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RELATIONSHIP OF THE THAI FISH CULTURE PROGRAM TO PRODUCTION OF FISH IN THE LOWER MEKONG AREA

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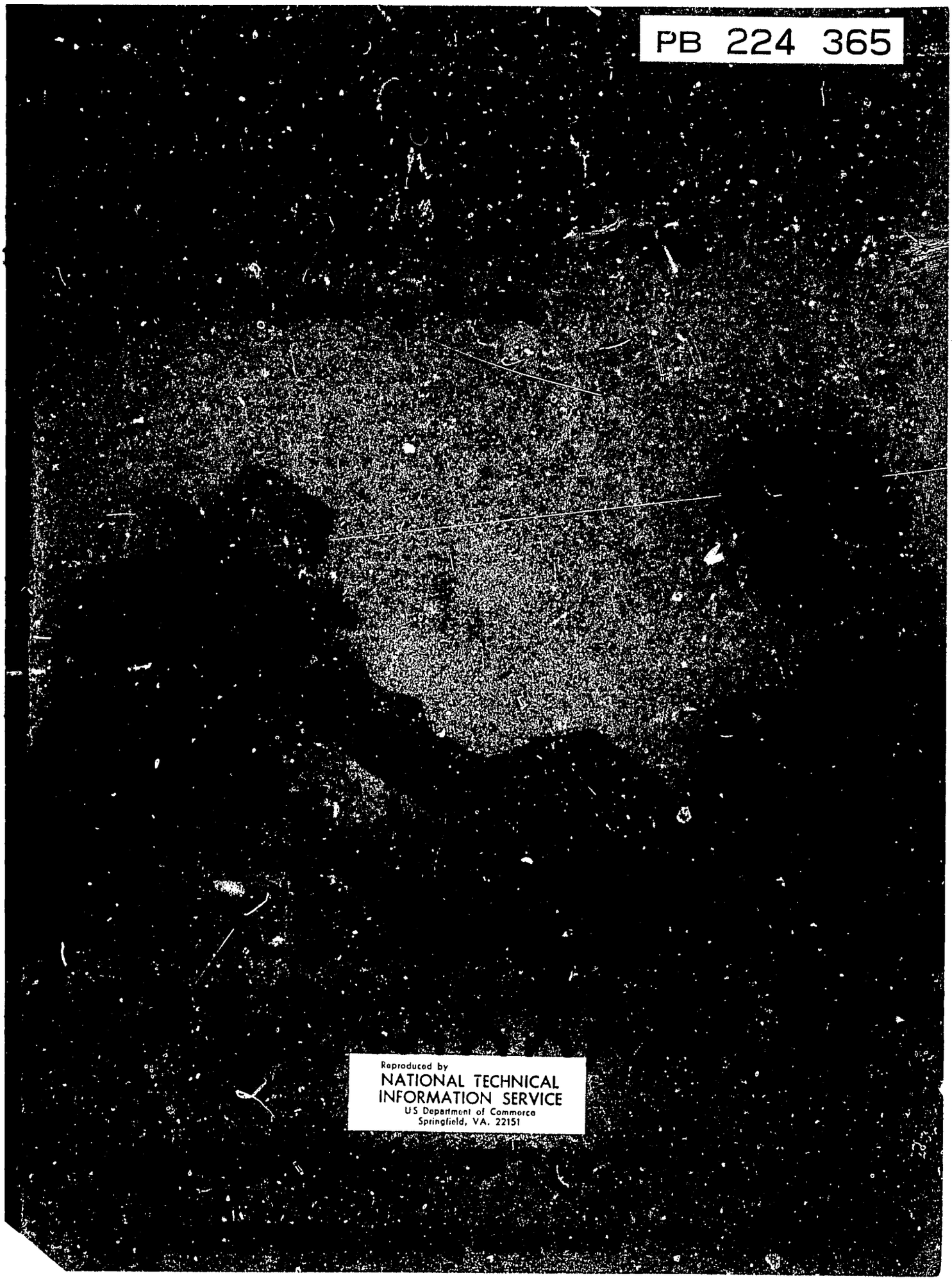

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Research by the Thailand Department of Fisheries Stations and Research Units has developed cultures for use in hatcheries, rice fields, ponds, cages, pens and irrigation ditches that can be utilized in rapid expansion of fish production as irrigation water is made widely available from Mekong impoundments. They have also determined the feeding habits of many indigenous species to facilitate selection of species capable of utilizing the various types of natural fish-food organisms in various habitants.

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1.0 INTRODUCTION

Research of the Thai Department of Fisheries in the Ministry of Agriculture began on inland fisheries in 1927 with establishment of a research station at Bung Bora Pet near Nakhon Sawan. This was augmented by establishment of Bangkhen as the central research station near Bangkok in 1937, of Chiang Rai Station in the North in 1941, and of Sakhon Nakhon in the Northeast in 1942. With increasing population and need for more food, 9 additional stations were constructed in the northeast and north in 1953-1964. At present there are 17 inland and 2 coastal stations producing fingerlings for stocking, and conducting research on the various problems involved in aquacultures and fisheries management. Seven of these stations are located in the Northeast, the area to be served by the impoundment of the Mekong. Also located in this region is the Northeast Agriculture Center at Khon Kaen which conducts some fisheries research. Beginning in 1967, a fisheries program[1] was developed under bilateral agreement with U.S.A.I.D. for intensified research and extension to rapidly increase fish production in the Northeast, where the farm income was least and need for improved nutrition was greatest. The Auburn University International Center for

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1. Projects AID/csd - 1581 and 2270, TO1 and TO7, and USOM/Thailand PIOT 493-180-3-80413. Information given in this report was adapted from reports prepared in cooperation with the Thai Fisheries Department and submitted to the Thai Government and to U.S.A.I.D. for the years 1967-1971.

Aquaculture assisted in planning the coordinated program of research and extension that involved all Thai fisheries stations; the Center also conducted backup research and provided academic training as well as on-the-job seminars on research methods, that were held at Bangkok and at selected Stations in the Northeast and in the North.

2.0 RESEARCH DEVELOPMENT

The research plans were production-oriented to develop techniques for increased fish production as rapidly as possible. Improved methods adapted to this region were developed for production of fingerling fish for stocking, and for fish cultures in rice fields, ponds, cages, pens and irrigation ditches. The stations also are evaluating the relative efficiency in cultures of various species and species combinations, and developing methods for spawning and rearing certain species endangered by impoundment of the Mekong. Additional research is in progress to develop cheap supplemental and complete mixed feeds for fish and shrimp culture. Feeding habits of the more important species of Thai fishes and the natural fish-food organisms that they utilize, are being determined as a basis for selection of efficient combinations of species for use in ponds or reservoirs. Such research-tested information developed under local conditions, is essential to a program for increasing fish production in the lower Mekong region.

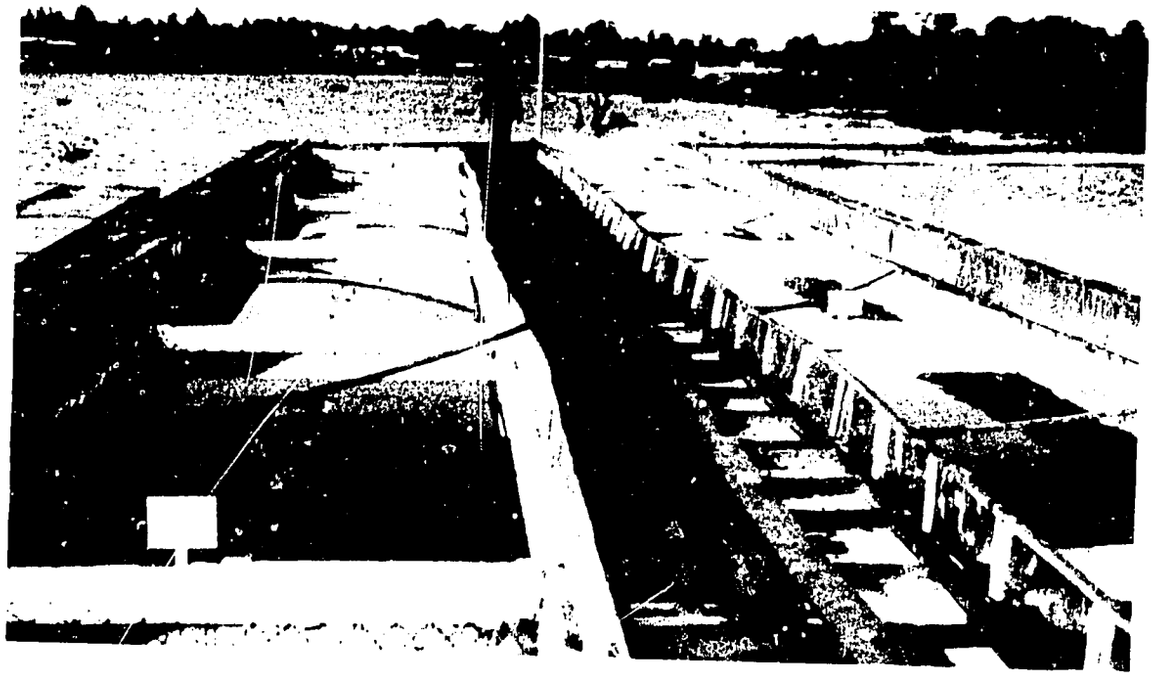
2.1 Improvement of Hatchery Methods

In earlier years, practically all the pond areas at the Fisheries Stations were needed for the production of fingerling fishes for stocking, and very little area was available for research. Consequently, the first job was to develop improved methods of fingerling production so that part of the pond areas could be freed for other purposes.

The Stations developed methods of spawning, fertilization, and feeding that practically quadrupled production of fingerlings per ha. They also developed multiple crop systems so that fish could be produced within a 3-month period, starting at any time in the year. This made unnecessary year-round carryover of seed fishes, as was formerly necessary under a 1-crop-per-year system.

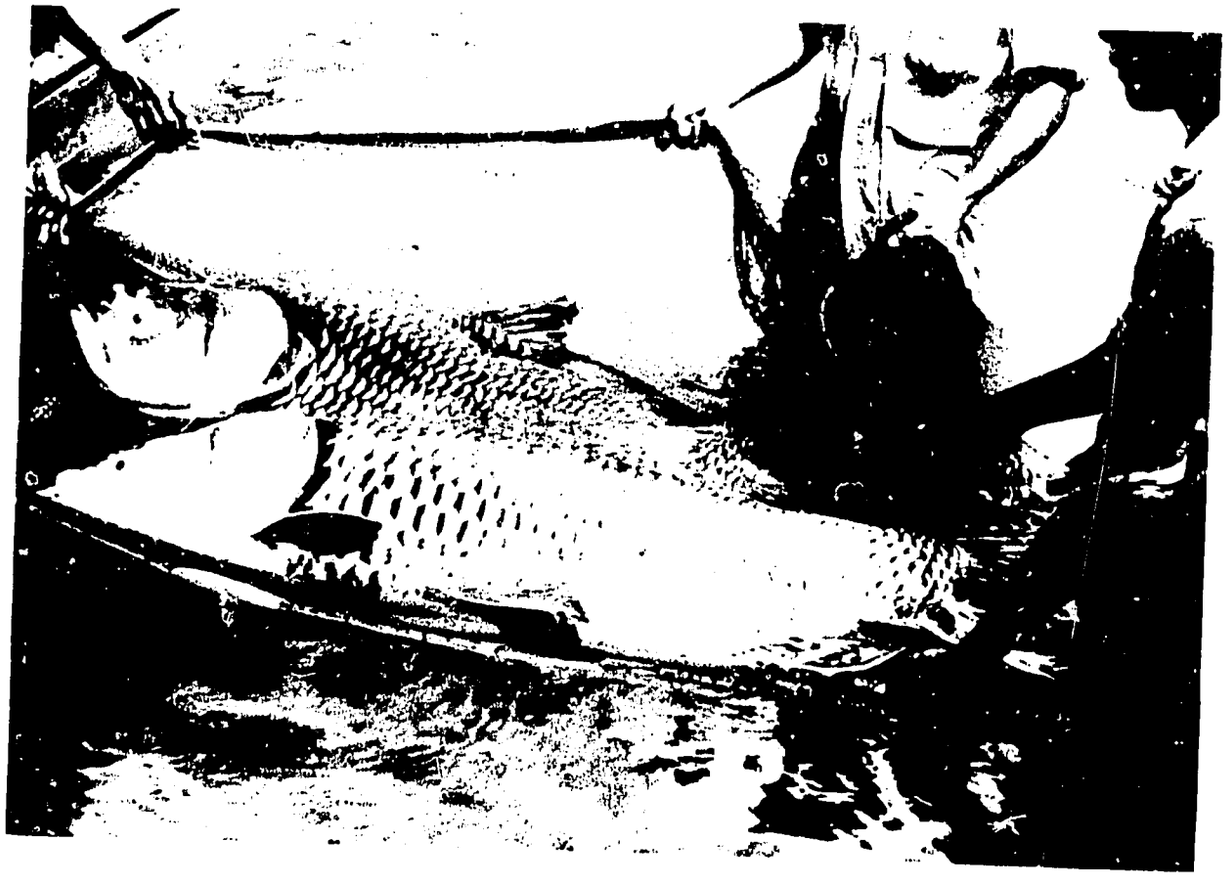
Another significant development was the spawning and production of fingerling fishes in cages floating on a reservoir. This system was developed at the Ubon Ratchathani Station by Vinus Boonyaratplin because his hatchery ponds would not hold water. He developed a system of floating walkways and plastic net cages supported by styrofoam which was effective in producing 1,545,200 fingerling fish in 100 cages with a total area of 400 m^2, a production per m^2 of 3,860 fingerlings as compared to 165 per m^2 under conventional pond methods. This development is of great significance as it makes possible use of the margin of reservoirs to produce fish for stocking, without necessity for pond construction.

The average size of fingerlings produced by hatcheries for distribution is 5 cm total length. However, for stocking into established fish populations in



(Above)--The entire hatchery production at Ubon Ratchathani is conducted in floating baskets on a reservoir. A total of 1,545,200 fingerling fish were produced in 100 cages totaling 400 square meters.

(Below)--Catlocarpio siamensis is the largest of the carps, growing to over 100 kg. Life history, feeding habits, and methods for its spawning are being studied to determine its usefulness in pond cultures and in reservoirs.



reservoirs or for rapid market production, fingerlings of 10 to 20 cm are usually needed. Hatchery space at the Stations is not sufficient for producing large numbers of fish of this size. Research is in progress for their production in rice paddies as a supplemental crop by farmers and also their production by cage or pen culture in reservoirs.

2.2 Rice-Fish Culture

First production research that was given high priority was the development of rice and fish culture for use in the Northeast because rice fields were widely available, whereas longer time was needed to develop other systems of fish culture.

Tests of species indicated best results were obtained by using common carp, stocked at approximately 2,000 per ha* ($0.2/m^2$) shortly after the rice was planted. Production per crop averaged 220 kg/ha without feeding and up to 440 kg/ha with supplemental feeding of rice bran.

These methods of rice-fish culture were demonstrated throughout the Northeast and adopted by some farmers. However, it did not develop into wide-spread use in many parts of Thailand because farmers had to purchase fish for stocking and excessive losses occurred from drying up of rice fields in some seasons, and loss by flooding in others. Also, they reported heavy loss to predators and poachers.

Also, additional labor was involved as the method required construction of higher and wider dikes and of ditches around the margin inside the rice field for fish sanctuary, growth, and harvest. In some areas of Thailand, use of insecticides on the rice also prevented use of rice-fish culture.

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*1 ha = 2.5 acres = 6.25 rai

(Above and below)--Rice field fish culture and pond fish culture were combined on the farm of Mr. Kotsen by connecting the pond with irrigation ditches and rice fields with underground tile. When water is drawn off the rice fields, the fish return to the ditches and to the pond where they are harvested.

One promising development made by Mr. Tum Kotsen, a farmer at Khon Kaen, was the construction of a deep pond beside his residence connected to his rice fields by underground tile, this giving fish access to the rice fields for grazing, and a sanctuary to which they could return as waters on the fields receded. Harvest was accomplished by cast net in the pond at intervals as needed for sale on the local market.

2.3 Pond Cultures

Work at the Fisheries Stations has indicated that efficient fishes for intensive pond culture include the common carp (Cyprinus carpio); the catfishes Clarias batrachus and Pangasius sutchi; the Chinese carps, Aristichthys nobilis, Ctenopharyngodon idella and Hypophthalmichthys molitrix; and the tilapias Tilapia nilotica, and T. rendalli (=melanopleura).

These species gave productions in monocultures of 500 to 2,000 kg/ha when ponds were fertilized with inorganic fertilizer or with chicken manure, and productions of 2,000 to 5,000 kg/ha or more with supplemental feeding.

With feeding of a mixture of ground trash fish and rice bran (9-1), productions of pla duk dan (Clarias batrachus) from 50,000 to 90,000 kg/ha in a 2-crop per year culture were obtained in areas south of Bangkok. This high production was possible because the fish is an air-breather, highly resistant to low oxygen and to high concentrations of CO_2, ammonia and other wastes. However, the waters do finally become so polluted that the fish cease to feed, at which time the pond owner adds fresh water to replace part of the polluted waters. This culture is presently possible only around the Gulf of Thailand where trash fish are available, and its culture elsewhere awaits development of suitable formulated pelleted feeds.

In comparative efficiency tests with fertilization and with feeds, the nile tilapia (T. nilotica), a plankton feeder, was greatly superior to the common carp, an insect feeder. However, in monocultures, tilapia reproduced while the common carp did not, with the result that farmers preferred the common carp because a large proportion of the tilapia produced were too small for sale on local markets. Tests are being conducted for use of tilapia in polycultures that include the piscivorous species, such as pla chon (Ophicephalus striatus) or pla tepo the catfish (Pangasius larnaudii).

Pla salid (Trichogaster pectoralis) was found useful for culture in converted rice fields, where 600 kg/ha can be produced from flooded grasses. This species was inefficient for use in more intensive cultures, using either fertilization or feeding. Other indigenous species are currently under tests to determine their suitability in mono- and polycultures.

2.4 Suspended Cage Culture

This is the culture of fish in cages made of wire, or netting or bamboo, that are suspended in top waters of rivers or impoundments. High production with feeding is possible because water circulates through the cage, removes wastes, and replaces the oxygen-depleted water. Cage culture has been in use for culture of the catfish, pla sawai (Pangasius sutchi), on the rivers of Thailand and Cambodia. Recent research at the Thai Fisheries Stations and at the International Center for Aquaculture at Auburn has extended its use in ponds, streams and reservoirs for other species.

In Thailand, fishes cultured in cages included pla sawai, the common carp, nile tilapia, and pla duk dan (walking catfish). These experiments were made with locally formulated and pelleted feeds, which were not complete fish feeds from the standpoint of amino-acid balance and of vitamins. Productions up to 160 kg/m^2 of cage were obtained with pla sawai, but conversion of feed to fish was inefficient. Further research on this problem was postponed at most of the Stations until a complete feed could be developed from locally available materials by the Bangkhen Station.

Back-up research at the Auburn International Center was conducted with the channel catfish, (Ictalurus punctatus), which normally feeds on insects, and the tilapia, (Tilapia aurea), which is a plankton and detritus feeder. Using a complete floating pelleted feed, productions of channel catfish up to 190 kg/m^2 in 4 months were obtained, with conversions ranging 0.9 to 1.5 kg food per kg fish produced. Tilapia cultured in cages failed to reproduce and yielded with feeding up to 150 kg/m^2 of cage, with conversions of 1.0 to 1.2. Of great interest also were experiments demonstrating that caged tilapia in eutrophic waters were able to subsist on plankton, yielding productions up to 40 kg fish per m^2 of cage without additional feeding. These cultures are usable in impoundments, ponds, rivers, or irrigation ditches.[3]

2.5 Pen Cultures

Pen culture differs from suspended cage culture in that a fence or netting is used with 1 to 2 cm openings to enclose a portion of a reservoir or

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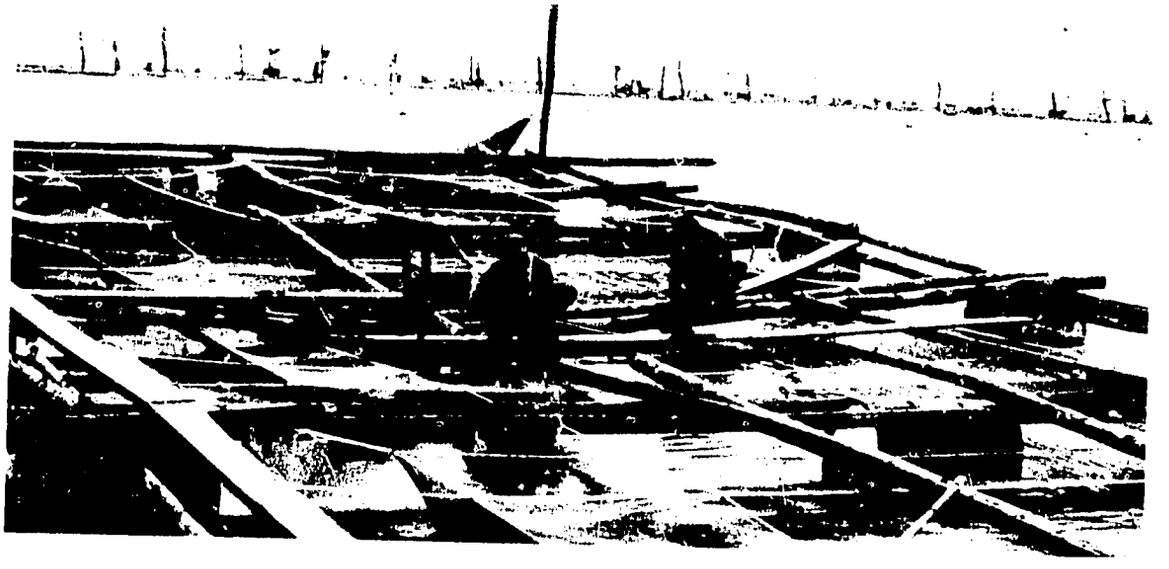
3. From Annual Reports for the Department of Fisheries and Allied Aquacultures of Auburn University Agricultural Experiment Station for 1960, 1969, 1970 and 1971.

(Above)--Pen culture is being studied to develop methods for intensive fish culture within marginal waters of reservoirs. Productions up to 18,000 kg/ha of pen have been obtained with feeding. Bamboo fencing is used to retain the fish.

(Below)--Intensive culture of fish in net cages suspended in the top waters of a 48,000-rai reservoir is being studied at the Sakon Nakhon Fisheries Station.



pond, including the underlying bottom soils. Consequently, benthic fish food organisms are produced within the pen. Water circulation is through the fencing on the sides and one end of the pen. Usually the fencing extends from the margins of the impoundment outward to areas where the waters are not over 2 m in depth. High production by feeding within the pen is possible, because water circulating from the reservoir replaces the water within the pens before low oxygen and high CO_2 becomes a limiting factor in fish production.

Research was begun on this method of fish culture at the Auburn Center Experimental Pond Research Unit in 1964, and intensified in 1970. Using a combination of channel catfish and Tilapia aurea, and feeding with a complete pelleted feed inside the pen, production was up to 12,000 kg/ha, whereas the standing crop in the phosphate-fertilized reservoir outside the pens was approximately 400/kg/ha. Without feeding, channel catfish in pens produced only 12 kg/ha, but the tilapia, because of their plankton-feeding habit, produced up to 1,360 kg/ha.

In Thailand, the first pen experiment was made in 1970-71, using chicken wire fencing. This developed holes and only 30 per cent of the population of Tilapia nilotica was recovered, giving a total production of 1,900 kg/ha in the pen, whereas in the reservoir the standing crop was 62.5 kg/ha. Additional experiments are continuing at both locations to determine best types of fencing, best species, stocking rates, production with fertilization, feeding and other management practices. Tests are in progress using aquatic plants as fertilizer and as fish feed.

These results also are quite significant, indicating a method for intensive culture of fish in reservoirs where intensive management of the entire area is not feasible.

2.6 Ditch Cultures

The Ditch and Dike Unit, and the fisheries Stations of the Thai Fisheries Department have developed methods for culture of fish in irrigation ditches on farms. The ditches leading to rice fields, vegetable or fruit gardens are made approximately 1 m deep and 1 to 3 m wide for culture of fish. Pens can be added for culture of different fishes or fish of different sizes. Fertilization with manures and supplemental feeding are practiced. Depending on the practice employed and the amount of water passing through the ditch, production from 500 to 70,000 kg/ha of ditch (0.05 to 2 kg/m^2) are obtained. The development of the Mekong irrigation system will result in wide usage of this method of culture.

2.7 Research with Endangered Species

Impoundment of the Mekong will flood areas of the river where most intensive spawning of the giant catfish Pangasionodon gigas occurs. Attempts are being made to spawn this species in the hatchery of the Ubon Ratchathani Station and, if successful, subsequent experiments on its culture will be[illegible]

Other species which are numerous in the Mekong, but less abundant in the other areas of Thailand are:

Pangasius sanitwongsai

Probarbus jullieni

Leptobarbus hoeveni

Puntius schwanenfeldii

These are being collected by the Nong Khai Station for attempts at their spawning and culture.

2.8 Fish Feeds

Fish feeds are being developed by the Bangkhen Station from locally available products, and are subsequently delivered in pelleted forms to the various Stations for testing as supplemental or as complete feeds. Supplemental feeds are those fed to fish in environments such as ponds, where the fish can feed also upon natural fish-food organisms. Examples of supplemental feeds are rice bran, broken rice, seed meals, and cassava wastes, used alone or in various combinations. Several suitable mixtures have been developed.

Complete feeds that contain all the food components in the ratios needed by fish must be used where fish do not have access to natural foods. An example is the culture of catfish in cages or raceways. The various formulations prepared by the Bangkhen Station have so far been suitable only as supplemental feeds, but current research indicates that a suitable formulation will soon be developed.

2.9 Feeding Habits of Fishes

In order to obtain highest yield from aquatic areas, a combination of species with different feeding habits must be present to utilize all types of abailable foods. Since little was known of the feeding habits of many indigenous

species, biologists at each station and research unit in Thailand specialized in study of different species. From this work it was possible in 1970 to prepare a list of species that spawned freely in reservoirs and a list of species that had special spawning requirements, together with the food habits of each. This list is tentative and is being subjected to yearly revision as new information is available.[4]

3.0 EXTENSION ACTIVITIES

Early extension activities were handicapped by lack of research-tested methods for fish production.

The Fisheries Extension Service has headquarters in Bangkok, with field men located at the various Thai Stations. Their task is that of publicizing and teaching methods for fish production, demonstrating new methods of culture in local areas where it can be seen by local farmers, distributing fish for stocking, and to accumulating data related to fisheries management and improvement of extension methods.

They have found that farmers prefer to raise fish in ponds rather than in rice fields because higher production can be obtained and there is less danger of loss of fish to drought, flooding or poaching. Construction of ponds is increasing at the rate of 10 per cent or more per year in the Northeast and in north Thailand.

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4. Can be obtained from the Thai Department of Fisheries, Bangkok.

They are teaching farmers in various areas to spawn various fishes and raise fingerlings for sale to local farmers. This has been effective in the Northeast in expanding local production of fish and reducing dependence on distant hatcheries. It also provides supplemental income to farmers.

The experiences of the extension personnel, and the confidence their work has developed among local farmers, should make for rapid progress in increasing fish production as additional water is made available in the Northeast by the Mekong impoundments.

4.0 SUMMARY

Research by the Thailand Department of Fisheries Stations and Research Units has developed cultures for use in hatcheries, rice fields, ponds, cages, pens and irrigation ditches that can be utilized in rapid expansion of fish production as irrigation water is made widely available from Mekong impoundments. They have also determined the feeding habits of many indigenous species to facilitate selection of species capable of utilizing the various types of natural fish-food organisms in various habitats.