yr @ LE .50/1000
2. Carp : 1200 (2g)/feddan/yr @ LE .50/1000
3. Tilapia :10,000 - 15,000/feddan/yr from natural sources

B. Fertilizer Inputs:

1. Superphosphate (15%): 340 kg/feddan/yr @ LE 60/t
2. Manure: 1,850 kg/feddan/yr @ LE 30/t
3. Feed: None

C. Fish Production and Wholesale Price:

1. Mullet = 10% of production = 100 kg/feddan/yr

   a. Govt. price = LE 0.72/kg
   b. Private sector price = LE 1.30/kg

2. Carp = 20% of production = 200 kg/feddan/yr

   a. Govt. price = LE 0.32/kg
   b. Private sector price = LE 0.45/kg

3. Tilapia = 70% of production = 700 kg/feddan

   a. Govt. price = LE 0.32/kg
   b. Private sector price = LE 0.45/kg

D. Pond Fish Production:

Maximum fish production per feddan, using only fertilizers, will be about 1000 kg/yr. It will require three years to attain this production capacity, as follows:

Year I = 60% of maximum production
Year II = 80% of maximum production
Year III = 100% of maximum production

II. Material Inputs (quantity and cost) for a 20-Feddan (water area) Fish Farm

A. Year I

Item	No.	Quantity (t/yr)	Cost (LE/yr)
1. Fish fry			
a. Mullet	20,400		10.2
b. Carp	14,400		7.2
2. Manure		37	370
3. Superphosphate (15%)		6.8	408
4. Feed		- -	- -
Total			LE 796/yr

B. Year II

Item	No.	Quantity (t/yr)	Cost (LE/yr)
1. Fish fry			
a. Mullet	27,200		13.6
b. Carp	19,200		9.6
2. Manure		37	370
3. Superphosphate (15%)		6.8	408
4. Feed		- -	- -
Total			LE 801/yr

C. Year III

Item	No.	Quantity (t/yr)	Cost (LE/yr)
1. Fish fry			
a. Mullet	34,000		17
b. Carp	24,000		12
2. Manure		37	370
3. Superphosphate (15%)		6.8	408
4. Feed		- -	- -
Total			LE 807/yr

III. Output from a 20-Feddan (water area) Fish Farm: Quantity & Gross Income

A. Year I

Item	Production (kg/yr)	Wholesale Value (LE/yr)			
		Government Prices		Private Sector Prices	
		LE/kg	Total Value (LE)	LE/kg	Total Value (LE)
1. Mullet (10%)	1,200	0.72	864	1.30	1,560
2. Carp (10%)	2,400	0.32	768	0.45	1,080
3. Tilapia (70%)	8,400	0.32	2,688	0.45	3,780
Total	12,000		4,320		6,420

B. Year II

Item	Production (kg/yr)	Wholesale Value (LE/yr)			
		Government Prices		Private Sector Prices	
		LE/kg	Total Value (LE)	LE/kg	Total Value (LE)
1. Mullet (10%)	1,600	0.72	1,152	1.30	2,080
2. Carp (20%)	3,200	0.32	1,024	0.45	1,440
3. Tilapia (70%)	11,200	0.32	3,584	0.45	5,040
Total	16,000		5,760		8,560

C. Year III

Item	Production (kg/yr)	Wholesale Value (LE/yr)			
		Government Prices		Private Sector Prices	
		LE/kg	Total Value (LE)	LE/kg	Total Value (LE)
1. Mullet (10%)	2,000	0.72	1,440	1.30	2,600
2. Carp (20%)	4,000	0.32	1,280	0.45	1,800
3. Tilapia (70%)	14,000	0.32	4,480	0.45	6,300
Total	20,000		7,200		10,700

ANNEX VI

COMPARATIVE PRODUCTION INPUT* VS OUTPUT

Method	Superphosphate 15% (t/feddan/yr) @ LE 15/t	Manure 1/ (t/feddan/yr) @ LE 10/t	Supplemental 2/ Feed (t/feddan/yr) @ LE 30/t	Compounded 3/ Feed (25% Protein) @ LE 140/t	Fish Production 4/ (t/feddan/yr)
I	- -	- -	- -	- -	0.15 - 0.20
II	0.34	1.85	- -	- -	1.00
III	0.34	1.85	2.4	- -	1.60
IV	- -	- -	2.4	- -	0.75 - 0.80
V	0.34	1.85	- -	2.4	2.2
VI	- -	- -	- -	2.4	1.35 - 1.40

1/ Can be replaced by Ammonium Sulfate @ 340 Kg/feddan/yr.

2/ Cottonseed cake + Rice bran in 3:1 mix; conversion rate = 4:1.

3/ Pelleted feed; price/t quoted is estimated world free market price (f.o.b.) conversion rate = 2:1.

4/ Production figures presume proper mix of the following fish: Carp, Tilapia, Mullet and good management. Production data should be considered maximum possible.

* Total quantity of supplemental and compounded feed used per feddan are calculated to avoid oxygen depletion in pond water in the absence of artificial aeration and/or water exchange.