

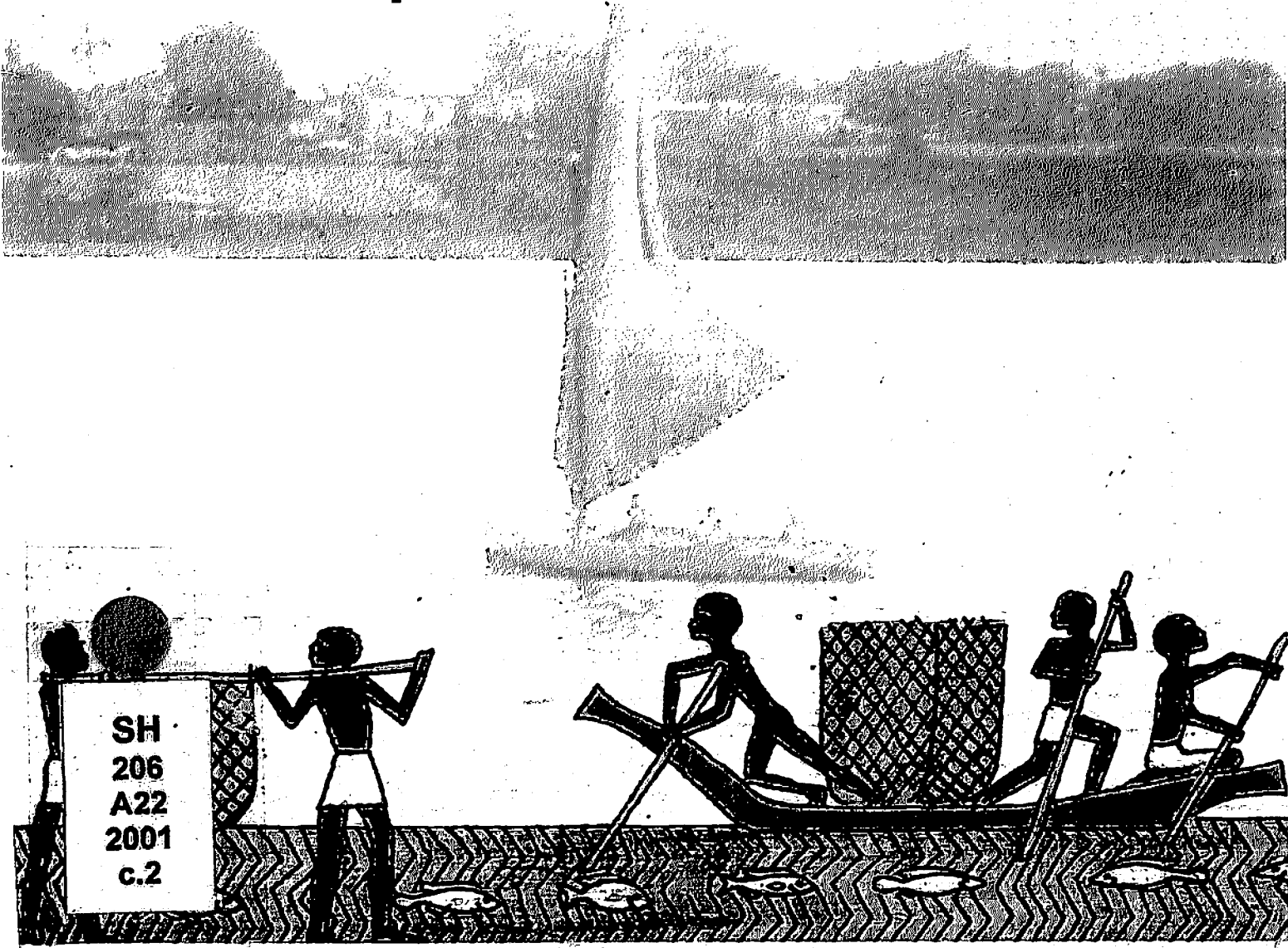


ICLARM
THE WORLD FISH CENTER

ICLARM in Egypt

2001

**Research Partnerships for Sustainable
Aquaculture and Fisheries**



ICLARM IN EGYPT

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June 2001

Our VISION is to contribute to food security and poverty eradication in developing countries.

Our MISSION is to promote sustainable development and use of living aquatic resources based on environmentally sound management.



ICLARM is one of the 16 international research centers of the Consultative Group on International Agricultural Research (CGIAR) that has initiated the public awareness campaign, Future Harvest.



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ICLARM IN EGYPT

Research Partnerships for Sustainable Aquaculture and Fisheries

“For those who use and depend on fish and
aquatic life in the developing world”

June 2001

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Preface



The World Fish Center (ICLARM) is an autonomous, nonprofit, international scientific and technical center which was established to conduct, stimulate and accelerate research on all aspects of fisheries and other living aquatic resources. The Center was incorporated in Manila on 20 January 1977 and its operational base was established in Manila in March 1977. ICLARM became a member of the Consultative Group on International Agricultural Research (CGIAR) in May 1992. In February 2000 ICLARM's headquarters moved to Penang, Malaysia where laboratory and research facilities are being established.

ICLARM set out in 1996 to increase its level of operations in Africa and West Asia by establishing a regional research center in Egypt. The Government of Egypt made available the facilities of the Central Laboratory for Aquaculture Research (CLAR), originally built with support of USAID, at Abbassa, Egypt. With support from the Government of Japan, the field, laboratory and office facilities were renovated.

Today ICLARM's regional center at Abbassa provides an outstanding facility from which to pursue research on a number of critical issues facing the development of fisheries and aquaculture in Africa and West Asia and to build effective links with regional partners.

The priorities of the research and training program currently underway at the Abbassa facility focus upon the improvement of aquaculture management techniques, and the genetic improvement of tilapias, including their potential environmental implications. As the program develops in the coming years, and partnerships with national and regional institutions are strengthened and extended, it is intended that this work will expand to include other issues of concern for aquaculture as well as capture fisheries.

This is the third report prepared by ICLARM to inform organizations and individuals in Egypt of the research and training activities being carried out at Abbassa. In this report we are very pleased to be able to acknowledge many of the organizations in Egypt with whom we have been able to work.

Meryl J Williams
Director General

Introduction

The images of ancient Egypt depicting fish and fishing activities provide evocative testimony to the historical importance of fish to the people of the Nile and the wider region of Africa and West Asia. Today that importance is arguably even more acute, in particular for the rural and urban families that have limited access to more expensive meat and for those who earn a living from farming, catching, and selling fish.

In Egypt the importance of fish to contemporary society has been a central factor in creating the market conditions that have helped Egypt emerge as the leading center for aquaculture development in Africa and West Asia over the course of the past 30 years. In the late 1990s Egypt was responsible for more than 60% of total recorded aquaculture production in Africa and output has continued to grow.

Egypt's leadership in this field was one of the reasons that ICLARM established our regional center for Africa and West Asia at Abbassa in 1997. Analysis of future global supply and demand for fish protein, and the specific regional projections for Africa and West Asia suggest that the demand for aquaculture production will continue to grow rapidly over the course of the next 20 years. We believe that the rapid development of aquaculture seen in Egypt needs to be sustained and the lessons applied in

other countries as changing conditions there create the market environments that will favour future growth. To this end ICLARM is working to expand our program of work in Egypt and the region, focusing on the development of aquaculture management techniques that have wide applicability, and upon environmentally sound approaches to genetic improvement of priority aquaculture species.

Analysis of supply and demand projections also emphasise the importance of maintaining, and where possible enhancing, the region's capture fisheries. These currently account for over 90% of all fish production in Africa and West Asia. While these figures are projected to decline in relative terms as aquaculture develops further, it is clear that sustainable management of existing capture fisheries will remain an essential component of any strategy for long term provision of fish protein as a means to improved nutrition and household incomes. For this reason ICLARM will increase its investment in supporting sustainable use of the region's freshwater and marine capture fisheries.

In order to address the dual challenge of developing aquaculture while sustaining and enhancing capture fisheries ICLARM is preparing a new program for Africa and West Asia. This will benefit from wide consultation over the course of 2001, a regional planning workshop held at Abbassa from 23-25 April 2001, and our growing track record of achievement in the region. As part of this process ICLARM will seek to expand our program in Egypt by intensifying work on aquaculture both at Abbassa and on selected farms, by initiating work on capture fisheries, by incorporating socioeconomic studies in this work, and by expanding training including by fostering doctoral and post-doctoral research fellowships for Egyptian students. As we do so we look forward to being able to strengthen our partnership with all who are working on these issues in Egypt.



Egypt is the leading center for aquaculture development in Africa and West Asia

Regional Planning

The future demand for fish protein and the other factors that will influence ICLARM's work were examined in a regional program planning workshop held at Abbassa from 23-25 April 2001. This brought together 32 participants from 11 countries in the region, selected international partners including FAO and SADC, and staff from the region and HQ. After reviewing the overall regional trends that should influence ICLARM's work, the impact of those trends on aquatic resource systems, and the research questions that emerge from this, the workshop identified a number of specific research goals and objectives that ICLARM should pursue in order to help improve fisheries and aquaculture in the region.



The river Nile and associated lakes contribute some 50% of Egypt's fish harvest

Goal 1. To support the role played by riverine systems in sustaining rural and urban food security and livelihoods.

Objective 1.1 Identify systems of governance that enhance the contribution of riverine systems to food security.

Objective 1.2 Acquire, interpret and supply information on the value of fisheries in support of such systems of governance (and so foster more

influential engagement by fisheries stakeholders in the management and allocation of multi-use systems in rivers).

Objective 1.3 Provide information on ways in which fish and fishermen respond to natural and artificial changes in riverine systems as a basis for improved management and mitigation of losses caused by external interventions such as dams.

Goal 2. To realize the total potential value of coastal fisheries

Objective 2.1. Assess the extent, health, and current and prospective value of the coastal fisheries of the region.

Objective 2.2. Identify institutional arrangements that will foster sustainable management of this resource.

Goal 3. To realize the total potential value of lake and reservoir systems.

Objective 3.1 Review and identify means to improve the availability of existing data on fisheries productivity (past, present and potential) and management of the region's lakes and reservoirs.

Objective 3.2. Evaluate options for maximising fish production (including pen and cage culture), in face of competing demands for water in lakes and reservoirs and associated catchments

Objective 3.3. Evaluate and identify approaches for conserving biodiversity in the region's natural lake systems.

Goal 4. To increase fish production and to optimize water use for the benefit of urban and rural food security.

Objective 4.1 Enhance the contribution of, and participation in, aquaculture through a better understanding of the adoption process.

Objective 4.2. Enhance aquaculture productivity, including through efficient seed production and genetic enhancement.

Objective 4.3. Develop and implement methods to measure, monitor and maintain environmental integrity.

Building Partnerships

Partnerships at all levels are critical to the achievement of ICLARM's Mission. Only by working with and through others will our work be effectively rooted amongst the key stakeholders in fisheries and aquaculture development and so have the quality and scale of impact we seek. Considerable energy has therefore been invested in establishing and working through partnerships.

The **Fayoum Fish Farming Association (FFFA)** serves to further fish farming in the Fayoum Governorate. Several members of FFFA have participated in ICLARM training, and on-farm trials are now being conducted with members of FFFA. An FFFA technician has also been trained in water quality assessment. While in time ICLARM hopes to be able to transfer this training work to national institutions the intensive interaction with FFFA has not only provided direct support to farmers, but also helped identify issues upon which our research program should focus

The **Multi Sector Support Programme (MSSP)** provides a soft loan facility to help stimulate development of selected agricultural industries in Egypt, one of which is aquaculture. Over 60 loans have been provided for aquaculture activities so far and ICLARM has supported this by providing information and training to current and potential clients for loans. A total of three training courses have been held with the MSSP in 2000-2001 and a fourth scheduled for August 2001. In addition the on-farm trials at Fayoum are carried out in full collaboration with MSSP.

Members of the Fish Farming Association (FFFA) sampling fish at Fayoum

The **Central Laboratory for Aquaculture Research (CLAR)** at Abbassa is a leading institution responsible for conducting aquaculture research in Egypt. ICLARM is therefore working closely with CLAR, including through the provision of pond and other facilities for selected experiments, and training for staff. Of particular importance is the involvement of CLAR in the International Network of Genetics in Aquaculture (INGA) that is managed by ICLARM. Three CLAR staff participated in an INGA training course on selected breeding of tilapia held in the Philippines in March 2001.

The **National Water Resources Plan project (NWRP)** is an initiative of the Ministry of Water Resources and Irrigation designed to help improve use of Egypt's water resources. ICLARM has worked with NWRP to provide guidance on the fisheries and aquaculture aspects of the Plan and will seek to identify future research that may assist with the implementation of follow-up to the NWRP.

ICLARM has worked closely with the **Near East Regional Office of FAO** to conduct regional training courses in aquaculture in 1999 and 2000 and a third course will be held in October 2001.

The **Arab Organisation for Agricultural Development (AOAD)** has also collaborated on training for government staff in Egypt and further collaboration with AOAD at national and regional level is planned.

Supporting much of this work is extensive collaboration with the **Universities and research institutes** engaged in aquaculture and fisheries in Egypt. This collaboration includes supervision of research students, reciprocal participation in conferences and seminars, and identification of opportunities for joint research. Further development of this collaboration will play a central part in the future growth of ICLARM's work in Egypt.



Program Focus 2000-2001

1. Research

The regional program development process that is being pursued in 2001 will provide a stronger strategic framework for future investment in the research program carried out at Abbassa. As this is developed work in 2001 will focus upon pushing forward existing areas of agreed priority research where significant progress was made in 2000.

1.1. Improving Aquaculture Management Techniques. In Africa and West Asia, Nile tilapia *O. niloticus*, and African catfish *C. gariepinus*, are in high demand as fast-growing and hardy species, both for aquaculture and culture-enhanced fisheries. The main limiting factor for their extended use is the lack of high-quality fingerlings. Most existing technology for reproduction and larval rearing is too complicated and expensive for use by smallholders. ICLARM has therefore been working to develop simple farmer-friendly techniques that will facilitate use of these species in aquaculture. Work on tilapia was carried out in 1999 and 2000, while in 2000 and 2001 ICLARM has been studying the structural and ecological requirements for natural pond spawning and larval rearing of African catfish.

The work on tilapia focused on the effect of temperature manipulation and feeding regimes on spawning performance. This has demonstrated that use of a simple plastic cover to help retain heat in the broodstock tanks enabled a gain in water temperature of about 5 °C resulting in production of fry at least three weeks earlier compared to the uncovered tanks. In addition a significant positive effect of feeding broodstock diets with 35 % protein level under covered conditions was observed. Together this work has shown that it is possible to produce sufficient numbers of fry ready to be stocked into the production ponds by the middle of April thus allowing the pond growing season to be started three weeks earlier. In temperate conditions such as those of Egypt and the other countries of North Africa and West Asia this will allow the growing season to

be extended, or for fish to be brought to market earlier, both enhancing income potential for farmers.

Work carried out in 2000 has shown that exposure of *Clarias gariepinus* to reduced water levels and high temperatures can induce spawning, and that provision of shelter can significantly increase fry survival. We believe that these simple techniques will be readily adoptable by small farmers across the region. Before promoting their widespread uptake more refined experiments are however being carried out in 2001 to obtain more precise data on both the impact of stress, flushing with freshwater, and swarming behaviour on spawning, and the impact of shelter on survival. From this work a set of specific recommendations and guidelines for farmers on the inputs required to produce a given number of *C. gariepinus* fingerlings with a given size at a given period of time will be developed.



Clarias spawning technology developed at Abbassa is now being tested in Cameroun

1.2. Fish Health. The relatively non-intensive aquaculture systems of Egypt (as in the rest of Africa and West Asia) have so far not experienced major fish health problems. This is expected to change when intensification increases. Since many disease-causing organisms are indigenous or have already been introduced to the region, documentation of relatively minor outbreaks in both natural and culture systems can provide valuable information for predicting future problems. Quarantine and early warning systems will be more effective if the particular diseases against which to guard have been identified.

The fish health activities being pursued by ICLARM include the establishment of a disease control system for Abbassa and the establishment of a fish disease documentation center for Egypt. This will include data on type of disease, the location and timing of its occurrence, and its impact on the fish populations, including both quantitative and qualitative measures. The disease control system for Abbassa is designed to be a pilot for the country and region and will be used to derive guidelines to be used by farmers in managing disease outbreaks on their farms.

Discussions are also underway with FAO concerning establishment of a regional network and an Aquatic Animal Quarantine and Pathogen Information System (AAQPIS). A formative workshop is planned for Abbassa in the second half of 2001. Once established AAQPIS will be an important database for fish health information for the region.

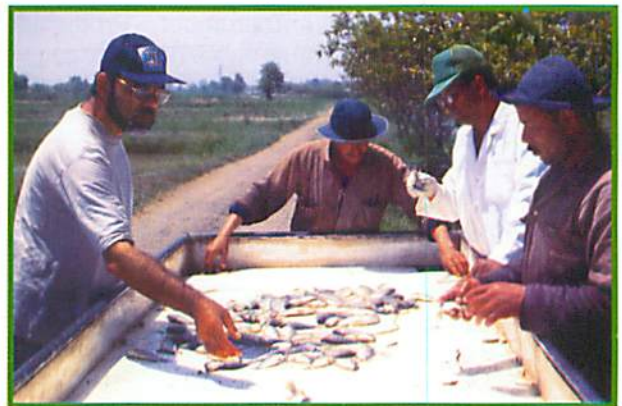
1.3. Genetic improvement of tilapias.

Tilapia culture in the region is based largely upon unimproved populations and natural mixes of species from the wild. Yet in the way that selective breeding has brought great improvements in production of domestic livestock and crops over many centuries it is believed that substantial increases in production of tilapia and other fish can also be achieved through selective breeding. Accordingly a number of selective breeding techniques are being tested on tilapia species at Abbassa. It is hoped that this will result in the development of improved strains of tilapia that can be used in Egypt, but in doing so also identify techniques that can be applied to other species and populations elsewhere in the region.

A first program of improvement of *O. niloticus* and *O. aureus* for aquaculture in Egypt through **mass selection** started in 1999 and is on-going. After two generations of selection the selected Nile tilapia have grown 22.5% larger than the non-selected control. The 3rd generation will be evaluated over the course of 2001.

A program of **combined family selection** also began in 2000. Seventy families have been formed from four populations of tilapia (3 from the Nile delta and one from Aswan). These have been spawned in hapas and winter growth rate and survival were recorded in April 2001. Individuals with the best genetic makeup will be paired for mating to produce the 2nd generation of full-sib and half-sib families for the next cycle of the selection program.

In collaboration with Auburn University **marker-assisted selection** is being attempted on a mixture of the local Nile Delta and Aswan strains of Nile Tilapia. In 2000 families were formed from four populations of tilapia for mixing of genetic material. These have been spawned in hapas and their progeny has been individually tagged and stocked in a communal pond for growth evaluation and family/within family selection. Samples of each full-sib/half-sib family will be shipped to Auburn for DNA analysis.



In the mass selection experiment over-winter growth is evaluated in April.

1.4. Assessment of environmental impacts of aquaculture activities.

Future development of aquaculture will benefit from the use of improved stocks that will increase production and income to farmers. However escapees from hatcheries and farms may influence the naturally existing stocks in the surrounding environments. A study is now being developed to monitor and evaluate these effects. The on-station phase includes customized pond-spawning conditions in which Nile tilapia were stocked separately and in different combinations with three other species of tilapia to assess the rates of introgression between these species. The out-of-station phase includes sampling irrigation and drainage canals at variable distances from aquaculture activity centers to detect possible changes in species composition as well as potential introgression.

1.5. Controlled production and on-farm trials.

The management regime used for individual ponds can greatly affect production. Over the course of recent seasons controlled production at Abbassa has improved and the lessons integrated into training courses and other materials. Much remains to be done in this field however with research at the Abbassa facility linked to parallel on-farm trials.

One issue of growing importance is the need for farmers to be able to diversify their market options by producing fish over a period of several months rather than in a more restricted traditional harvest season concentrated in November/December. Production trials at Abbassa in 2000 have shown that this can be achieved by stocking in May with overwintered fingerlings. These were harvested at marketable size after less than 4 months pond growth.

Another approach tested has been mixed stocking of overwintered fingerlings (stocked in early May) and young of the year (stocked in early and late June), followed by partial harvesting of the overwintering fish starting in late August and final harvest in early

December. This approach achieved very similar total production figures and similar net income to the first one, but with fish of different size and market niche.

A third trial has shown that when ponds were stocked in May with young of the year at lower density (1/m²) and harvested later (late December/early January), the total weight of fish harvested was lower, but that net value was comparable with trials using overwintered fingerlings and/or young of the year stocked at higher densities. This was due to the larger number of high grade (larger) fish produced at lower density. For the farmer this means that when fingerlings are in short supply it is possible to start at lower densities but achieve a comparable net income.

Overall this work has shown that a range of technologies are available to farmers according to the specific situation faced. In 2001 this work will be continued to test other options. A number of different fertiliser treatments, feed types and stocking regimes will be tested at Abbassa and compared with on-farm trials at Fayoum and Kafr El Sheikh.



Harvesting controlled production at Abbassa

On-Farm Trials

As follow up to training programs for fish farmers, and in order to test on the farm elements of the production technology being used at Abbassa and taught in the training courses, ICLARM, jointly with the Multi-Sector Support Programme (MSSP), is carrying out on-farm trials using representative fish ponds in Fayoum governorate. These started in the 1999-2000 season and were followed in the 2000-2001 season by a second trial. Preliminary results of the 2000-2001 trial indicate further development in farm productivity on both farms with increases in production since 1998 now reaching from 100-300%. As in 2000, it is intended in 2001 to share these findings among fish producers and concerned personnel through a one day workshop.

Building on this successful approach a third trial season will be carried out at Fayoum in 2001-2002. In addition a more detailed trial will be carried out on a farm in Kafr El Sheikh.

It is intended to expand this work in future years in order to incorporate additional farms where conditions and the constraints to production may vary. This will both strengthen our understanding of the diversity of conditions being faced by farmers, but also identify constraints where future research may help identify solutions.



Stocking fry for the on-farm trials at Fayoum

2. Training

The yields that can be obtained from aquaculture depend greatly on the state of technology, levels of inputs, and skill of the farmers. The future success of the sector depends to a large extent on the availability of properly trained and experienced personnel. ICLARM's training program aims to transfer appropriate technology directly to specialists and fish farmers with the goal of increasing productivity. Over the course of the past three years training in a range of issues has been organised at Abbassa. These include courses for Egyptian farmers on field application of fish culture technology, enhancing productivity of fish farming, production of tilapia seed, and improving farm management; and regional courses on aquaculture management and on genetics in aquaculture. This work has played a major role in the development of national and regional capacity for aquaculture management, both through the participation of staff from government institutions concerned with fisheries and aquaculture and through courses for farmers. The involvement of local universities and research institutions in the training courses has also strengthened collaborative links with these bodies and allowed further transfer of ICLARM's research results.

In 2001 one additional national course on Enhancing Hatcheries Management and one regional course on Sustainable Aquaculture Production will take place. A more extensive set of regional training courses is being developed for 2002.



Participants in the training program on tilapia hatchery management

Future Plans

The work carried out at Abbassa since 1998 has made a significant contribution to the development of aquaculture in Egypt and it is hoped that the work described here for 2001 will build successfully upon this. However in view of the importance of fisheries and aquaculture in Egypt, and the leading role it enjoys in this field in the region, ICLARM will work to further expand its activities in Egypt, seeking to bring specific benefits to fisheries and aquaculture in Egypt while developing technology and other research results that can be applied in other parts of Africa and West Asia.

Amongst the approaches that will be pursued are:

- ◆ development of technology that can foster further intensification of aquaculture under Egyptian conditions
- ◆ improved understanding of the socioeconomic factors impacting aquaculture and fisheries
- ◆ further development of genetic selection techniques
- ◆ quantification of the importance of freshwater capture fisheries and potential for enhancement
- ◆ development of a fellowship program that will provide opportunities for a new generation of students to pursue high priority research for aquaculture and fisheries



Freshwater capture fisheries will receive greater attention in ICLARM's new program for Africa & West Asia

Annex I Training Activities

Recent training activities conducted at the ICLARM Regional Center are summarized below:

Field Application for Fish Culture Technology in Egypt

Objective: to produce a technical pool of fish farmers who will be in a position to adopt new technology in their farm operations and who will spread the technology further.

Duration: 7-24 March 1999.

Outside Lecturers: Dr Abdel Rahman Moustafa, Central Laboratory for Aquaculture Research, Egypt; Dr. Ahmed Barrania, Institute of National Planning, Egypt.

Donor: Social Fund for Development and ICLARM core funds.

Collaborators: Fayoum Fish Farming Association.

Participants: 14 fish farmers from the Fayoum area.

Training Program on Aquaculture for Near East Countries

Objective: to assist aquaculture professionals working in the Near East to update and integrate their scientific and technological knowledge on the different disciplines needed for successful and responsible hatchery and farm management.

Duration: 3-14 October 1999

Outside Lecturers: A. Barrania, Institute of National Planning, Egypt; Mohamed Saif (FAO); K. Abdul-Elah, Mariculture and Fisheries Department, Kuwait; S. Sadek, Arab Aquaculture Consultants, Egypt.

Donor: FAO Near East Regional Office and ICLARM core funds.

Collaborators: FAO, Near East Office (Cairo).

Participants: 11 from: Egypt, Jordan, Palestine (2), Kuwait, Algeria, Iran (2), Bahrain, Syria and Sudan.

Enhancing the productivity of fish farming in Egypt

Objective: to give researchers, extension staff and producers information on how to achieve more productivity per unit of water or land using the appropriate technology for each farming situation.

Duration: 6-11 November 1999

Outside Lecturers: Dr. Ali Abdel Ghani, Central Laboratory for Aquaculture Research, Egypt.

Donor: Arab Organization for Agricultural Development (AOAD) and ICLARM core funds.

Participants: 19 from the General Authority of Fish Resources Development (2), CLAR (2), Ministry of Agriculture (2), Universities (9) and the private sector (4).

Enhancing the productivity of fish farming in Egypt

Objective: to give producers information on how to achieve more productivity per unit of water or land using the appropriate technology for each farming situation.

Duration: 20-24 February 2000

Outside Lecturers: S. Sadek, Arab Aquaculture Consultants, Egypt; Dr. Ismail Radwan, Private Sector, Egypt.

Donor: Multi Sector Support Programme (MSSP) and ICLARM core funds.

Participants: 19 from the private sector.

Enhancing the productivity of tilapia hatcheries

Objectives: Employing updated scientific and technological knowledge to achieve a better outcome of tilapia seeds as an important element in the development of aquaculture in Egypt.

Duration: 6th - 10th August 2000

August, 2000 Collaborators: Multi-Sector Support Programme (MSSP).

Participants: 18 participants (private fish farmers) from Behira, Kafr El Sheikh and Fayoum governorates.

Application of Genetics in Aquaculture and in Fisheries Management

Objectives: To provide useful information on genetic resources and the means of conserving genetic variation during programs of genetic enhancement for aquaculture and/or stock enrichment of natural waters.

Duration: 7-14 October 2000

Outside Lecturers: Mohamed Saif (FAO); Jorn Thodesen (ICLARM HQ).

Collaborators: FAO Near East Regional Office and ICLARM Regional Research Center.

Participants: 13 from: Cyprus, Egypt, Libya, Morocco, Palestine, Iran (2), Saudi Arabia, Syria, Sudan, Tunisia and Turkey.

Improving farm management

Objectives: Employing updated and appropriate scientific and technological knowledge to achieve a better production per unit of water and unit of farm land.

Duration: 20-24 February 2001

Outside Lecturers: Siad Abdel Hafez (ARC), Mohamed El Gazzar (GAFRD), Abdel Rahman Moustafa (CLAR).

Collaborators: MSSP

Participants: 16 participants (private fish farmers) from Behira, Kafr El Sheikh and Fayoum governorates.

The ICLARM staff who presented lectures and demonstrations were A.R. El-Gamal, G.O. El-Naggar, K.H. Zagloul, A.S. Diab, M.A. Rezk, E. Kamel, R.E. Brummett, Diaa Qenawy, Wahid Elwan, Moustafa Abdel Mohsen, Tharwat Dawood, Amr El Nagaawy, Mohamed Yehia, Rezk Hara, Abdelhay Sobky.

In addition to the larger courses for groups, more tailored training was provided for a number of individuals. For example, a 5-day training program (23 - 27 April 2000) was organized to train one participant from the Fayoum Fish Farming Association on laboratory techniques for water quality analysis and pond management. This person operates the association laboratory in Fayoum and will assist members by doing water quality analyses. The course focused on laboratory testing and relating test results to fish production.

Annex II Post graduate supervision by ICLARM staff

Diab, A.S. Graduate student supervision.

1. Studies on the scales of healthy and diseased fish, MSc, Faculty of Veterinary Medicine, Zagazig University.
2. Diagnosis of fish viruses in Egypt, MSc, Faculty of Veterinary Medicine, Suez Canal University.
3. Studies on crustacean diseases affecting fish and their control in Aquaculture, PhD, Faculty of Veterinary Medicine, Suez Canal University.
4. Environmental and pathological studies affecting broodstock and larvae of freshwater shrimp in hatcheries in Egypt, PhD, Faculty of Veterinary Medicine, Zagazig University.
5. Ecological and immunological studies on external parasites affecting fresh water fishes, PhD, Faculty of Veterinary Medicine, Suez Canal University.
6. Some pathological studies on deficiency of vitamin C in fresh water fishes, PhD, Faculty of Veterinary Medicine, Zagazig University.

El Gamal, A. A. Graduate student supervision.

1. Study of some engineering and environmental parameters on fish production in tanks, PhD, Faculty of Agriculture, Moshtohor, Zagazig University.
2. Technology of all-male tilapia production. University of Montpellier, Meze, France

El Naggar, G.O. Graduate student supervision.

1. Growth performance of Nile tilapia fry under different methods of rearing, MSc, Faculty of Agriculture, Cairo University.
2. Reproduction performance and egg hatchability of Nile tilapia (*Oreochromis niloticus*) under different environmental conditions, MSc, Faculty of Agriculture, Cairo University.
3. Studies of some factors affecting fish performance, PhD, Faculty of Agriculture. Zagazig University.
4. Toxicological effects of copper and lead on some physiological aspects in two fish species, blue tilapia (*Oreochromis aureus*) and African catfish (*Clarias gariepinus*), PhD, Faculty of Science. Cairo University.

Annex III Workshops

Organized by ICLARM in collaboration with partners

1. Fisheries and Aquaculture Policies

Organizers: Policy Reform Program, FAO, GAFRD, and ICLARM

Date: May 29, 2000

Objectives of the workshop: identification of policy constraints hindering the development of the fishery sector in Egypt as well as to identify practical solutions for decision makers.

2. Program Development Workshop

Organizers: ICLARM

Date: 23-25 April 2001.

This regional planning workshop was convened to help develop the substantive rationale and technical focus for ICLARM's work in the region over the next five years. It examined critical issues which may impact fisheries and aquaculture in the region over the next 25 years, the role of research in addressing these issues, current activities and future plans of other institutions and the unique value-added of ICLARM.

In which ICLARM participated

1. FAO sponsored meeting held 3-5 April 2000 in Cairo to establish a Regional Commission on Fisheries (RECOFI)
2. Fisheries and Water Resources Workshop ICLARM scientists participated in a one-day workshop (9 April 2001) "Fisheries and Water Resources in Egypt" and presented a keynote paper. The workshop was organized by the National Water Resources Plan (NWRP) and was designed to assist identification of key fisheries issues to be considered in the Plan. Of particular importance is the need to maintain water quantity and quality for future fisheries production.

Annex IV Advisory Services

EI Gamal, A.A. 1999. Fish production in Egypt with regard to: sources, development, and potential, with special emphasis on lake fisheries, the River Nile and aquaculture. Consultant's report to the Strategic Research Unit (National Water Research Center) and Italian Cooperation.

The report covered the main fisheries resources in Egypt including the River Nile, lakes and aquaculture in regard to historic review, status, development trends, constraints and outlook.

EI Gamal, A. A. 1999. Factors affecting fish production in Egypt with special emphasis on the relationship between water quality and fishery production as well as human health. Consultant's report to the Strategic Research Unit (National Water Research Center) and Italian Cooperation. The report focused on factors affecting the productivity of major fisheries resources in Egypt. This included those of a general nature as well as specific resources. The report included a summary of the current development activities for each resource and the outlook for the future.

EI Gamal, A. A. 1999. Regional Review of Aquaculture Status and Development Trends in the Near East Countries. Consultant's report to FAO. The report included a review on the aquaculture status in the Near East countries (production, culture systems and main

constraints); marketing of aquaculture products; and specific issues of concern such as responsible aquaculture, development planning trends and requirements- and research in aquaculture.

EI Gamal, A. A. 2000. Translating into Arabic "FAO Fisheries Technical Paper: Selective breeding programmes for medium-sized fish farms".

EI Gamal, A. A., and Mohamed Saif Abdullah. 2001. Establishment of mariculture center in the Islamic Republic of Iran. (A mission report).

Annex V Outreach Activities selected lectures

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