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REPORT ON
EXTENSION AND RESEARCH
AT THE
FISHERIES STATIONS
OF
THAILAND

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REPORT ON EXTENSION AND RESEARCH AT
THAILAND FISHERIES STATIONS

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Project AID/csd-1581, Increasing Fish Production Through Improved
Fish Culture.

USOM/Thailand PIOT No. 493-180-180.7 Fisheries Development.

1. INTRODUCTION

This investigation was made 15 April to 15 May, 1969 under the general directives to furnish consultant and advisory services on freshwater fisheries to the Department of Fisheries, Ministry of Agriculture in Thailand; to advise on freshwater fisheries development in the Northeast, in sensitive Changwats in the North, and at Bangkhen Fisheries Research Center at Bangkok.

1.1 Procedures

The fisheries stations at Bangkhen and those in the Northeast, including Ubol, Udorn, Khon Kaen, Maha Sarakham, Sakol Nakorn and Nakorn Rajsima were visited and the program and problems of each were investigated. The stations at Nong Khai and Surin were not visited, but information on their operations and problems was obtained from the heads of these stations. Each of these stations had been visited on a trip by the Auburn team in 1968. The biologists from all stations were met at a seminar conducted by the Department of Fisheries at Bangkhen Station in Bangkok, where lectures followed by discussion

were given May 18 on Fishery Research Methods and May 19 on Fish Population Dynamics.

For each of the stations, information was obtained upon:

1. Areas available for hatchery production, research and extension.
2. Personnel and levels of training.
3. Species and numbers of fingerling fish produced for stocking and the areas of ponds required.
4. The numbers and size of ponds, paddy fields and reservoirs stocked from the station.
5. Pond areas available for research and demonstration.
6. The current research project.
7. Equipment available at the station.
8. Equipment needed.
9. Extension Activities:

Personnel and equipment

Number of demonstrations in ponds, rice fields and reservoirs

Transportation available

1.2 Plan of the Report

The results of the investigations will be presented under the headings "Status of Fishery Extension and Production Program, Advisory Activities, Major Problems Encountered, and Recommendation

2. STATUS OF FISHERIES EXTENSION AND PRODUCTION PROGRAM

2.1 Research at the Fisheries Stations

The research dealing with efficiency of various species of fishes, and that on the effects of rates of stocking, fertilization and feeding upon fish production in rice paddies, ponds and cage cultures is summarized below

2.1.1 Relative Efficiency of Various Species of Fishes

Various stations produced and distributed fingerlings of the following species:

Pla Nai	<u>Cyprinus carpio</u>
Pla Nin	<u>Tilapia nilotica</u>
Pla Morted	<u>Tilapia mossambica</u>
Pla Khang lai	<u>Tilapia melanopleura</u>
Pla Salid	<u>Trichogaster pectoralis</u>
Pla Prom	<u>Osteochilus hasselti</u>
Pla Mortan	<u>Helostoma temmincki</u>
Pla Lin-Hue	<u>Hypophthalmichthys molitrix</u>
Pla Soong-Hue	<u>Aristichys nobilis</u>
Pla Chao-Hue	<u>Ctenopharyngodon idellus</u>
Pla Sawai	<u>Pangasius sutchi</u>
Pla Ret	<u>Osphronemus goramy</u>
Pla Tapien	<u>Puntius gonionotus</u>

Some records of production have been obtained with the Common carp (Pla Nai) in ponds, rice paddies and in floating cage cultures. Isolated production records have also been obtained on Pla Sawai, T. nilotica and T. mossambica, Clarias batrachus, Pla Salid,

and Catlocarpio siamensis. However, no research has been conducted upon the relative efficiencies of the various species under natural condition, or with fertilization or with feeding. The common carp appear to be preferred by farmers in the Northeast, but much higher production can probably be obtained by the use of other species alone or in combination. Tilapia nilotica is a plankton feeder and should give almost twice the production per rai that is obtained by use of the carp which feeds on insects. Information upon the relative efficiencies of the various species is urgently needed for high production. These tests are being planned so that comparable results will be obtained at the various stations.

2.2 Production of Fish in Rice Paddies

2.2.1 The Species Used

In paddy-fish culture, the common carp, Pla Nai, was used in all areas. Pla Salid was used in combination with carp in Ubol Rajthani, and Pla Nin to a limited extent in Khon Kaen.

2.2.2 The Number Stocked Per Rai

Insufficient research has been conducted upon the rates of stocking needed for best production and most economical use of fish. The rates per rai used were as follows:

Common Carp : 300 at Khon Kaen

400 at Sakol Nakorn

500 at Ubol Rajthani

645 at Udorn Thani

Pla Nin : 300 at Khon Kaen

Pla Salid: 400 with 100 carp at Ubol Rajthani

2.2.3 Fertilization

There is no information from research at the stations upon the effects of fertilization upon rates of stocking or upon production of fish in the paddy fields. Some research on this problem is being conducted at the Chainat Station.

2.2.4 Feeding

Some experiments are in progress upon the effects of feeding carp in the rice paddies.

2.2.5 Production of Fish Per Rai.

The production of fish in combined rice paddy-fish culture was;

Ubol Rajthani	29 kg. carp; carp + Pla Salid
Sakol Nakorn	20-30 kg. carp
Udorn Thani	42 kg. carp
Khon Kaen	29-33 kg. carp
	44.5 kg. Pla Nin
Chainat	26-39 kg. oarp
Huey Sithon	18 kg. carp

At the Huey Sithon Fisheries Demonstration and Extension Unit near Kalasin fish culture in rice fields produced added income of 144 baht per rai. This program was so popular that the area devoted to rice-fish culture increased from 44 rai in 1967 to 220 rai in 1968. During the same period the number of fish ponds increased from 44 to 135.

2.3 Production of Fish in Ponds

2.3.1 Species Used in Ponds

The fish most commonly cultured in ponds are:

Common Carp

Pla Salid

Pla Nin

Additional species used are Pla Sawai, Pla Mortan, Pla Duk, Pla Chon, Pla Chao-Hue, Pla Soong-Hue, Pla Tapien, Pla Kapong (Lates calcarifer), Pla Lin-Hue, and Pla Tepo.

There are no experiments on the production that can be obtained using each species alone or in combinations.

2.3.2 Rates of Stocking

The rates of stocking ponds varied from 2,000 to 8,000 fish per rai. There were no experiments upon the best rates of stocking for ponds without fertilization, with fertilization or with feeding for species alone or in combination. Fish farmers stock Pla Duk with feeding at rates from 64,000 to 320,000 per rai.

2.3.3 Fertilization

No experiments have been conducted in the Northeast to evaluate the increase in fish production that could be obtained with either organic or inorganic fertilizers. Fertilizer commonly used are manures from cows, buffaloes, pigs and chickens. Inorganic fertilizers are not presently used.

Khon Kaen Station had used chicken manure as fertilizer at the rate of 320 kg. per rai monthly in the culture of Nilem. Production for a 1-year period varied from 32 to 48 kg. per rai.

No similar experiment have been conducted with other species.

The production that can be obtained by use of inorganic fertilizers, specially phosphates, should be determined on various soil types.

2.3.4 Feeding

At present the principal feed used by many local farmers are termite nests. Their food value was determined at Ubol Station by feeding termites to carp in cages. The nest contained 5% termites by weight. It required 5.2 kg. termites to produce 1 kg. carp. The cost of the termites was calculated at 2.5 baht per kg., thus costing 13 baht to produce 1 kg. fish. The carp sold for 20 baht per kg.

Some commercial fish farmers used rice bran and broken rice to feed fish. Also used were Ipomea, duckweed and other aquatic weeds, soybean cake, peanut cake, fish meal, and fresh or frozen trash fish. The value of these various materials as supplemental fish feeds has not been measured experimentally.

2.3.5 Production of Fish Per Rai

There are very few data in th Northeast on production obtained from pond culture of various species of fish in unfertilized ponds or in fertilized ponds with or without feeding. This information must be obtained by the stations so that intelligent planning for future production may be possible.

The Bangkhen Station at Bangkok has not evaluated the effect of pond fertilization upon production. However, since this varies with local soils, it should be carried out at the outlying stations on their particular soil types.

Bangkhen has worked upon fish feeds and feeding, which is generally applicable over the country: Production of Pla Morted (T. mossambica) up to 4 tons per rai per year was obtained by heavy feeding with rice bran, broken rice and seed meals plus heavy fertilization of the pond with pig manures.

Measured in cooperation with commercial fish farmers south of Bangkok, average production of Pla Duk (Clarias catfish) was 15.478 tons per rai when the fish were stocked at the rate of 180 fish/m² and were fed on a mixture of fresh ground trash fish (90%) plus rice bran (10%). It required 5.3 kg. of the mixture to produce 1 kg. of the catfish.

Other experiments with various mixtures of feeds are being used with carp, tilapia and hybrid tilapia. In 1 rai of pond stocked with a mixture of Chinese carps and receiving the wastes from 5 to 8 hogs, production was 400 kg. Catlocarpio siamensis yielded 173 kg. per rai in a pond receiving fertilization plus feeding.

2.4 Production of Fish in Floating Cages

2.4.1 Species Used in Cage Culture

Experiments on raising fish in cages suspended in the surface waters of reservoirs are being conducted on common carps at Ubol Rajthani, Sakol Nakorn and Nong Khai. Similar experiments with Pla Nin are in progress at Ubol and with Pla Salid at Sakol Nakorn. Culture of Pla Sawai in cages is conducted at Chainat in an irrigation canal with flowing water.

At Ubol Rajthani, the entire hatchery production was obtained by raising fish in floating cages on Huey Muang Reservoir. This method was initiated because none of the hatchery ponds would hold water. The species propagated were common carp, Pla Salid, Tilapia mossambica and T. nilotica.

2.4.2 Rates of Stocking Used in Cage Culture

For holding fingerling fishes for sale, 3,000 fingerlings 3-5 cm. were held in 6 m² cages, or 500 per m².

For production to marketable size, carp were stocked at 80 per m² at Ubol, and at 70 per m² at Sakol Nakorn. These rates are too low for maximum production and experiments were planned to determine optimum stocking rate. From research at Auburn University it appears that the rate of stocking can be increased to between 300 and 500 fish per m².

2.4.3 Feeding in Cages.

Feeding fish in floating cages is a different problem from that in ponds. In the latter case, the feed used does not need to be nutritionally complete as the fish obtain part of their diet from natural fish-food organisms produced in the pond. When fish are grown at high concentration in cages, however, few natural foods are available and the feed used must be nutritionally complete.

At Ubol Rajthani, the feed used was a pelleted commercial chicken feed, but the conversion rate to fish flesh was not yet determined.

At Sakol Nakorn, a feed was used containing

Fish Meal	25%
Rice Bran	25%
Acacia Leaf	25%
Broken Rice	25%

The broken rice was boiled and mixed with the other ingredients to form a gummy mass. When fed to carp at the rate of 5% daily on a dry weight basis, the conversion obtained was 5.05 kg. per kg. of fish. This is too high for commercial production, partly due to quality of the feed and partly because the rate of feeding was too high. More efficient usage of the feed would result at lower rates of feeding.

In cage cultures near the coast, ground fresh trash fish are used to feed Clarias (Pla Duk) and the sea bass (Pla Kapong). The ground fish are usually mixed with 10 to 20% rice bran. Conversion obtained with Pla Duk was approximately 6.5 kg. feed per kg. of fish on a wet-weight basis.

Experiments are being planned at the Bangkok Central Research Station to devise and test various feed mixtures for fish from locally available materials. These will then be furnished to stations in Northeast for local testing.

2.4.4 Production in Cage Cultures

In the commercial production experiments at Ubol Rajthani carp stocked at 70 per m² reached a total weight of 6 kg. in 5 months

with the experiment incomplete. Much more extensive testing is in progress at Sakol Nakorn, but results are not yet available.

In experiments conducted elsewhere, productions in excess of 100 kg. of marketable fish per m² have been produced.

At Ubol Rajthani, where hatchery production was in cages floating on a reservoir, 1,545,200 fingerling fish were produced in 1968 using 90 cages of 3 m² each plus 11 cages of 12 m² each, a total of 402 m² or approximately 1/4 rai. The production was at the rate of 3,843 fingerlings per m². The best production when ponds were used was at the rate of 125 fingerlings per m² when 4 crops of fish were raised per year. Part of the difference in production was caused by feeding the fish in cages, while those in ponds received no feeding.

If a high-quality feed is available, high production in cage cultures is possible because the waste produces from the fish pass through the nylon net into the pond, reservoir, or river. In the river they pass downstream, but in the pond or reservoir they must be dissipated by biological processes. Consequently, the amount of fish that can be produced in cages suspended in a pond or reservoir is limited by their ability to dispose of these wastes. Usually more kilograms of fish can be produced per rai of pond where the fish are free to distribute themselves over the entire pond area than can be produced in cages suspended in the same pond. However, cage cultures are very useful in better utilization of reservoirs, lakes, rivers and coastal waters.

3. HATCHERY PRODUCTION AND FISH DISTRIBUTION

3.1 Species of Fishes Propagated in Hatcheries

The species presently being propagated in the stations are:

<u>Thai name</u>	<u>Common name</u>	<u>Scientific name</u>
Pla Nai	Common carp	<u>Cyprinus carpio</u>
Pla Salid	Sepat Siam	<u>Trichogaster pectoralis</u>
Pla Nin	Nile tilapia	<u>Tilapia nilotica</u>
Pla Morted	Java tilapia	<u>Tilapia mossambica</u>
Pla Mortan	Kissing goramy	<u>Helostoma temmincki</u>
Pla Khang lai	Congo tilapia	<u>Tilapia melanopleura</u>
Pla Lin-Hue	Silver carp	<u>Hypophthalmichthys molitrix</u>
Pla Tapien	Puntius	<u>Puntius gonionotus</u>
Pla Ret	Giant goramy	<u>Osphronemus goramy</u>
Pla Sawai	Pangasius	<u>Pangasius sutchi</u>

In 1969, the propagation of Pla Morted was discontinued, as the farmers and the general public preferred Pla Nin (*nilotica*) which were recently introduced from Japan. Research is currently being carried on at Bung Borapet on the spawning and culture of Pla Sawai. Also, work is starting at Khon Kaen on the spawning of Nile tilapia, Osteochilus hasselti. Catlocarpio siamensis brood fish are being sought for experimental spawning. Also 1 male Pangasianodon gigas weighing 40 kg. is being kept alive at Ubol in hope of finding a suitable female for experimental spawning.

3.2 Numbers of Fingerlings Produced For Stocking in 1968

Following are the numbers of each species produced by all hatcheries combined :

<u>Species</u>		
<u>Thai name</u>	<u>Common name</u>	<u>Number produced</u>
Pla Nai	Common carp	5,529,714
Pla Nin	Nile tilapia	2,721,473
Pla Salid	Sepat Siam	1,633,640
Pla Morted	Java tilapia	982,290
Pla Tapien	Puntius	634,528
Pla Khang lai	Congo tilapia	555,515
Pla Lin-Hue	Silver carp	473,000
Pla Sawai	Pangasius	200,000
Pla Mortan	Kissing goramy	166,300
Pla Ret	Giant goramy	46,000
	Total	<u>12,942,472</u>

The distribution of production by various areas of Thailand were as follows :

<u>area</u>	<u>numbers</u>
Northeast	6,498,523
North	2,628,649
Central	3,499,000
South	316,000
Total	<u>12,942,472</u>

3.3 Numbers of Fish Stocked in Ponds, Paddy Fields and Reservoirs

The following table gives the total numbers of fish, and the total water areas stocked with fish in 1968 in North, Northeast, Central and South Thailand.

A total of 6,520 ponds were stocked with 4,313,458 fingerlings at a rates of 1,636 fish per rai. The average pond had an area of 0.4 rai, or approximately 640 m².

Rice paddies on 831 farms totalling 3,152.8 rai were stocked with 1,037,240 fingerlings. This was at the rate of 330 fingerling fish per rai.

Irrigation reservoirs at 78 locations received a total of 1,533,890 fingerling fish in 492,240 rai; this was at the rate of 3.1 fish per rai.

Village ponds at 39 location and totalling 3,971 rai were stocked with 307,242 fingerlings; this was at the rate of 105 fish per rai.

The fish stocked usually varied in size from 2 cm. to 5 cm. in total length. In some areas smaller fry were stocked.

Other areas for which 307,242 fish were supplied by the station were swamps, water canals on vegetable and fruit farms, and floating baskets.

For stocking natural waters, for extension demonstration ponds and paddy fields, for village ponds, and for governmental use, the fish are supplied without charge. Private individuals pay at

NUMBERS OF PONDS, RICE PADDIES AND RESERVOIRS,
THEIR AREAS AND NUMBERS OF FISH STOCKED IN 1968

Region	Ponds			Rice Paddies			Irrigation Reservoir			Village Ponds			Other Areas
	No.	Rai	Fish	No.	Rai	Fish	No.	Rai	Fish	No.	Rai	Fish	Fish
North	1,134	233.0	422,455	124	223	118,030	12	377,013	602,660	-	-	-	72,400
Northeast	4,235	2,028.5	2,753,855	674	2,728.8	870,660	66	115,227	931,230	39	3,971	416,600	200,900
Central	1,067	364.5	1,297,774	26	195	44,050	-	-	-	-	-	-	73,850
South	84	10.0	19,374	7	6	4,500	-	-	-	-	-	-	60,092
Total	6,520	2,636.0	4,493,458	831	3,152.8	1,037,240	78	492,240	1,533,890	39	3,971	416,600	307,242

* Swamps, irrigation ditches and cage culture.

3.4 Production of Fingerlings per Rai of Hatchery Ponds

The average production per rai of ponds at various stations in the 4 regions is indicated below.

<u>Region</u>	<u>Station</u>	<u>Average Fingerling per Rai</u>
North	Chiengmai	49,900
	Chiengrai	44,140
	Tak	59,000
Northeast	Khon Kaen	50,000
	Maha Sarakham	87,130
	Nakorn Rajsim	112,800
	Nong Khai	- *
	Sakol Nakorn	74,525
	Surin	30,000
	Ubol Rajthani	6,180,000**
	Udorn Thani	101,030
Central	Bangkhen	251,217
	Chainat	45,555
South	Patalung	146,400**

* Nong Khai was under construction in this period.

** Produced in 101 floating net cages (0.25 rai) - 1,545,200; fingerlings cages were suspended in the surface water of 2,144 rai reservoir.

The stations producing fingerlings at the lower rates used various rates of fertilization. Those with highest production used fertilization plus feeding to produce fingerlings. The highest production (Ubol) was with fish in net cages that were fed a pelleted chicken feed. The wastes from the fish and feed passed through the netting into the reservoir water.

In ponds where wastes from fish and feed must be disposed of by biological and physical processes, feeding must be at lower rates than in suspended cages and production per unit of water is less. However, feeding can be used in hatchery ponds to greatly increase production of fingerlings.

At Bangkhen, fertilization and feeding were used to obtain the production of 251,217 fingerlings per rai. The ponds were fertilized with 13-13-13 using 60 kg. per rai distributed in 3 applications and the young were fed with rice bran. This procedure produced 400,000 fingerlings per rai to a size of 3-5 cm. in 3 months.

At Nakorn Rajsima, 100,000 fingerling carp per rai were produced to a size of 3 to 5 cm. in 1 month by stocking into ponds fertilized with 120 kg. of 13-13-13 per rai, followed by fertilization with chicken manure at the rate of 400 kg. per rai. Subsequently the fish were fed daily with rice bran. The biologist had succeeded in spawning the carp monthly from February to May, thus making possible multiple crops of fingerlings in 1 pond. At most stations 3 to 4 crops per year were raised if necessary to supply the demand.

3.5 Possibilities for Expanded Production of Fingerlings
for Stocking

At present some stations produce in excess of their needs, while others produce only sufficiently to supply local demand. Below the stations are listed by regions giving the number of fingerlings produced and the number distributed.

<u>Region</u>	<u>Station</u>	<u>Produced</u>	<u>Distributed</u>	<u>Fish Unused</u>
North	Chiengmai	997,524	660,000	330,000
	Chiengrai	1,321,125	370,545	950,000
	Tak	310,000	185,000	125,000
Northeast	Khon Kaen	1,320,968	659,325	671,000
	Maha Sarakham	409,500	333,695	76,000
	Nakorn Rajsima	341,800	206,500	135,000
	Nong Khai	-	243,000	-
	Sakol Nakorn	1,341,443	1,478,705	-
	Surin	600,000	600,100	-
	Ubol Rajthani	1,545,200	1,134,190	411,000
Udorn Thani	939,600	341,580	598,000	
Central	Bangkhen	2,889,000	1,330,024	1,559,000
	Chainat	416,000	30,700	379,000
South	Patalung	316,300	83,966	232,000

A certain amount of fingerling fish are necessarily lost each year because after the fingerlings are produced, they are held

in ponds until sold to farmers or distributed to public waters. If the fingerlings are disposed of within a short period of time, the loss is small. If held for several months in ponds losses up to 50% may occur.

Since farmers are raising fish in more ponds and paddies each year, the demand for fingerlings for stocking increases. Production will need to be increased at Sakol Nakorn and at Surin. This will not require additional pond space, but more effective usage of ponds already available. At Sakol Nakorn, a large hatchery development in cages on Nong Harn Reservoir could be used to free many of the ponds for badly needed research on methods of stocking, feeding and management.

4. THE EXTENSION PROGRAMS IN THE NORTHEAST

4.1 Programs and Activities

A vigorous extension program is principally being developed in the Northeast, where 54 extension specialists work out from the 8 stations. Of the various stations the best extension programs appeared to be those at Sakol Nakorn and at Ubol Rajthani.

At Sakol Nakorn, 15 extension personnel held 64 meetings with 2,700 attending at the station to teach selection of brood fish, spawning, and rearing of fish in ponds and rice paddies. An inadequate meeting room is available that can seat 40 or more at a time. Also 302 meetings were held in the province, showing movies of fish culture and featuring a musical trio, one of which plays the kaeayn and the other two, a man and a girl, sing and recite the values of raising fish and methods to be used in developing ponds and paddy fish culture in the old traditional Thai manner of musical recitation. We heard it and thought it quite effective in holding the interest of the audiences. Also, demonstrations were set up on paddy fields in 16 locations, and 144 farmers were visited and advised on fish management on additional 576 rai of paddies. Several commercial fish farms are in operation and others under construction.

At Ubol Rajthani, 11 extension personnel worked out in the sensitive areas along the border, holding 220 group meetings and setting up 24 demonstrations, as well as advising farmer who is

presently engaged in raising fish in ponds and rice paddies. Commercial fish farming on a larger scale is beginning to develop in the area. Twelve group short courses on fish propagation and culture with a total of 600 attending were held at the station, although there are no facilities available for this purpose.

Other stations with active extension personnel are Udorn Thani (11), Nong Khai (7), Khon Kaen (4) and Maha Sarakham (3). These groups have held a total of 20 meetings at the stations and 301 meetings with groups in the provinces. Udorn Thani had 26 demonstrations in rice paddy-fish culture.

4.2 Village Ponds

4.2.1 Methods of Construction

A program is underway at the Northeast stations to locate able areas and to assist through technical services and supplies onstruction of ponds at villages where they are urgently needed. village usually supplies labor for building the dam. This ram is supported through Accelerated Rural Development (ARD). neers from the Engineering Division of the Fisheries Department located at the various stations to assist in the program. Their onsibility is to select the site, plan the dam, do the necessary eying and supervise the construction.

The station at Ubol Rajthani reported that there were 14 unity ponds in the province. They had helped in the construction). Locations for 458 village ponds had been investigated and ruction planned for villages where they were urgently needed.

However, under the present level of available funds and personnel, they can only help in the construction of 3 per year. The Head of the Station considered the program of great importance and urged that tractor equipment be made available so that a much greater number of ponds could be constructed each year.

At Sakol Nakorn, the station has also helped in the construction of 2 to 3 village ponds per year, and many more were needed. Tentative sites for several hundred have been located. In Udorn Thani the Station had helped in construction of 1 village pond last year and was planning to assist in the construction of 3 this year.

At all stations, the difficulty in construction by the use of labor furnished by the village was pointed out. It required 20 men 4 months to build a dam by hand at Ubol. The dam was 200 m. long, 2 m. high and the top was 2 m. wide, containing approximately 2,000 m.³ of fill. While labor construction by the village appears a good idea, it was pointed out that the father, mother and all larger children spent each day finding and gathering food for that day and it was difficult for them to furnish the labor required for construction of a community pond. One dam was half built by 40 laborers in a month, while the other half was built by a tractor rented by the station in 2 days.

4.2.2 Methods of Operation

As soon as a village pond begins to fill with water it is stocked with fish by the extension personnel and subsequently the

village is advised on its management. Some of them have developed into a productive fishery in addition to their other usages. In some villages no restrictions or fees are required for fishing. In others, fishermen are charged a small fee, the returns from which are used for upkeep of the reservoir and the balance for village improvement.

4.2.3 Evaluation of the Program

The program of assistance for the construction of village or community ponds appears to be an excellent one. It is probably the fastest way of helping large numbers of people in the rural areas of the Northeast where water shortage is a common fact of daily life during the long dry season. In addition to its other multiple uses, the community pond can be managed from high fish production and thus can serve as a demonstration of fishculture in the local areas. The expansion of this program and the use of tractor equipment for its more rapid implementation should receive high priority. The extension personnel and engineers at the stations have demonstrated that they are quite capable of carrying out an effective program of village pond construction.

5. RESEARCH PROGRAM

5.1 Projects Active or Recently Completed

The research carried out at the various stations are presented in the following table, according to the categories :

(1) Culture of fishes in baskets or cages, (2) Culture of fishes in ponds, (3) Culture of fishes in rice fields, (4) Culture of molluscs, (5) Culture of shrimps, (6) Diseases of fishes, (7) Feeds and feeding, (8) Life History, (9) Pollution (10) Spawning fishes, (11) Surveys of impoundments or streams (12) Taxonomy, and (13) Miscellaneous. The Auburn team discussed the results of each of these projects in detail and made suggestions for the extension or improvement of each. Additionally 9 new projects of pertinence to fisheries of the Northeast were designed.

FISHERIES RESEARCH PROJECTS

Culture of Fishes in Baskets or Cages

Station or Unit		Year Active		
		1967	1968	1969
Thainat	Cage Culture of Pla Sawai, <u>Pangasius sutchi</u>		*	*
Maha Sarakham	Growth rate of Common carp in floating baskets		*	*
Nong Khai	Common carp culture in nylon baskets			*
Sakol Nakorn	Experiment on culturing Common carp in baskets			

Culture of Fishes in Ponds

Station or Unit		Year Active		
		1967	1968	1969
Bangkhien	Growth rate of Pla Sawai, <u>Pangasius sutchi</u>		*	*
"	Culture of <u>Moina macrocopa</u>		*	
"	Effect of pH on fingerling pond fishes			*
"	Production of <u>Tilapia nilotica</u> fry with various ratios of ♂:♀ brood			*
Khon Kaen	Growth rate of Nilem, <u>Osteochilus hasselti</u>		*	
Maha Sarakham	Growth rate of Pla Salid, <u>Trichogaster pectoralis</u>		*	

Culture of Fishes in Rice Paddies

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Chiengmai	Experiment on rice-field fish culture in the North (tilapia and carp)	*	*	
Ditch & Dike	Common carp culture in rice fields by using animal manure		*	
N. E. Center	Experiment on rice-field fish culture (Common carp)	*	*	*
Udorn	Evaluation of rice-field fish culture in Udorn Thani and Nong Khai Provinces (Common carp)	*	*	*

Culture of Molluscs, Crabs

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Chantaburi	Study on oyster culture		*	*
"	Experiment on culture of <u>Scylla serrata</u> ¹		*	*
Prachuap	Study on oyster culture		*	*

¹ Blue Crab.

Culture of Shrimps in Ponds

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Chhainat	Growth rate of the giant prawn, <u>Macrobrachium rosenbergi</u>	*	*	*
"	Production of <u>Macrobrachium rosenbergi</u> in combination with <u>Trichogaster pectoralis</u> and <u>Puntius gonionotus</u>			
Chantaburi	Production of shrimps (<u>Penaeus</u> sp.) in brackish water ponds		*	*

Diseases of Fishes

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Bangkhen	Diseases of fish	*	*	
"	Parasites and diseases of pond fishes			*

Foods and Feeding

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Bangkhen	Feeding, consumption, and digestive rates of fingerling <u>Pangasius sutchi</u> and <u>Clarias batrachus</u>	*	*	
Bangkhen	Feeding <u>Clarias batrachus</u> with trash fish, and with Auburn No. 2 pelleted feed			*
Bangkhen	Development of supplementary feeds for Common carp fingerlings			*
Ubol	Termites as food for Common carp		*	*
Surin	Comparison of growth of Common carp given 3 different feeds		*	

Life Histories

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Bangkhen	Morphological development of Pla Salid		*	
"	Preliminary study on biology of <u>Anabas</u> <u>testudineus</u>			*
Biological Survey Unit	Life history of <u>Probarbus jullieni</u>			
Chiengmai	Life history of Pla Tapien Khao (<u>Puntius</u>)		*	
Chiengrai	Life history of <u>Pristolepis fasciatus</u> in Kwan Payao Reservoir		*	
"	Life history of Pla Grai, <u>Notopterus chitala</u>			*
Khon Kaen	Food habits of nilem, <u>Osteochilus hasselti</u>	*		
"	Food habits of <u>Morulus chrysophekadion</u> in Ubol Ratana Reservoir			*
Maha Sarakham	Fecundity and young production of <u>Tilapia</u> <u>nilotica</u>			*
"	Life history of <u>Hampala dispar</u>			
Tak	Biology of <u>Puntius</u> sp.			*

Pollution

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Ditch & Dike	Toxicities of insecticides to fish in rice fields	*		
Ubol	Effect of pollution from Kenaf retting to fish in irrigation tanks		*	*

Spawning of Fishes

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Bangkhen	Selective breeding of <u>Cyprinus carpio</u>	*	*	*
"	Artificial breeding of Chinese carp (Silver, Grass, Bighead)	*	*	*
"	Ovarian development of Silver carp			*
"	Induced spawning of <u>Cirrhinus microlepis</u>			*
Chiengrai	Induced spawning of Chinese (Silver, Grass, Bighead) carp		*	*
Nakorn Sawan	Induced spawning of Pla Sawai, <u>Pangasius sutchi</u> , by pituitary injections		✓	✓

Surveys of Impoundments and Streams

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Biological Survey Unit	Fisheries surveys in Ubol Ratana, Nam Pung Irrigation Tank and water areas in South of Khong River project	*	*	*
"	Fisheries surveys of Khong River project	*	*	
"	Fisheries surveys in Ayuthya Province	*		
"	Fisheries survey of Nan River		*	
Chiengmai	Study on populations of fishes in the reservoir		*	
Chiengrai	Fisheries surveys in Kwan Payao Reservoir	*		
Maha Sarakham	Evaluation of fish stocking in Kaeng Lerng Charn Irrigation Tank		*	
"	Survey of production of fish in Huey Sithon Irrigation Tank	*		
Nong Khai	Survey of fishes in Nong Khai Province			*
Northeast Ag. Center	Fisheries surveys in Huey Syo, Huey Yang, Huey Yai and Huey Sai Irrigation Tank		*	*
"	Fisheries surveys in Sok-Ruak Irrigation Tank	*		
Sakol Nakorn	Fisheries survey of Nam Pung Irrigation tank	*	*	*
"	Fisheries survey of Nong Harn Reservoir	*	*	*
Tak	Fisheries survey of Phumipol Reservoir			
Ubol	Survey of fishes and fishing gear in Moon River			*

Taxonomy

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Inland Fishery	Taxonomy of freshwater fishes of Thailand	*	*	*
Station Section				
"	Characteristics of the Genus <u>Clarias</u> Scopoli		*	*
Ubol	Taxonomy of fishes in Lam Nam Moon		*	*

Miscellaneous

Station or Unit	Project Title	Year Active		
		1967	1968	1969
Bangkhien	Transportation of fish in polyethylene bags			*
Nakorn Rajsim	Role of Sodium Cyanide in fish culture		*	*
Prachuap	Efficiency of various gears for collecting milkfish fry			

5.2 Projects for the future

Pertinent areas are being studied, and several should be expanded as pond space at the stations permit. These include feeds and feeding, culture methods of most species to maximize both fingerling production at the hatchery and yield from the ponds, impoundment management, and life histories of important native species which may be of promise for intensive fish culture. The Auburn team will work closely with the Thai Fisheries Department to re-evaluate the research aimed at increasing fish production.

6. ADVISORY ACTIVITIES

In addition to consultations on research projects, the Auburn team advised the Thai Fisheries biologists on construction of ponds at Bangkhen Fisheries Station. Instructions for locating pond and reservoir sites in the Northeast, including soil boring techniques were given to station chiefs. Methods of extension and demonstration for more effective dissemination of fish cultural information were discussed with extension-demonstration personnel. It was re-emphasized that, in order for an extension man to make meaningful demonstrations, he should have personally raised at least one crop of fish. The stations were urged to allocate at least one pond so that each extension man might gain this experience.

A conference was held with personnel at the Northeast Research Center at Khon Kaen for the purpose of integrating the research projects with those of the Fisheries Stations.

7. MAJOR PROBLEMS ENCOUNTERED

The difficulties encountered that affect the fisheries programs will be discussed under physical facilities at the stations, hatchery production and distribution, stocking and management, and extension.

7.1 Physical Facilities at the Stations

7.1.1 Ponds.

At the Ubol Station none of the excavated ponds will hold water, as the station was built on sands. Consequently no tests or demonstration on methods of pondculture are possible there. Attempts were made to seal two ponds with asphalt, but this was not successful. Possible the ponds could be sealed by soil cement, but this would be costly. Various methods of sealing leaking ponds and of reducing loss by seepage should be tried experimentally in this area. At present adequate numbers of fingerling fish for stocking are being produced in floating cages on Hucy Muang Reservoir, which belongs to the Irrigation Department. The area of the reservoir is only 144 rai and is too small for future production if considerable amounts of water are used for irrigation. It would probably be advisable to move the station to a new location nearby where the soils are suitable for construction of a reservoir and hatchery ponds.

At Bangkhen, the station will lose 15 ponds and 16 rai of area to Kasetsart University in return for 40 rai. of land nearby on which 30 rai will be available for ponds. Since their old earthen ponds were reconstructed into 98 ponds with concrete sides for experiments on feeds and feeding of fish, it is necessary to construct an additional 100 to 150 ponds for research if this is to be an effective center for fishcultural research. On the new area of 30¹ rai, it will probably not be possible to construct over 60 to 70 ponds, and a considerable number of these will be required for hatchery use in providing fingerlings for stocking. Also there is doubt that the water supplies from the irrigation canal in the edge of Bangkok can long remain unpolluted or can supply sufficient water. Because of these factors it would be better to relocate the hatchery work and experimental testing of fishculture in ponds at a location farther away from Bangkok. A suitable area investigated was 35 km. from Bangkhen on heavy clay soils and beside a large irrigation canal at Pratum Thani. Also the costs of land is much less than at Bangkok. This area could be developed into an outstanding research center for fishcultures.

Part of the ponds at Sakol Nakorn rise and fall with the water level in Nong Harn Lake, drying up in the dry period and flooding behind the perimeter dike in the wet season. These ponds could probably be sealed off from the lake by a clay or concrete-field ditch around the inside of the dike. Additional ponds can be built around the edge of the lake. This is the best location in the Northeast for expanded research, testing of management methods and

¹ Since this was written, the price requested for the land increased so that its purchase was not feasible.

for training extension personnel in fishcultural procedures. Either the hatchery operations should be transferred into floating baskets on the lake to free the 40 ponds for experimental testing or 30 additional ponds should be constructed at that station. This is one of the few station in the Northeast with adequate water and space for future expansion.

Additional ponds could be built for research at Khon Kaen. The salt content of the underlying soils on one part of the station was sufficiently high to give the pond waters a salinity of 9.4 parts per thousand (9,400 parts per million). This was too salty to grow carp, or Pla Salid, but Pla Nin (T. nilotica) grow successfully there, although they could not spawn at this salinity. Consequently such ponds are not representative generally of water in the Northeast.

In the North, Chiangrai has the best water supply and room for additional expansion. At present expansion is not necessary there, but may be necessary in future years.

7.1.2 Water Supply Systems

At Bangkok, the water supplies are inadequate for ponds, and for operation of fish feeding troughs. A pipeline should be constructed with transite pipe (10-inch) from the irrigation canal to the station, approximately 300 m. in length. One or 2 additional wells with electric pumps will be needed to supply water for feeding troughs which will require 150,000 liters of water per day for 100 troughs. The maximum loss of water from the 7 rai of ponds at Bangkok due to seepage plus evaporation was calculated to be

224 m³ per day. The well presently in use delivers 50 m³ per hour. Consequently all water for ponds immediately at the station could be supplied from wells if and when the irrigation canal becomes too polluted.

At the Sakol Nakorn Station, no provision had been made to pump water from the lake bordering the ponds to keep water levels in the ponds during dry weather. A system of water supply should be devised for the station. A suitable procedure would be to pump water over the perimeter dike into canal to the ponds or the water might be carried by pipes to each pond. A system of draining ponds into a central drainage canal by gravity, with water being lifted by pump over the dike to the lake should be developed.

At Udorn Thani Station, the reservoir was empty, but the ponds were still holding water well. However, water can well become a limiting factor in operation of this station because the city pumps from the reservoir and requires increasingly larger amounts year after year.

7.2 Hatchery Production and Fish Distribution.

The stations are in general supplying the full demand for fingerlings for stocking, and can produce at least 2 to 3 times the present amount if trained in better methods of production.

Lack of adequate transportation facilities for distribution of fish for stocking limits the development of fishculture to areas close to the stations. In most cases, the fish are kept in ponds at the station until the farmer comes for them. Since the farmer

also must pay for the fish and cannot transport them for long distances without all or most of the fish dying, a system of distribution to local areas will be necessary for a rapid increase in the areas devoted to fish culture. The stations are trying to make fish more available by teaching farmers how to spawn the fish themselves, and a limited amount of commercial fingerling production by individuals is developing.

7.3 Stocking and Management

Attention in research has been concentrated on paddy - fish culture because this could result in the most rapid improvement in the diet of people in the Northeast. Paddies needed only slight modification to raise the combined crop of rice plus fish, and experiments seem to indicate that the presence of fish may increase rice production. However, as higher yielding strains of rice are raised with high fertilization, the use of insecticides will be necessary to safeguard the investment. This may be expected to greatly reduce or eliminate raising rice and fish together, and fish will have to be cultured in ponds with uncontaminated water. Insufficient and fragmentary research on the stocking, fertilization, feeding and management procedures has been carried out. This lack of information has handicapped extension personnel in developing the culture of fish in ponds, as there are no accepted and tested methods to demonstrate or teach.

7.4 Extension Activities

These are generally handicapped by the following:

- a. Inadequate transportation to serve more remote areas.
- b. Inadequate equipment in the form of visual aids (projectors, movies, slides, etc.).
- c. Lack of training of extension personnel on better methods of fishculture.
- d. Insufficient demonstrations of good fish culture management in local areas.
- e. Lack of adequate research at the stations to develop highly efficient methods of fish culture for the areas they serve.

The village pond program is principally handicapped by lack of tractor equipment to build the dams and low allotments in the station budgets for the required assistances in construction of concrete spillways.

8. RECOMMENDATIONS

8.1 Improvement of Facilities at the Fisheries Stations

8.1.1 Sealing of Leaking Ponds

At Ubol Rajthani and Sakol Nakorn the soils should be examined and methods for reduction of seepage in ponds should be tested experimentally to determine the most effective and cheapest methods for reducing seepage.

8.1.2 Water Supply Systems

At Bangkhen, a water pipe should be installed from the irrigation canal to the station, and one additional well drilled to provide water for research on fish feeds and feeding.

At Sakol Nakorn the electric pumps and water canal should be installed to make water from the lake beside the station available for maintenance of water levels in ponds.

8.1.3 Ubol Rajthani Station

This station should be moved to a nearby location where soils will hold water and an adequate reservoir can be constructed. It is presently located on deep sands and none of its ponds will hold water.

8.1.4 Central Bangkhen Station

A new area should be selected for the construction of adequate numbers of experimental ponds so that effective research can be done. A minimum of 100 additional earthen ponds are needed with adequate supply of unpolluted water.

3.1.5 Equipment at the Stations

Many of the stations have inadequate equipment. A list of equipment available and of equipment needed at each station has been prepared and will be supplied to the Fisheries Department. Equipment essential to current activities of the stations should be provided as soon as possible.

For extension work and distribution of fingerlings, at least two additional jeeps and 1 truck should be provided at each station so that farmers in the more remote areas may benefit from their services.

3.2 Village Pond Construction

Tractor equipment and additional funds should be made available to greatly increase the rate of construction of village ponds as this is considered to be one of the most effective ways of rapidly improving living conditions in local areas of the Northeast.

3.3 Research

The Central Bangkok Station should be developed to serve the rest of the Country in research and should specialize in fish feeds and feeding, development of new aquacultures, and on control of fish parasites and diseases.

A secondary research center for local problems in the Northeast should be developed at Sakol Nakorn as this is the only station having the necessary water and space. For the salt-containing soils Khon Kaen is a suitable station for development of management of saline waters.

In the North, Chiangrai should be enlarged to test and adapt cultural methods to that region.

Research should be intensified upon the various phases of pond fishculture management to provide the basis for a sound extension program. Research is needed to determine the species of fish best adapted to local conditions, the effects of phosphate fertilizers on production and the effectiveness of various organic materials as fertilizers or as supplementary feeds. Efficient pelleted feeds for fish must be developed using locally available materials, so that intensive commercial fish farms can develop in each region.

3.4 Extension Activities

Pond space should be provided at the stations so that extension personnel can learn intimately methods of fishculture by raising for market at least one crop of fish under intensive culture before they are sent out to tell others how to raise fish.

Demonstrations of improved methods of intensive fishculture should be placed in local areas so that farmers can see the results of good management. The only effective demonstration is one that produces 3 to 10 times as many fish as the farmer himself can produce.

More jeeps and trucks should be made available at the stations to enable extension personnel to expand service throughout the Northeast and the North.

It is recommended Thai Fisheries extension personnel have their headquarters at the stations, so that they will keep informed on fishcultural developments.

8.5 Training Abroad

Three fellowships per year should be made available to personnel in the Fisheries Department for 2 - year periods of advanced graduate training in the United States. Preference should be given to personnel conducting research. Part of their training should include the planning, execution and preparation for publication of a research project.

8.6 Within - Country Training.

Training courses for Fisheries Department personnel at the stations is necessary each year to upgrade their abilities in research, extension and hatchery operation. The Auburn Team will conduct short courses to give the personnel a better understanding of pond water chemistry, advanced hatchery management and fish-cultural techniques on the next visit, scheduled to begin approximately next August 15. These training courses will be held at stations to be selected, with attendance by personnel from neighboring stations.

An annual seminar should be conducted by the Fisheries Department in Bangkok to acquaint all personnel with various phases of the Department's work and to bring to their attention the most recent developments in fisheries elsewhere.

8.7 Publication of Research Results

A large volume of research data accumulated by the Department has never been published. A large amount that would be

of value in neighboring Countries and elsewhere in the world has been published in Thai, which makes it unavailable to other Countries.

All the publications of research results should have a summary in English and those most valuable to other Countries should be published in international journals.

The Department should employ a translator and an editor to put important research results in form for publication.

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