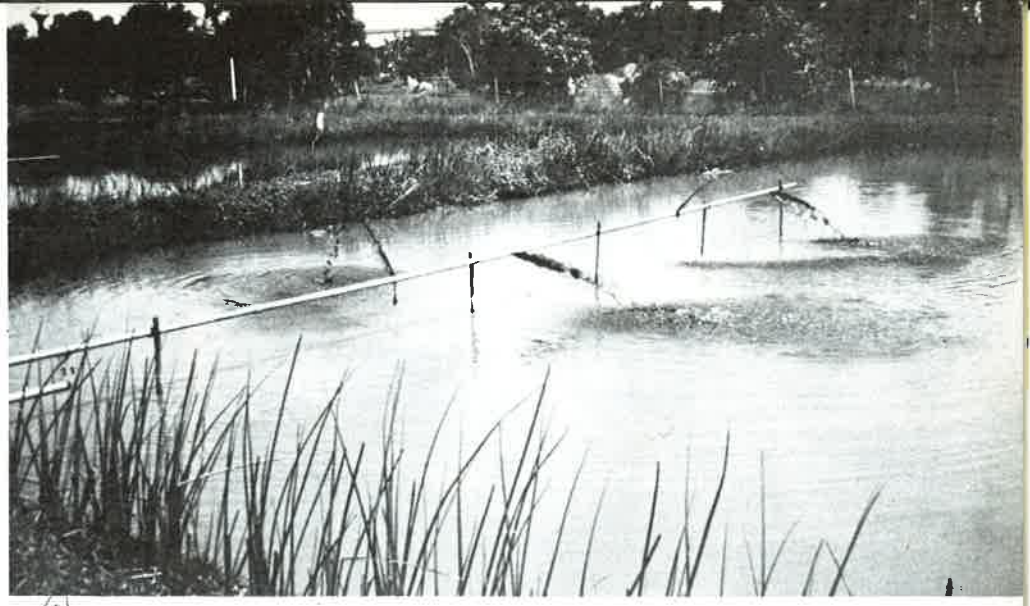


Aquaculture Research and Training Asian Institute of Technology

PETER EDWARDS
Associate Professor of Aquaculture
Division of Agricultural and Food Engineering
Asian Institute of Technology
G.P.O. Box 2754, Bangkok 10501
Thailand

The Asian Institute of Technology (AIT) is an autonomous, international, postgraduate technological institute, situated on 160 hectares of land, 40 km north of Bangkok. AIT offers degree and diploma programs in nine academic Divisions. One of these Divisions, Agricultural and Food Engineering, has a program in aquaculture led by Dr. Peter Edwards, who is seconded to AIT by the Overseas Development Administration, United Kingdom.

Master's Degree Course

The five-term (20 months) Master's program requires a minimum of 30 credit hours of coursework, approximately 10 courses, plus a thesis. The following aquaculture courses are taught at the Institute:

- Aquaculture systems (Dr. Peter Edwards)
- Fish nutrition (Dr. Kok Leong Wee)
- Fish breeding (Dr. Wee)
- Waste recycling in aquaculture (Dr. Edwards)
- Analytical aquaculture techniques (Drs. John Colman and Wee)

A student may register for any other course in the Institute considered appropriate by his adviser. The following courses are often selected by aquaculture students:

- Introduction to tropical agriculture
- Agricultural mechanization and management
- Food chemistry
- Environmental health and sanitation
- Applied statistics

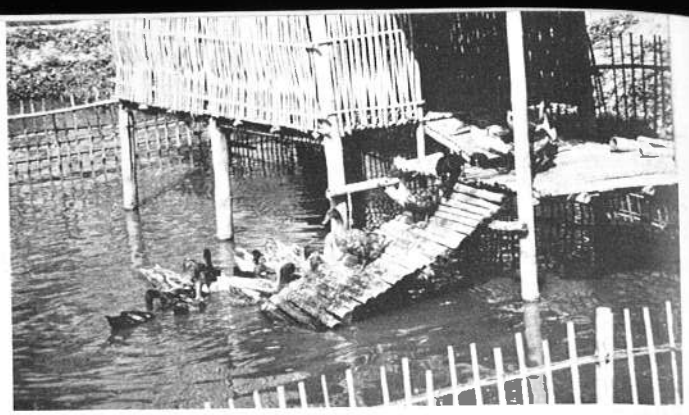
Facilities

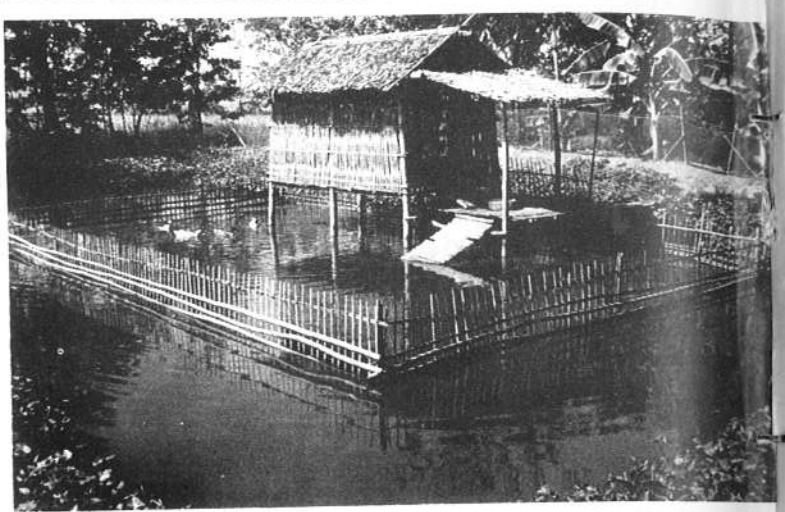
The aquaculture program has excellent laboratory and field facilities for both student theses and contract research:

- A series of eighty 3- to 5-m^3 static water concrete tanks.
- A series of sixteen 4-m^3 concrete tanks with a water treatment/recirculation system.
- Forty-nine 200-m^2 earth fishponds.
- Five 1,600- to 2,000-m^2 earth fishponds.
- A fish hatchery.
- Well equipped laboratories for the analysis of water, biological materials and microorganisms.
- A wet laboratory with aquaria.
- A 5-km long, 8-m wide canal surrounding the campus, suitable for cage culture.

The Institute is located in Pathumthani Province, an excellent location for field studies. The Province has a 1,000-km network of canals with a year-round water supply, and more than 500 commercial fish farms which raise more than a dozen different species of fish including *tilapia*, snakehead, catfish, barbs, Chinese carps, and giant freshwater prawn. A wide variety of techniques are employed with monoculture and polyculture, integration with various types of livestock and crops, and

Above: Experimental ponds receiving metered amounts of sewage wastes. ***Below:*** Harvesting an experimental pond, AIT, Thailand.





Pilot family level fish/duck integrated farming system in Khlong Luang, Pathumthani Province, Thailand. *Clockwise:* drained pond showing detail of the duck fence; ducks on the ramp; overview of the whole 200 m^2 unit.

ne addition of different kinds of supple-nentary feed. The Gulf of Thailand, vhere sea bass, shrimps, oysters and mus-els are reared, is within easy reach of he Institute.

Research Directions

The research program is directed first nd foremost to the solution of practical iquaculture problems relevant to tropical leveloping countries. Special emphasis is placed on low cost, low energy systems in contrast to similar programs in devel-oped countries which stress high value species.

Research at AIT involves the recycling of human excreta into microalgae and duckweed for fish feed; the integration of crops, livestock and fish; the utiliza-tion of water hyacinth as a fishpond input; the assessment of non-conventional feedstuffs for pelleted fish feed; and tilapia hatchery and pond management techniques.

To date, over $700,000 has been received in the form of research grants from the Governments of Canada, the Netherlands, United Kingdom, United States, and West Germany, and from the European Economic Community.

One of the major aquaculture research goals at AIT for the last seven years has been the development of bioengineering design criteria for fish production from human waste.

Scheme to Recycle Septage

Excreta reuse could provide a posi-tive economic incentive for the improve-ment of sanitation in developing coun-tries, as in China, the only country where such organic wastes are fully utilized.

Research was carried out initially on the mass cultivation of phytoplankton in a sewage driven high rate stabilization pond in which the algal rich effluent was fed into fish ponds. Good fish growth and food conversion ratios were obtained with phytoplankton, but it was con-cluded that such a two stage system was not economically viable. The phyto-plankton were produced at a much more efficient rate in the high rate pond than they could be removed by the fish in the fishpond so that large amounts of phytoplankton were lost in the fishpond effluent.

Work is now focused on the reuse of Bangkok septage in a single waste treat-ment-fishpond system. Net extrapolated fish yields of 5 to 6 t/ha/year have been obtained in small-scale 200-m^2 earth ponds but an attempt is now being made to double these yields by intermediate harvesting of fish in septage loaded pilot-scale 2,000-m^2 earth ponds.

The intention is to use the harvested fish as feed for fish of higher market value, since in many societies the direct recycling of waste is traditionally un-acceptable.

The fish being used in these experi-ments, Nile tilapia *(Oreochromis nilo-ticus),* have considerable tolerance to low oxygen levels as experienced in heavily manured fishponds in the early hours of the day. Moreover, Nile tilapia seem to occupy more than one feeding niche since they may be able to derive nutrition not only from phytoplankton but from zooplankton, bacteria and detritus.

The exact food pathway is not known but is an important matter for aqua-culturists using such waste-fed systems. This issue is the subject of a joint AIT-ICLARM project described on p. 16.

Excreta Reuse by Duckweed

Research has also been conducted at AIT to simultaneously treat and recycle septage into the giant duckweed *Spirodela polyrhiza* in a septage fed duckweed pond, followed by its harvest and use as a feed for Nile tilapia in a second pond system. A mean extrapolated yield of almost 10 t dry duckweed/ha/year was obtained in a six-month long

experiment in a series of four 200-m^2 earth ponds. Since the mean crude protein content of the duckweed ranged from 24 to 29%, it is an ideal feed for herbivorous fish. Ten family level human excreta reuse systems involving duckweed are currently being evaluated in Thai villages.

Integrated Farming

Integrated farming is a second priority of aquaculture research at AIT. An early project proved the viability of the fish component of small-scale Thai integrated farms.

The study was conducted to investigate the feasibility of developing family level fishponds for small-scale farmers to increase their supply of dietary animal protein, which would help to alleviate widespread protein-energy malnutrition reported among pre-school children in rural Thailand. Twelve 200-m^2 family level fishponds were constructed and monitored in Pathumthani and Udornthani Provinces in central and northeast Thailand, respectively. Ten of the fishponds were integrated with 30 egg laying ducks each to provide fertilizer for fish feed. Two ponds were fed with composted water hyacinth from a weed infested village fishpond (tank). All ponds were stocked with Nile tilapia.

An illustration from AIT's extension manual on fish culture for small-scale farmers.

Experimental integrated farm on campus, AIT, Thailand.

The range of extrapolated (gross) fish yields from the integrated fish/duck units was 114.5 to 292.1 kg/200 m^2/year equivalent to 5,726 to 14,603 kg/ha/year. It is remarkable that the mean extrapolated gross fish yield of approximately 180 kg from a small pond of only 200 m^2 is sufficient to supply 100% of the annual animal protein need of a family of five persons, assuming that 1/3 of their total protein need is derived from animal sources.

The fish subsystem had high capital investment costs due to the cost of labor for pond construction but if it were assumed that the opportunity cost of farm labor for pond construction was zero, the economics of fish cultivation would be attractive from a consideration of cash costs.

The economics of the duck subsystem was not acceptable since revenue from selling eggs and old ducks was not even sufficient to cover cash costs, mainly duck feed. This was attributed to a large extent to the low egg laying rates of old ducks but also to the relatively low market price for duck eggs in Thailand. The economics of the integrated farming system may well prove to be attractive in other countries.

A report on this project has been published by AIT* as well as an extension manual in Thai and English versions on backyard or small-scale fish farming.**

AIT researchers have now begun a two-year project to evaluate the effects of different densities of ducks in these small-scale farms as well as the use of buffalo manure and the addition of rice bran to such systems.

Water Hyacinth

Research is currently being conducted at AIT on the use of water hyacinth as a fishpond input. In one approach involving the incorporation of water hyacinth into pelleted feed, it was found that composted water hyacinth could replace up to 50% of the ingredients in tilapia pelleted feed without a reduction in the growth of the Nile tilapia. A second approach involves adding water hyacinth in various ways to fishponds: as compost, as freshly chopped material, or as whole plants which decompose *in situ* in the pond in bamboo frames. Preliminary experiments in 200-m^2 earth ponds have produced extrapolated net yields of Nile tilapia in the same range as those of manure-fed ponds.

AIT is encouraging persons interested in the Master's degree course in aquaculture to apply for entry. AIT provides some scholarships to assist well qualified students. Enquiries should be addressed to Dr. Peter Edwards, Associate Professor of Aquaculture, Asian Institute of Technology, G.P.O. Box 2754, Bangkok 10501, Thailand. •

*"A feasibility study of fish/duck integrated farming at the family level in central and northeast Thailand" by P. Edwards et al. 1983. AIT Research Report No. 163.

**"Fish culture for small-scale farmers" by P. Edwards and Kamtorn Kaewpaitoon. 1984. Available from the Environmental Sanitation Information Center, AIT, G.P.O. Box 2754, Bangkok 10501, Thailand.

Prices: $5.00 and $3.00, respectively, including airmail.