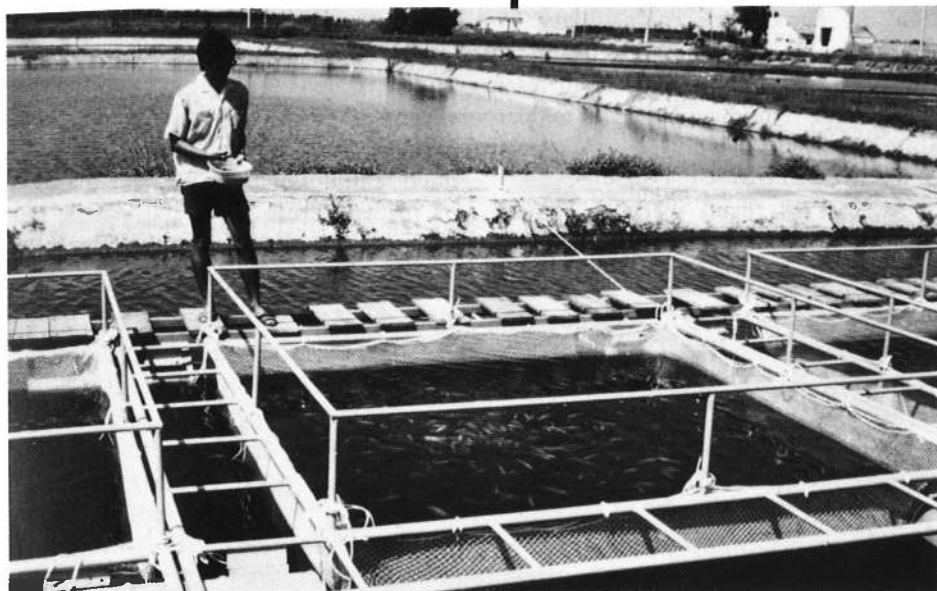


ICLARM's Tilapia Research



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ICLARM has been organized to conduct, stimulate and accelerate research on all aspects of fisheries and other living aquatic resources. Its program of work is aimed at resolving critical, technical and socioeconomic constraints to increased production, improve resources management, and insure equitable distribution of benefits in economically developing countries. In the field of aquaculture, the biological and socioeconomic aspects of aquaculture development have received equal emphasis.

The biological element of ICLARM's aquaculture program continues to focus on research with tilapia, mullet, milkfish and carp. Research is being organized into a commodity-oriented approach, based on the above species groups, while maintaining the disciplinary focus on the principal basic research targets—reproduction, nutrition, genetics and pathology. This approach is being implemented through initial heavy emphasis on the most promising commodity group, the tilapias, with continuing studies on mullet and milkfish to gradually establish parallel research programs on these two commodities.

Recognizing the growing importance of aquaculture in the tropics, as well as the urgent need for more reliable economic information for policy formulation and development planning, ICLARM has also emphasized the economic component of aquaculture research and is developing a network of cooperating research institutions with initial focus on 1) country case studies of aquaculture trends and development prospects, and 2) economic analysis of selected aquaculture production and marketing systems.

Tilapias possess an impressive range of attributes that make them well-suited for widespread culture. They are best described as omnivorous and show excellent growth rates on low-protein diets, whether from natural aquatic life or from supplementary feed. They tolerate wide ranges of environmental conditions, show little susceptibility to disease and are amenable to handling and other rigors of captivity. Most importantly, they are favorably accepted as food fish. With all these advantages, the tilapias are likely to become the prime domesticated species for tropical fish culture.

The goals of tilapia research at ICLARM include:

- Increasing efficiency of production systems.
- Increasing economic intensification of production.
- Increasing integration of fish farming with agriculture.
- Increasing use of brackishwater and marine systems.

Red tilapia cages in Taiwan (*top*) and net pens (*hapas*) for tilapia fry in the Philippines (*right*).

Cooperative Projects

As ICLARM's research approach in aquaculture shifts toward an interdisciplinary-commodity orientation, the need for a research network strategy for coordinating critical problem areas for each species group becomes more important. The beginning of such a network is already in place for tilapia. It includes institutions in the Philippines, Taiwan and Kuwait and is likely to expand during the coming years.

The usual mode of operation of ICLARM has been to conduct research using the facilities and involving the staff of a cooperating institution. The following projects are in progress at such institutions:

1. MASS PRODUCTION OF TILAPIA FRY

Despite tilapias' reputation for uncontrolled breeding at an early age in ponds, they are fish with low fecundity. This is the basic problem. As tilapia production has expanded and become more intensive, the failure of hatcheries to produce adequate numbers of fry at optimum times has become a major constraint to production.

Although the problem of low fecundity cannot be solved without long-term studies involving genetics, hybridization and selection, the fry production rate can be rapidly improved through methods now being tested, such as early removal of fry from brood females, improved systems for fry rearing, more rapid "recycling" of



females, inducement of early breeding, synchronization of breeding, and use of females only at their most reproductive ages.

The fundamental reproductive performance of certain tilapia species/strains is now being compared at the Freshwater Aquaculture Center (FAC), Central Luzon State University (CLSU), Philippines.

Experiments are being conducted currently in a concrete raceway system with the following foci:

- Definition of optimum stocking densities of adult broodstock.
- Definition of optimum sex-ratios of mating broodstock.
- Definition of optimum size and age ranges of spawners.
- Increasing frequency of spawning through feeding, environmental control, egg removal or special treatment of broodstock.

Activities likely to be undertaken as a follow-up to present research include selection for improved reproductive and growth performance, induced synchronization of spawning, and development of a refined method for rearing fry in hatcheries.

2. GENETIC IMPROVEMENT OF TILAPIA BROODSTOCK

This project was undertaken at FAC-CLSU, initially funded by the Rockefeller Foundation and terminated in 1981, although selected aspects continue to be a part of ICLARM's tilapia research program.

The study has been focused on evaluation of reproductive compatibility between the species and strains, of growth performance, and of survival of each species and hybrid under given temperature and salinity.

3. MARICULTURE OF TILAPIA

At least 14 tilapia species have been cultured to varying extent. Some are tolerant to brackishwater, and a few

species may thrive and even breed in seawater. However, tilapia culture is at present confined mostly to freshwater.

The search for species and hybrids which are fast-growing and preferably capable of reproduction in saline waters is important, not only for further expansion of tilapia culture in coastal waters, but also to reduce conflicts with agricultural users of tillable lands and freshwater.



Concrete raceways (above) for mass fry production and circular broodstock-holding tanks (below) at Central Luzon State University, Philippines.

For this project, the red tilapia (presumably the hybrid of *S. mossambicus* x *S. niloticus*) and blue tilapia (*S. aureus*) were selected initially, and a continued search for other candidate species and improved hybrids is underway.

The project was initiated in May 1981 at the Lukang Station, Taiwan Fisheries Research Institute, in cooperation with the Council for Agricultural Planning and Development. The growth, survival and reproduction of these tilapias have been evaluated in 3m x 3m x 1.5m cage systems at various salinities. In addition, the temperature tolerance of these species under similar saline conditions is being examined by comparing the growth between summer and winter seasons.

The tilapias are likely to become the prime domesticated species for the tropics.



A parallel 3-year project begins this month in Kuwait in cooperation with the Mariculture and Fisheries Department (MFD) of the Kuwait Institute for Scientific Research (KISR). Dr. Kevin Hopkins, newly promoted ICLARM Associate Scientist, has already been sent on secondment to the MFD for this purpose.

The project is aimed at selecting appropriate tilapia species and/or developing suitable hybrids for intensive mariculture systems in arid regions.

The program of work in 1982 will focus on development of mass fry-production methods and grow-out tests in raceways and cages, using locally produced and imported feeds.

4. INTEGRATED FARMING

A three-year integrated farming research project was conducted at CLSU (see ICLARM Newsletter, October 1980,

- Clarification of the economics of the methods developed.

- Design and packaging of a technology for use in integrated farming appropriate to rural development in the Philippines.

The optimum stocking rate for ponds fertilized with pig manure was determined to be 20,000 fish per hectare with a species mix of 85% *S. niloticus* and 15% common carp. Optimum (wet) manure loading rates of 25 mt/ha/90 days can produce tilapia yields of about 1,700 kg/ha/90 days.

Preliminary analyses of results have been published (ICLARM Technical Reports 2, 1981), and a final report is in preparation. The most important contributions of this project are documentation of production rates and cost-benefit relationships for pig-fish and chicken-fish

5. TILAPIA MARKETING STUDIES

Tilapia are in competition not only with other cultured species, such as milkfish in the Philippines and Taiwan, but to a certain extent also with the wild fish catch, though the export market may offer some potential for expansion.

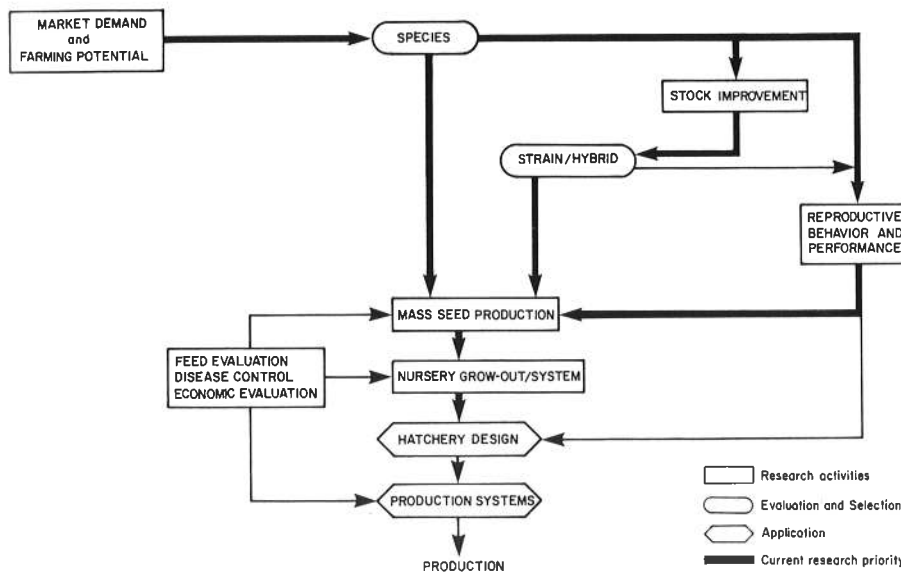
ICLARM has begun a study on the marketing of tilapia in the Philippines and Taiwan. Specific objectives are:

- To describe the structure, conduct, and performance of the market.
- To measure consumer preferences and characteristics.
- To estimate the demand for tilapia (price and income elasticities) and the market relationship (cross-price elasticities) between tilapias and other sources of animal protein.

6. CONFERENCE ON BIOLOGY AND CULTURE OF TILAPIAS

In line with tilapia research, a Conference on the Biology and Culture of Tilapias was convened in September 1980 by ICLARM in cooperation with the Rockefeller Foundation. A group of

With tilapia as top priority commodity in aquaculture, ICLARM has embarked on a program for biological and socioeconomic research on the commercial species. Present research directions are shown in the diagram (left).



p. 12-13) and completed late 1981. *S. niloticus* was the major fish species in this integrated polyculture system. Animal manure, from pigs, chickens or ducks, was the sole source of fertilizer for the fish pond.

The objectives of this project were:

- Design of a fish polyculture system that provides the highest economic return under conditions of manuring only.
- Determination of optimum numbers of pigs, chickens or ducks per unit area of freshwater pond.

systems, establishment of optimum manure loading levels and stocking levels for the tilapia-carp and tilapia-carp-snakehead species combinations, and demonstration of economically viable procedures with outstanding yields. The resulting techniques are now being tested by the International Institute of Rural Reconstruction among Filipino farmers. Ongoing analysis of data relating detailed chemical and biological parameters of the system is expected to increase understanding of means for improving the efficiency of the system.

leading international tilapia specialists gathered to review existing information, discuss current research areas and culture methods, define future research requirements and comment on any other measures which would help the future development of tilapia culture (details in ICLARM Newsletter, October 1980, p. 11). The proceedings, just published,* will be used to improve information dissemination on tilapias, while the reviews will, in addition, serve as the backbone for future research planning.**○

*The Biology and Culture of Tilapias, edited by R.S.V. Pullin and R.H. Lowe-McConnell. ICLARM Conference Proceedings 7, 432 p. Cost \$12 surface, \$25 airmail. Hardbound, add \$4.50.

**A summary report of the conference is available on request from ICLARM free of charge.