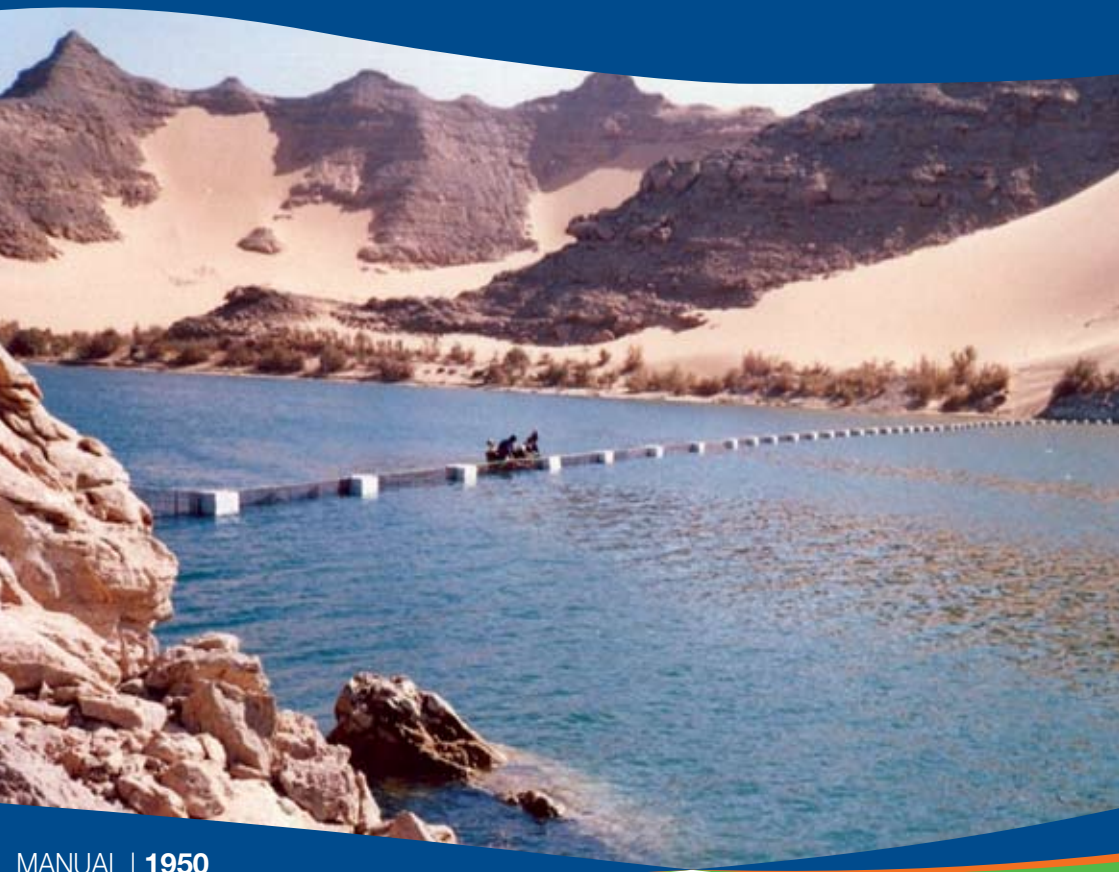

MANUAL | **1950**

Building Fish Enclosure in Lake Nasser

Technical manual prepared for the Project: Improved fisheries productivity and management in tropical reservoirs, CP-PN34: Challenge Program on Water and Food

CGIAR Challenge Program on WATER & FOOD

WorldFish CENTER

Building Fish Enclosure in Lake Nasser

Nile Basin CP-34 Project
Improved Fisheries Productivity and Management in Tropical Reservoirs

Lake Nasser Development Authority
Ministry of Agriculture and Land Reclamation

CGIAR Challenge Program on WATER & FOOD

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MANUAL FOR ENCLOSURES

INTRODUCTION

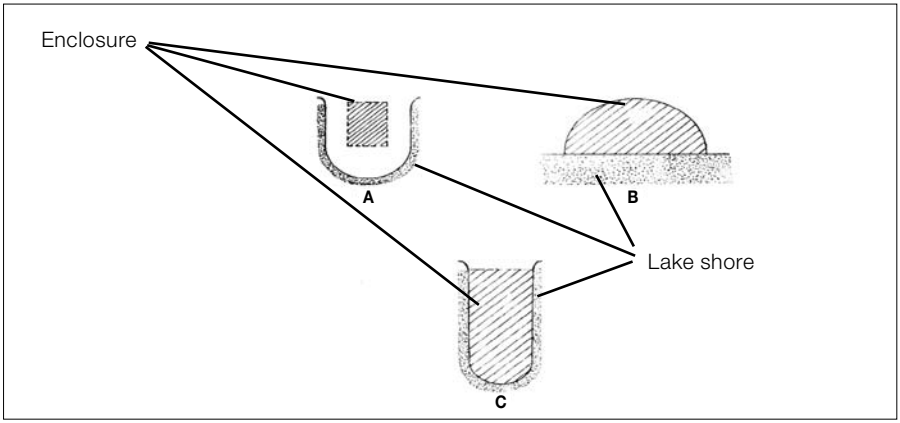
This manual is based on the experience gained by the partners of the project "Improved Fisheries Productivity and Management in Tropical Reservoirs" (CP34) funded by the Challenge Program on Water and Food. As part of this project, the partners designed, developed and tested in the field three enclosures in Lake Nasser in Egypt. The objective of the manual is to document for practitioners the main technical lessons gained from these experiments.

Prior experiments using enclosures in fresh- and seawater environments are described in Kutty and Campbell (1987). A pen or enclosure is defined as "a fixed enclosure in which the bottom is the bed of the water body". A pen is distinguished from a cage, which is an "enclosure with bottom and sides of netting or bamboo etc., whether floating at the surface or totally submerged".

Of the six zones of coastal waters — (1) shore, (2) interdidal, (3) sublittoral, (4) surface floating, (5) mid-water and (6) seabed (Milne 1979) — only three are appropriate for pen culture. These are the intertidal, sublittoral and seabed zones, all using the natural bottom as the bottom of the enclosure.

In freshwater bodies, tidal influence is relatively limited even in very large lakes, compared with the intertidal zone of the sea. Enclosures are therefore restricted mainly to shallow areas adjacent to the shore. The pen or enclosure may be completely enclosed on all four sides and placed in the middle of a bay with no contact with the shore (A in Figure 1), a shore enclosure with a foreshore

Figure 1: Types of enclosures (modified from Kutty and Campbell 1987)



extending to deep water surrounded by a net structure (B), or a bay enclosure with an embankment or net structure only at the mouth (C). The type of the enclosure developed for the project was type C as described above, using natural *khors* (bays) on the lake with a net set up across the mouth.

WHY USE AN ENCLOSURE?

The main concept of enclosures is not only to ensure the growth of released fry but also sustainable significant fish catch brought by reproduction inside the enclosures. The type of the enclosure developed for CP34 was of type C as described above, using the *khors* (embayment) formed by the Lake's shore as the natural loch of the enclosure, while a net was set up across the entrance of the khor.

In fisheries management, enclosures are usually set up to keep predators out and to increase the production of the selected species inside the enclosure, as was the case with the Lake Nasser experiment. The advantages enclosures offer include the following:

(1) **Intensive utilization of space.** High production per unit of area is made possible by adopting intense culture practices and protection from predators.
(2) **Safety from predators.** Predator fish were removed from the enclosure before stocking took place.
(3) **Ease of harvest.** Harvesting is much easier and faster from enclosures than from larger bodies of water.
(4) **Availability of natural food.** As the bottom of the enclosure is the natural bottom of the reservoir, food and other materials are readily cycled.
(5) **Natural productivity.** The enclosures are located in a shallow part of the lake, which is the most productive area.

HOW TO CHOOSE A GOOD SITE

The first general consideration is that the site should be in a body with good water quality that is suitable in terms of oxygen content, temperature and ambient nutrients for spawning and breeding fish. Assembling baseline data on fisheries and water quality and any trends that may affect them is recommended. The area should be easy to isolate with nets. The nets should not hinder natural fluctuation of the water level, or else the sudden changes in water level caused by storms may damage the net.

The features of the bay to consider are its depth, including any fluctuation, particularly at the mouth; surface area; water flow; bottom material; and

surrounding topography. The aquatic environment in the enclosure should be compatible with the needs of the target species, in particular regarding the production of natural food through the primary production of phytoplankton and zooplankton and the presence in the water of any chemicals that may affect the fish.

Establishing the enclosure must be done in accordance with the local legal framework regarding open or licensed access and any conservation measures in effect. National legislation may require that environmental impact be assessed both inside and outside the enclosure. The enclosure must be easily accessible to users but protected from intruders or poachers. Long-term economic viability should be ensured prior to the project by conducting feasibility studies that include biological, socioeconomic and market analyses.

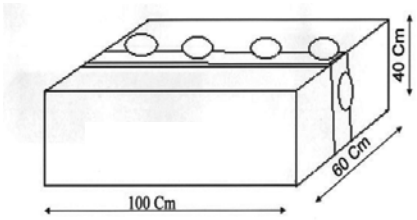
MATERIALS

The following materials are necessary to set the enclosure net: nets, buoys, a weight line, a float line, a winch, iron angles and shackles.

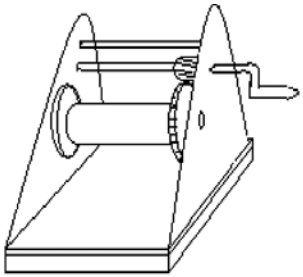
Cable cramp

Iron Angle

Hook



Buoy



Winch

PREPARATION

After choosing a suitable enclosure area, the precise location for the net must be determined, following these steps:

(1) A cross section of the mouth of the enclosure should be produced to document the depth and bottom profile.
(2) Based on this cross section, the nets should be designed to close up the khor mouth completely down to the bottom, to ensure that no fish escape.
(3) Nets should be prepared according to the design and sewn together to make one piece (photo 1) with ropes at both extremities, the upper part to fix the float line and the bottom extremity to fix the weight line.
(4) Buoys will ensure the buoyancy of the top extremity of the net, their number calculated according to the width of the enclosure mouth.
(5) The weight line, an iron chain of a suitable diameter, should be measured out to fix the net to the bottom.
(6) One winch with suitable capacity of not less than 5 tons should be fixed on one side of the khor mouth. The float line, a 12 millimetre steel cable, goes through the winch to fix the upper layer of the nets.
(7) Other materials such as iron angles, shackles and ropes to be used to fix the nets should be prepared.

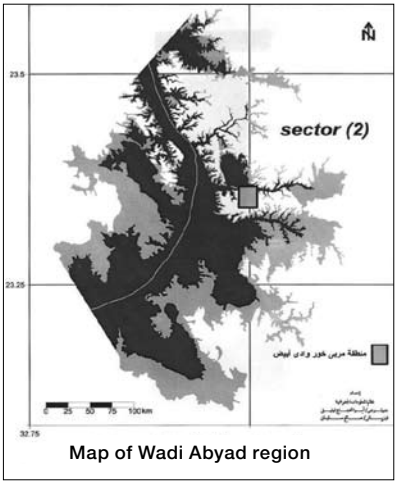
Photo 1

LAKE NASSER CASE STUDY (WADI ABYAD ENCLOSURE)

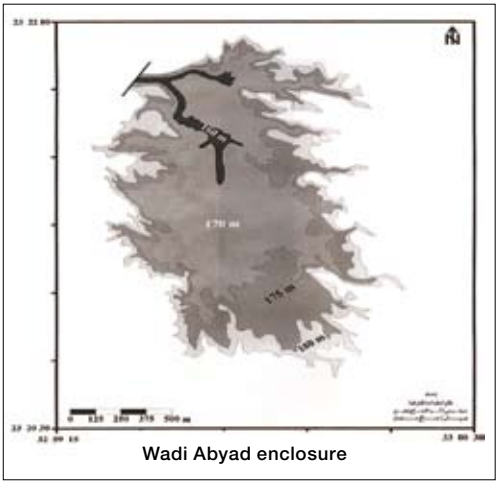
As part of the project CP34 funded by the Challenge Program on Food and Water, three enclosures were set up in Lake Nasser to rear Nile tilapia (*Oreochromis niloticus*). Suitable khors were selected using contour maps provided by the Egyptian General Survey that showed their depth at different water levels. The criteria used to select the suitable khors were the (1) total area at different water levels, (2) depth of the opening where the nets will be set (to control costs), (3) distance from landing harbours and (4) availability of naturally occurring food, primarily in the form of phytoplankton and zooplankton.

Figure 2 and Table 1 show the area of the Wadi Abyad enclosure at different water levels.

Figure 2: Maps of a portion of Lake Nasser showing the position of the Wadi Abyad enclosure (left) and the enclosure at larger scale (right)



Map of Wadi Abyad region



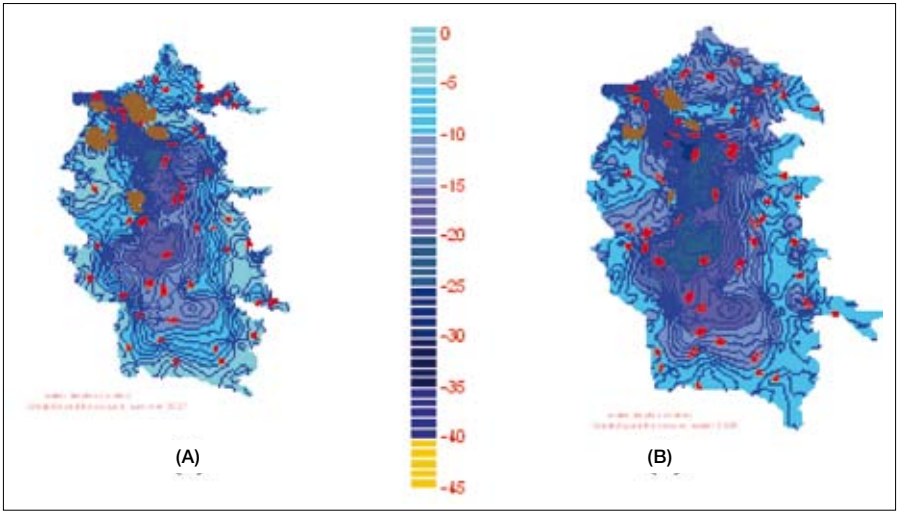
Wadi Abyad enclosure

Table 1: Wadi Abyad Enclosure Measurements at Various Water Levels					
Water level above sea level (metres)	**Change (%)**	**Net length (metres)**	**Change (%)**	**Area (hectares)**	**Change (%)**
170		76		99	
175	0.03	97	0.28	156	0.58
180	0.03	122	0.26	199	0.28

The annual change of water level was carefully observed. The water level was found to be lowest in July or August and to rise rapidly as the flood arrived from upstream, reaching its highest level some 4 months later, usually in early November but sometimes in October or December.

Water level fluctuations greatly affected the area of the enclosure. When the water level rose or fell the area of the enclosure increased and decreased accordingly (Figure 3). So, attention must be paid to variation in water level because a rising water level requires more netting to reach both sides of the khor mouth and the bottom.

Fig. 3. Water depth of the Wadi Abyad enclosure in summer 2007 (a) and winter 2008 (b)



MATERIALS USED AT WADI ABYAD

The nets of multifilament nylon, treated with antifouling, measured 210 x 25 metres and had a stretched-mesh opening of 3 centimetres (cm). The buoys, measuring 100 x 60 x 40cm, were made of painted 2-millimetre (mm) iron sheet, fitted with rings and set at 5-metre intervals along the float line, as shown in photo 2, and held in place with two shackles per buoy. The float line was made of 12-mm steel cable with rope. The weight line was made of 8-mm chain twisted along a rope. The winch had a 5-ton capacity.

Photo 2.

SETTING THE WADI ABYAD ENCLOSURE

Wadi Abyad enclosure was set up in April 2007 with the following procedure:

(1) Fix the winch on one bank at a location well above the higher water level, as shown in photo 3.
(2) Embed the iron angles in the earth on the other side of the winch, to fix the other side of the float line and the buoys (photo 4).
(3) Set the buoys in the water (photo 5).

Photo 3.

(1) Fix the winch on one bank at a location well above the higher water level.

Photo 4.

(2) Embed the iron angles in the earth on the other side of the winch, to fix the other side of the float line and the buoys.

Photo 5.

(3) Set the buoys in the water.

(4) Feed the float line out through the upper rings of the buoys, fix it at the other end at the iron angles and stretch straight across the enclosure mouth (photos 6 and 7).

(5) Distribute the buoys along the mouth of the enclosure at 5-metre intervals and fix them tightly to the float line.

(6) Fix the upper ropes of the nets tightly to the straight float line and the buoys. Tie the bottom ropes of the nets temporarily to the float line all across the enclosure mouth.

(7) Transfer the bottom ropes of the nets to the weight line, tying them tightly to it. Undo the loose knots on the float line to allow the weight line to sink and settle on the bottom, working along the length of the float line. Figure 3 shows the final disposition of the net.

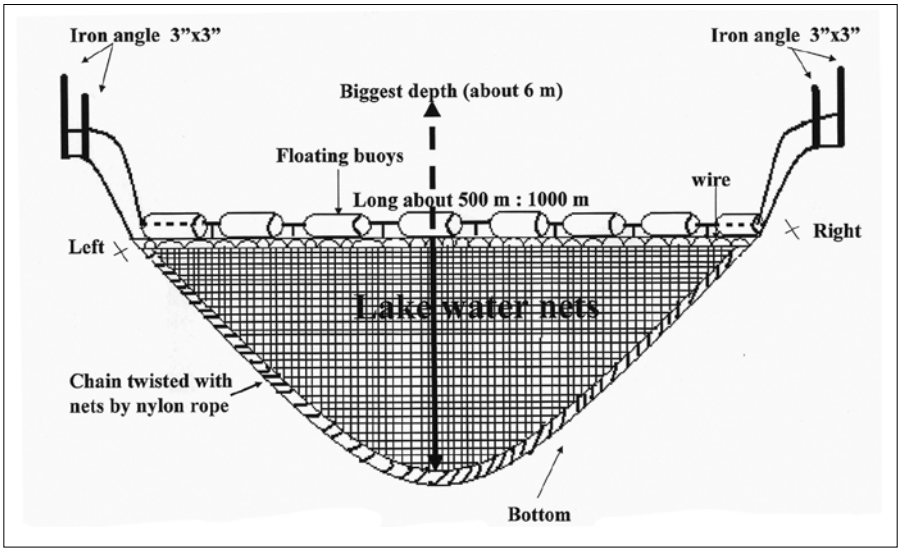
Photo 6.

(4) Feed the float line out through the upper rings of the buoys, fix it at the other end at the iron angles and stretch straight across the enclosure mouth.

Photo 7.

(5) Distribute the buoys along the mouth of the enclosure at 5-metre intervals and fix them tightly to the float line.

Fig. 3. Schematic view of the net drawn across the mouth of the enclosure



PREDATOR REMOVAL AND FRY RELEASE

To remove such predators as carnivorous fish and crocodiles, the most suitable fishing method must be used for each kind of predator. In the case of the Wadi Abyad enclosure, bottom gill nets with mesh sizes of 12, 14 and 20 cm were used to catch *Lates niloticus*, *Malapterurus electricus* and *Mormyrus kannume*. Floating gill nets with mesh sizes of 6 and 7 cm were used for *Hydrocynus froskalii* and *Alestes dentex*.

With the predators removed, 2.2 million fry and fingerlings of Nile tilapia were released. The number was arrived at according to several factors, including total area of the enclosure and its estimated carrying capacity. The first 200,000 fingerlings, with an average weight of 15 grams, were released in May 2007. September and October 2007 saw the release of a second batch of 1 million fry with an average weight of 2-5 grams. A third batch of 1 million fry with the same average weight was released in November 2008.

MAINTENANCE

Check the mouth of the enclosure daily to monitor the fluctuation of water level and adjust the net accordingly, as well as checking on the condition of the float line and fixing points. The net should be checked regularly and mended where

damaged. Cleaning algae from the net regularly is important, as accumulated algae can slow the flow of water though the net and damage it when the water level rises or falls quickly. Algae should regularly be removed from buoys as well. Beware that prolonged exposure to sunlight can damage ropes, and wires used to fix the net to the float line can rust and weaken, so these parts should be monitored.

COST OF BUILDING THE WADI ABYAD ENCLOSURE

Table 2 shows the costs, in US dollars (with an exchange rate of US$1 = 5.5 Egyptian pounds) of the materials used for the Wadi Abyad enclosure, not counting labour or maintenance.

Table 2: Cost of materials for the Wadi Abyad enclosure

Item	Unit price ($)	Spent for Wadi Abyad
Nets	9.92/kg	6,894
Winch	563	563
Buoys	84.82	3,309
Chain (8 mm)	2.68/metre	591
Cable (12 mm)	1.82/metre	261
Ropes	2.36/kg	145
Shackles	1.00	13
Cable cramps (5 cm)	3.00	24
Iron binding wire	1.00/kg	3
Threads 210/36	6.85/kg	?
Iron angles, hooks, metal sheets, paint, cement, grease, etc.		527
Total		**12,330**

CONCLUSION

As commercial fishing started only in January 2009, it is too early to determine whether or not the enclosures are economically viable or if they effectively increased the productivity of the fishery.

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The other Technical Manuals are:

- Cage Culture in Reservoirs in India.
- Enhancing fishery productivity in small reservoir in India.
- Engaging local communities in aquatic resources research.
- Producing Tilapia in small cage in West Africa.

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