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# REPORT OF FISHCULTURAL INVESTIGATIONS IN THE PHILIPPINES

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**Project:** AID/csd-1581

**Date:** October 10, 1967

**Title:** Increasing Fish Production  
by Improved Fishcultures

**Revised:** August 15, 1969

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**I. FRESHWATER FISHERY STATION\***  
**Capital Costs**

ITEM	<u>Year I</u>		<u>Year II</u>		<u>Total</u>	
	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>
<u>Pond Construction</u>						
Constructing Pond System	126,000	2,000	126,000		252,000	2,000
Water Supply Canal	<u>120,000</u>	<u>5,000</u>			<u>120,000</u>	<u>5,000</u>
<b>TOTAL</b>	<b>246,000</b>	<b>7,000</b>	<b>126,000</b>		<b>372,000</b>	<b>7,000</b>
<u>Buildings and Other Facilities</u>						
Laboratory	88,400				88,400	
Fish Processing House			30,000		30,000	
Refrigeration and Storage Room			20,000		20,000	
Residences	128,000		128,000		256,000	
Service Buildings	16,000				16,000	
Other Facilities	4,000	7,000	4,000		8,000	7,000
Graveling Roads	4,000		4,000		8,000	
Research Equipmer <sup>t</sup>		10,000		10,000		20,000
Office Equipment	10,000		10,000		20,000	
Car and 2 Trucks		9,000				9,000
Tractor-Mower		<u>3,000</u>				<u>3,000</u>
<b>TOTAL</b>	<b>250,400</b>	<b>29,000</b>	<b>196,000</b>	<b>10,000</b>	<b>446,400</b>	<b>39,000</b>
<b>GRAND TOTAL CAPITAL COSTS</b>	<b><u>496,400</u></b>	<b><u>36,000</u></b>	<b><u>322,000</u></b>	<b><u>10,000</u></b>	<b><u>818,400</u></b>	<b><u>46,000</u></b>

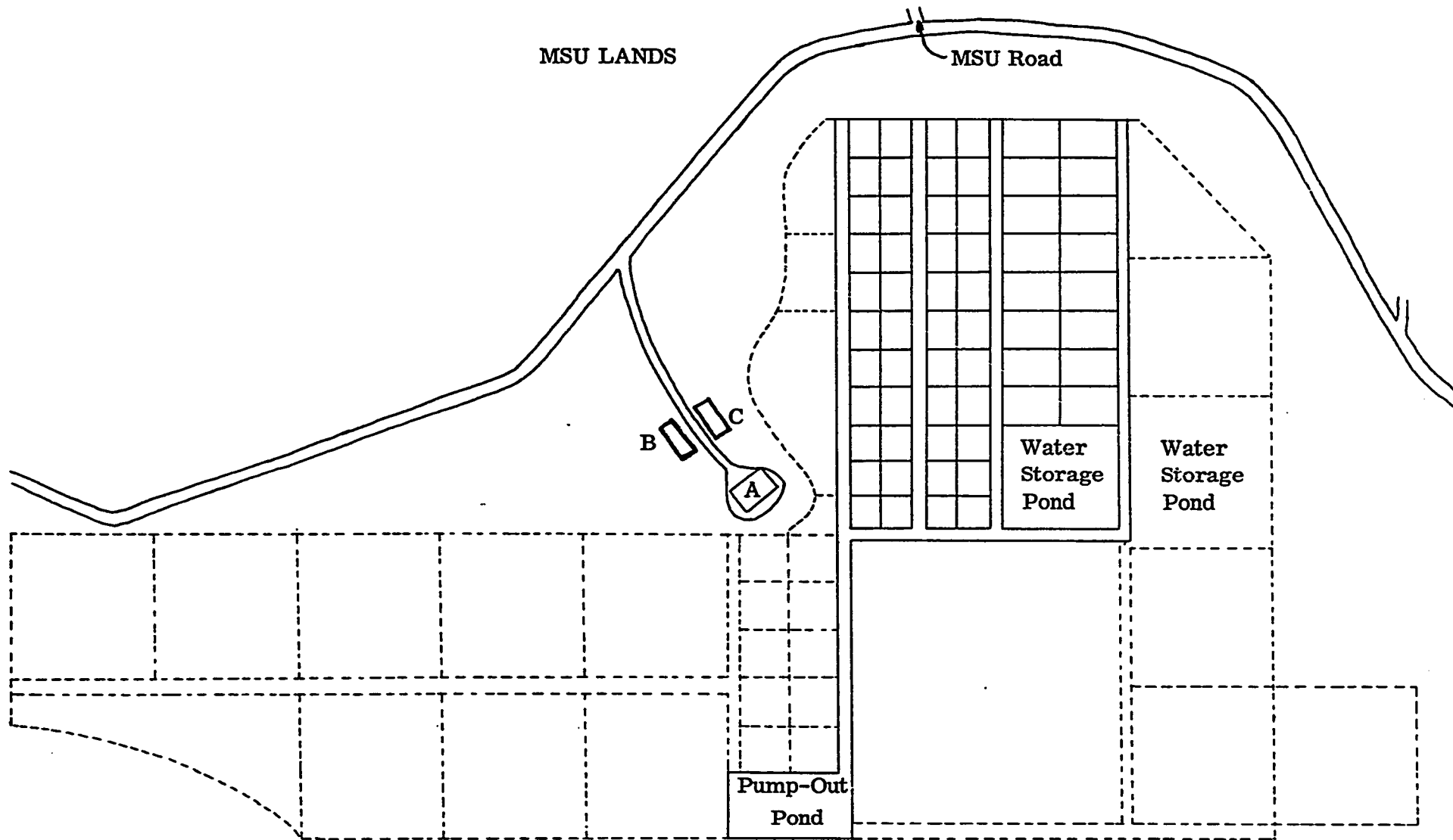
Proposed 60 EXPERIMENTAL PONDS: 44 ponds - 0.05 ha; 16 ponds - 0.1 ha with additional 25 ha of land for expansion. Revised May 20, 1968. Recommended location - Mindanao State University, Marawi City, Mindanao.

**I. FRESHWATER FISHERY STATION\***  
**ESTIMATED ANNUAL OPERATING COSTS**

ITEM	<u>Pesos</u>	<u>Year I</u> <u>Dollars</u>
<u>Maintenance</u>		
Fertilizers	2,000	
Feeds	16,000	
Ponds and Building Maintenance	20,000	
Utilities	10,000	
Transportation	4,000	
Equipment and Supplies	16,000	6,000
 <u>Local Travel</u>	 <u>4,000</u>	 <u>        </u>
<b>TOTAL</b>	<b>72,000</b>	<b>6,000</b>
 <u>Personnel</u>		
Philippines Staff		
Pond Superintendent	4,000	
Research Biologists (4)	26,000	
Drivers (2)	7,000	
Graduate & Student Assistant	12,000	
Typist	3,500	
Clerk	3,500	
Laborers (20)	<u>36,000</u>	
<b>TOTAL</b>	<b>92,000</b>	
<b>GRAND TOTAL OPERATING (ANNUAL) COSTS</b>	<b><u>164,000</u></b>	<b><u>6,000</u></b>

\* Proposed 60 EXPERIMENTAL PONDS: 44 ponds - 0.05 ha; 16 ponds - 0.1 ha with additional 25 ha of land for expansion.

Revised May 20, 1968. Recommended location-Mindanao State University, Marawi City, Mindanao.



Overall plan of freshwater fishery station recommended for Mindanao State University showing experimental pond complex (solid lines) and larger demonstration ponds (dotted lines) proposed for later construction: (A) - Laboratory and Office Building, (B) Garage and Shops, (C) - Fish Processing Building.

**II. BRACKISHWATER FISHERY STATION\***  
Capital Costs

ITEM	<u>Year I</u>		<u>Year II</u>		<u>Year III</u>		<u>Total</u>	
	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>
<b><u>Pond Construction</u></b>								
Constructing Pond System	80,000		80,000		80,000		240,000	
<b><u>Buildings and Other Facilities</u></b>								
Laboratory	117,000						117,000	
Fish Processing House	39,000						39,000	
Refrigeration & Storage Room	39,000						39,000	
Residences	50,700		101,400		100,000		252,100	
Service Buildings	15,600						15,600	
Other Facilities	62,400						62,400	
Graveling Roads	5,000		2,000		2,000		9,000	
Research Equipment		10,000		10,000		10,000		30,000
Office Equipment		5,000		5,000				10,000
Car and 2 Trucks		5,000		4,000				9,000
Tractor-Mower		3,000						3,000
<b>TOTAL</b>	<b>328,700</b>	<b>23,000</b>	<b>103,400</b>	<b>19,000</b>	<b>102,000</b>	<b>10,000</b>	<b>534,100</b>	<b>52,000</b>
<b>GRAND TOTAL CAPITAL COSTS</b>	<b><u>408,700</u></b>	<b><u>23,000</u></b>	<b><u>183,400</u></b>	<b><u>19,000</u></b>	<b><u>182,000</u></b>	<b><u>10,000</u></b>	<b><u>774,100</u></b>	<b><u>52,000</u></b>

\* Proposed 104 Ponds on a 50 ha area.

Revised May 20, 1968. Recommended location - Iloilo, Panay



II. BRACKISHWATER FISHERY STATION\*

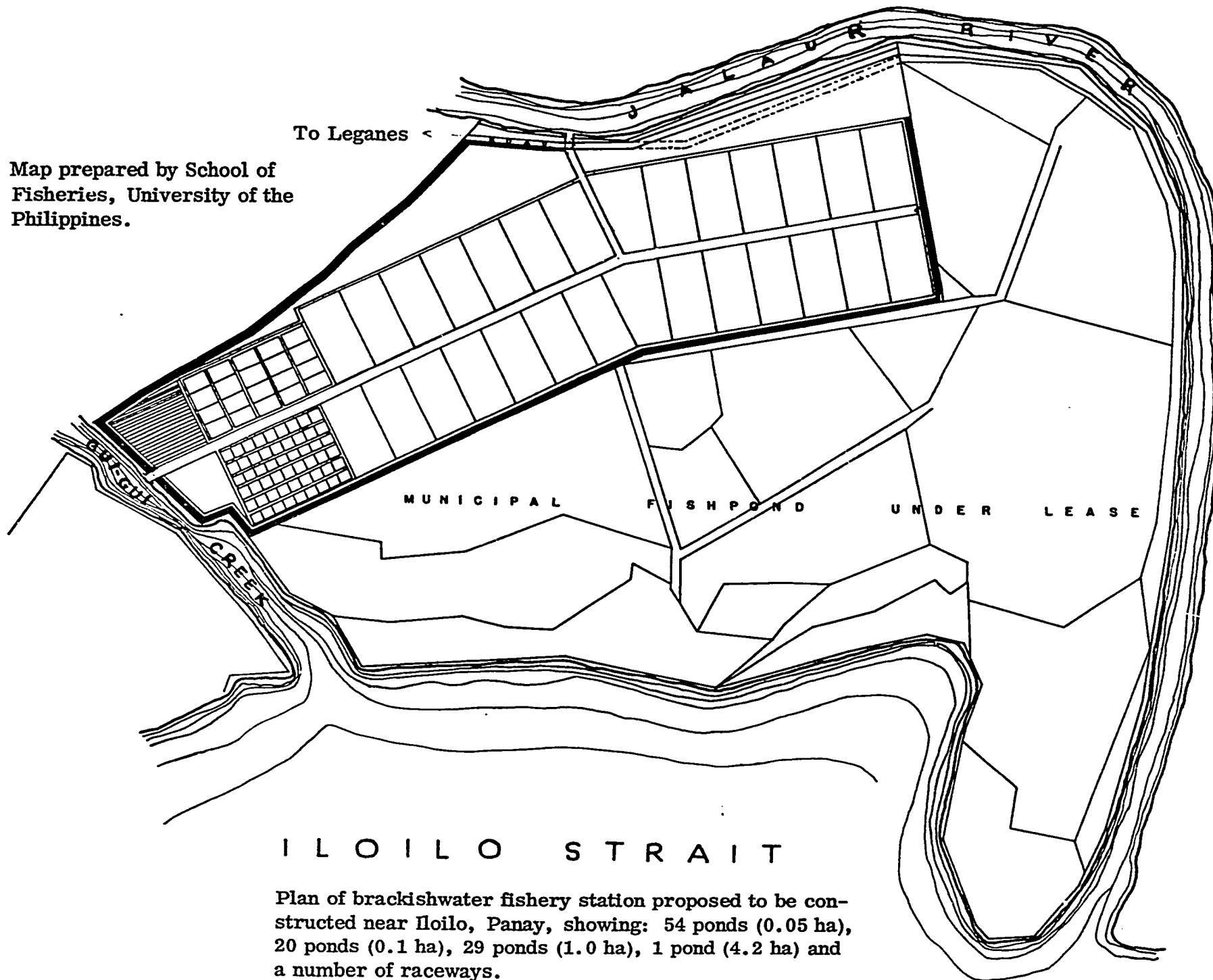
ESTIMATED ANNUAL OPERATING COSTS

ITEM	<u>Year I</u>	
	<u>Pesos</u>	<u>Dollars</u>
<u>Maintenance</u>		
Fertilizers	4,000	
Feeds	20,000	
Ponds and Building Maintenance	20,000	
Utilities	8,000	
Transportation	4,000	
Equipment and Supplies	40,000	10,000
<u>Local Travel</u>	<u>3,900</u>	_____
TOTAL	99,900	10,000
<u>Personnel</u>		
Philippine Staff		
Pond Superintendent (1)	5,000	
Research Biologists (4)	26,000	
Drivers (2)	7,000	
Graduate and Student Assistants	12,000	
Typist (1)	3,600	
Clerk (1)	3,600	
Laborers (30)	<u>72,000</u>	
TOTAL	129,200	
GRAND TOTAL OPERATING COSTS (ANNUAL)	<u><u>229,100</u></u>	<u><u>10,000</u></u>

\* Proposed 104 ponds on a 50 ha area.

Revised May 20, 1968. Recommended location - Iloilo, Panay.

Map prepared by School of Fisheries, University of the Philippines.



Plan of brackishwater fishery station proposed to be constructed near Iloilo, Panay, showing: 54 ponds (0.05 ha), 20 ponds (0.1 ha), 29 ponds (1.0 ha), 1 pond (4.2 ha) and a number of raceways.

REPORT OF FISHCULTURAL INVESTIGATIONS  
IN THE PHILIPPINES<sup>1</sup>

USAID-Auburn University Project (AID/csd-1581) Increasing  
Fish Production by Improved Fishcultures - Phase I

H. S. Swingle, Project Director, Auburn University  
D. D. Moss, Assistant Project Director, Auburn University

October 10, 1967

Introduction

The present catch of fish in the Philippines is approximately 600,000 metric tons annually, while the population is approximately 32 million. Average consumption of fresh fish per capita per year is 40 pounds, equivalent to 7.8 grams protein per capita per day. Thus, approximately 41 per cent of the total requirement for protein from animal sources is currently derived from fish alone in the Philippines.

It is estimated that the total catch would need to be increased over 25 per cent to satisfy minimum current needs, and that by 1987 even this catch must be doubled. The current rate of increase in population is slightly more than three per cent annually, which will result in doubling the population within 22 years. At present, the average Filipino is 17 years old, and over 33 per cent of the population is less than 10 years old.<sup>2</sup> Not only must total food production be increased, but also production per worker due to the increasing number of children in the population.

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1. This report is based on a survey made September 4 - October 10, 1967.

2. The population of the Philippines. E. M. Murphy, University of the Philippines Population Institute. Mimeograph, 24 p. Undated.

Of the total fish production, approximately 60,000 metric tons or 10 per cent are produced in the 200,000 hectares of brackishwater ponds utilized in milkfish culture. Average production in these ponds is low - between 300 and 400 kilos per hectare. By improved fishcultural techniques, production can be increased to over 2,500 kg, an increase of over 500 per cent. An additional 250,000 hectares of brackishwater fishpond sites are estimated to be available in the Islands.

The area of freshwaters was estimated by the Fisheries Commission in 1964<sup>1</sup> as 920,000 hectares, yielding approximately 40,000 metric tons of fish annually. In that report, freshwater ponds were estimated at only 402 hectares, but subsequent investigations indicated a total of 6,000 hectares in 1966.<sup>2</sup> Irrigated rice fields were included in these areas to the extent of 500,000 hectares, yielding 10,000 tons of fish annually. With the introduction of improved methods of rice culture which includes use of insecticides toxic to fish, the usefulness of these areas for fish production will be reduced or eliminated. Increasing fish production in lakes, swamps and rivers also will be quite difficult. The areas, however, that can be devoted to freshwater fishculture are very extensive and practically undeveloped. These include approximately 100,000 hectares of freshwater swamps and marshes, and an estimated 250,000 hectares suitable for ponds in upland and lowland areas. Production in excess of two metric tons per hectare can be achieved through development of improved fishcultural practices.

- 
1. Status and prospect of freshwater fisheries in the Philippines. Philippine Fisheries Commission, Freshwater Fisheries Information Leaflet 1, 5 p., 1964.
  2. Fish food production through improved techniques of freshwater fishculture. A report of recent results, H. R. Rabanal, S. S. Felix and E. Martinez. Mimeograph, Philippines Fisheries Commission, 19 p. Undated.

### Cooperative Fishery Project

The implementation of a cooperative fishery project through the USAID-Auburn University Contract can provide the basic knowledge and trained personnel to insure success of such a program. Specifically, it is proposed to establish both an adequate brackishwater and a freshwater fishcultural research station in the Philippines to determine or develop:

1. Efficient species and combinations of fish species to obtain highest production in ponds.
2. Efficient methods of water fertilization.
3. Cheap and efficient feeds for fish from locally available products.
4. Methods of control of fish parasites and diseases.
5. Improved management practices.
6. Efficient methods of producing fish seeds for stocking purposes.
7. Methods of shrimp culture and other aquatic crops.

In setting up this program of research (Phase II) and in training young men to extend and demonstrate improved methods of fishculture (Phase III), various possible cooperating agencies were considered from the standpoint of which ones could make the various programs more effective.

Good research requires well trained men who take as much time as necessary out of each 24 hours to think and plan their work. A research station is where new ideas are born and developed. Such a station is also a most effective teaching aid whereby young men become experts in their field of research and/or extension.

Consequently, it was considered desirable that the fishcultural research stations be located at or nearby universities. Here libraries are available to stimulate research. Also, scientists in the related fields of chemistry, zoology, botany, and nutrition, as well as specialists in other fields are available for consultation and advice to the research workers. Students are available to assist in research, thus simultaneously training the students and multiplying their effectiveness and amount of research. Too, the effectiveness of the fisheries teacher is increased because students can be brought to the research station to see and experience what is taught in the classes.

Various sites for these stations were visited to try to find the most ideal for each purpose. A list of areas investigated is given in the Appendix of this report.

#### Freshwater Pondculture Research Station

After due consideration, it was decided that the best location for this station was at Mindanao State University near Marawi City, Mindanao. A suitable site and/or an alternate site will be made available by the University. A School of Fisheries within the University is teaching courses in fish culture, pond construction, fish technology and related courses. Another advantage of this location is the presence of a Fisheries Demonstration Station operated by the Fisheries Commission, thus facilitating cooperation in research and extension. Two possible sites were selected - one a hillside site in a small watershed, and the other a lake-side site along Lake Lanao. These will be discussed in detail in a later section.

#### Brackishwater Pondculture Research Station

While many sites were investigated in Luzon, Mindoro, Panay and Mindanao,

only one met the requirements for a good research station. This was at Leganes, about six miles from Iloilo on Panay. This site is protected from typhoons by Guimaras Island, is bounded in the east by the Jalaur River and on the south by the sea and on the west by a tidal creek. The total area available at this site is over 140 hectares. It is owned by the municipal government of Leganes which was willing to lease without charge 50 hectares or more for the research station on a 50- to 99-year lease. Its disadvantage is that there is no university nearby teaching courses in fisheries, although nine colleges and universities are located in Iloilo, including Central Philippines University and a branch of the University of the Philippines. This site will be discussed more fully in a later section.

#### Cooperating Agencies and Institutions

During Phase III of this project, the demonstration of improved fishcultural methods and the training of fisheries personnel is to be emphasized. Here the established Demonstration Farms of the Fisheries Commission make their choice as the principal cooperating agency the most feasible. With additional money made available for this purpose, the use of the Commission's Fisheries Demonstration Farms in adapting, demonstrating and teaching the management methods developed by the research stations would be the most economical and efficient means for training interested fishpond managers and operators in the private sector, government extension personnel and development bank loan supervisors. By making training at the research stations available for the Fisheries Demonstration Farm Biologists, the effectiveness of the Commission's program will be greatly enhanced. Their

testing of methods in their own stations would make the biologists authoritative experts in their fields. Training would then be made available through the research stations and Fisheries Commission Demonstration Farms to large numbers of interested people.

#### Food and Agriculture Organization of the United Nations

This agency cooperated in the investigations by making available at various times the services of Mr. Yun-An Tang, fisheries specialist from Taiwan, and transportation to various local areas. Cooperation, both in demonstration and research, between the proposed research stations and FAO was discussed with Mr. Warren Cornwell, Resident Representative of the UN, and Mr. Subash Mazundar, FAO Agriculture Advisor. The possibility of FAO providing rotating specialists for research at these stations and for demonstration teaching under Phase III will be discussed further with FAO in Rome.

#### Rockefeller Foundation

This Foundation is presently supporting research on milkfish spawning and culture at Naujan Lake in Mindoro Oriental. Dr. Lucien Gregg, local representative of the Foundation, expressed an interest in a combined brackishwater pond-culture and marine station at the proposed site near Iloilo, possibly under the University of the Philippines at this city. He suggested establishing a department in a university to consolidate and coordinate research and teaching in all phases of water - hydrology, biology, oceanography, marine and freshwater fisheries. This could be called a Department of Hydro-Biology. This suggestion should be pursued further as it would appear to be the most feasible plan for developing good research and training in these fields.



The Foundation also makes available fellowships for advanced training for staff members and graduate students. This is a most important program because advanced training in fisheries, and especially in freshwater fisheries, is not available locally.

#### Ford Foundation

The extent of present involvement of this Foundation in fisheries in the Philippines was discussed with Dr. Clark Bloom, the local representative of the Foundation. Their interest at present is in upgrading capabilities of universities in teaching the basic sciences through advanced training of staff, rotation of professors from various universities in the United States and in providing equipment for research and teaching. Their program at Mindanao State University was providing a professor in biology specializing in limnology, and providing equipment required for conducting research on the chemistry and biology of aquatic areas.

#### Philippine Fisheries Commission

The Commission has suffered from too frequent changes in its Director, inadequate financing, activities too widespread for the money available, and especially, from the lack of well-trained young men.

No Director can be expected to organize such a large organization for efficient operation when his term of office is for only one or two years, or less. Frequent changes in this highly important administrative position result in few permanent policies and has resulted over the years in farflung operations which have never been adequately financed. The current rate of financing is inadequate for even basic operations of the Commission.

In several instances, it was observed that research was discontinued in the middle of planned experiments because of insufficient funds to purchase materials and supplies. Lack of travel funds also prevented the supervisor from adequately supervising the Demonstration Farms and Stations.

The best trained men in the Commission are heads of divisions, over 40 years old, and some are approaching retirement. Many younger men have a short 2 1/2-year university training as fisheries technicians, and are thus not prepared for graduate training abroad. Advanced training should have high priority within the Commission.

Many of the staff at Manila and at outlying research and demonstration areas are very capable people, but are handicapped by lack of budgeted funds and organized planning of their activities. When no definite funds are allocated to a station for its operation, advanced planning is difficult, if not impossible.

The Commission operated 16 field stations in the Freshwater Division and 8 in the Estuarine Division. Many are Demonstration Fish Farms set up to teach local people how to raise fish, but with no research results to demonstrate. Their usefulness would be greatly enhanced by establishment of the proposed research stations and subsequent training of many of their personnel in improved fishcultural practices. A list of these field stations is included in the Appendix of this report.

Mindanao State University (Marawi City)

This University is only three years old, and is growing at a satisfactory rate. It has a School of Fisheries, where emphasis is upon fishcultures in both freshwater and brackishwater. The courses emphasize practical experience in construction

and management. The staff includes two with the M. S. degree, one working toward the Ph. D. degree and two other faculty members with the B. S. degree.

There is a 2 1/2-year course leading to an "Associate in Fisheries Technology" and a more sophisticated training program leading to a B. S. degree. Those with a 2 1/2-year course are not adequately trained for effective work in research or demonstration stations. The usefulness of such training should be carefully evaluated because too many students do not go above this training.

The effectiveness of the staff and the training of students will be upgraded by establishment of the proposed freshwater fishcultural research station on campus.

University of the Philippines (Quezon City)

This University has a School of Fisheries which gives a 2 1/2-year short course and also has courses leading to the B. S. degree. Training in fisheries can also be obtained at the B. S. and M. S. levels in the Department of Zoology. The School of Fisheries has 200 students and a faculty consisting of one Ph. D., two M. S. and about 15 with the B. S. degree. Courses are more academic and better planned than at MSU, but with less field experience. No areas suitable for either freshwater or brackishwater fishcultural research could be located near the campus at Diliman. The University has a branch, Iloilo College of U. P., near the proposed brackishwater research station at Leganes, but no training there at present in fisheries. It offers good training in chemistry and less adequate courses in zoology and botany. There are two professors in each of these biological fields.

An "Institute for Fisheries Development and Research" under U. P., was authorized by the Philippine Congress in 1964. Ten coastal "development and research" stations are to be established at designated areas from Luzon to the Sulu archipelago, five of which are on Luzon. However, no funds have yet been made

available to implement acquisition and development of this scheme. There is no clear-cut reason for these locations and so many would prevent adequate support for their effective operation. A copy of the provision of the Act establishing this Institute and a map showing the proposed location of the Stations are included in the Appendix to this report. The Institute might be an established organization under which research could be set up. Its present Director is Mr. Pidlaoan with headquarters in the School of Fisheries at the University of the Philippines.

Central Philippine University (Iloilo)

This is a good University, with a good School of Agriculture. The University operates 155 hectares for research-teaching-production. Its training in biology is weak and there is none in fisheries. Its operating funds come seven per cent from Baptist Churches overseas and 93 per cent from student fees.

Fishpond Operators

Many fishpond operators were met and interviewed from Candaba, Malabon, Pampanga, San Miguel on Luzon, Cotabato and Lala on Mindanao, San Jose on Mindoro, and Iloilo on Panay. They were all interested in the Philippines getting the proposed fisheries research stations, preferably, close to their own operations.

The work of the FAO fisheries specialist, Mr. Tang, who is teaching adaptation of milkfish culture developed by research in Taiwan, has awakened the fishpond operators to the values of modern research methods. Some offered free sites for the research stations. One group at Iloilo had collected P 20,000 for research on special problems in milkfish culture which they hoped professors from the University of the Philippines might help solve. While interested in research, the

financial support from this sector would be spasmodic.

Private Companies

Sarmiento Enterprises expressed willingness to set up a fellowship for fisheries training. They operate 750 hectares of milkfish ponds and hope to hire three or more trained fisheries biologists.

Esso Corporation now supports some fisheries research at Mindanao Regional School of Fisheries, Zamboanga City, and their representative indicated a willingness of his company to support some research on pond fertilization at the proposed research stations.

Support from these and other companies could probably be expected for limited support of operation expenses for the proposed stations.

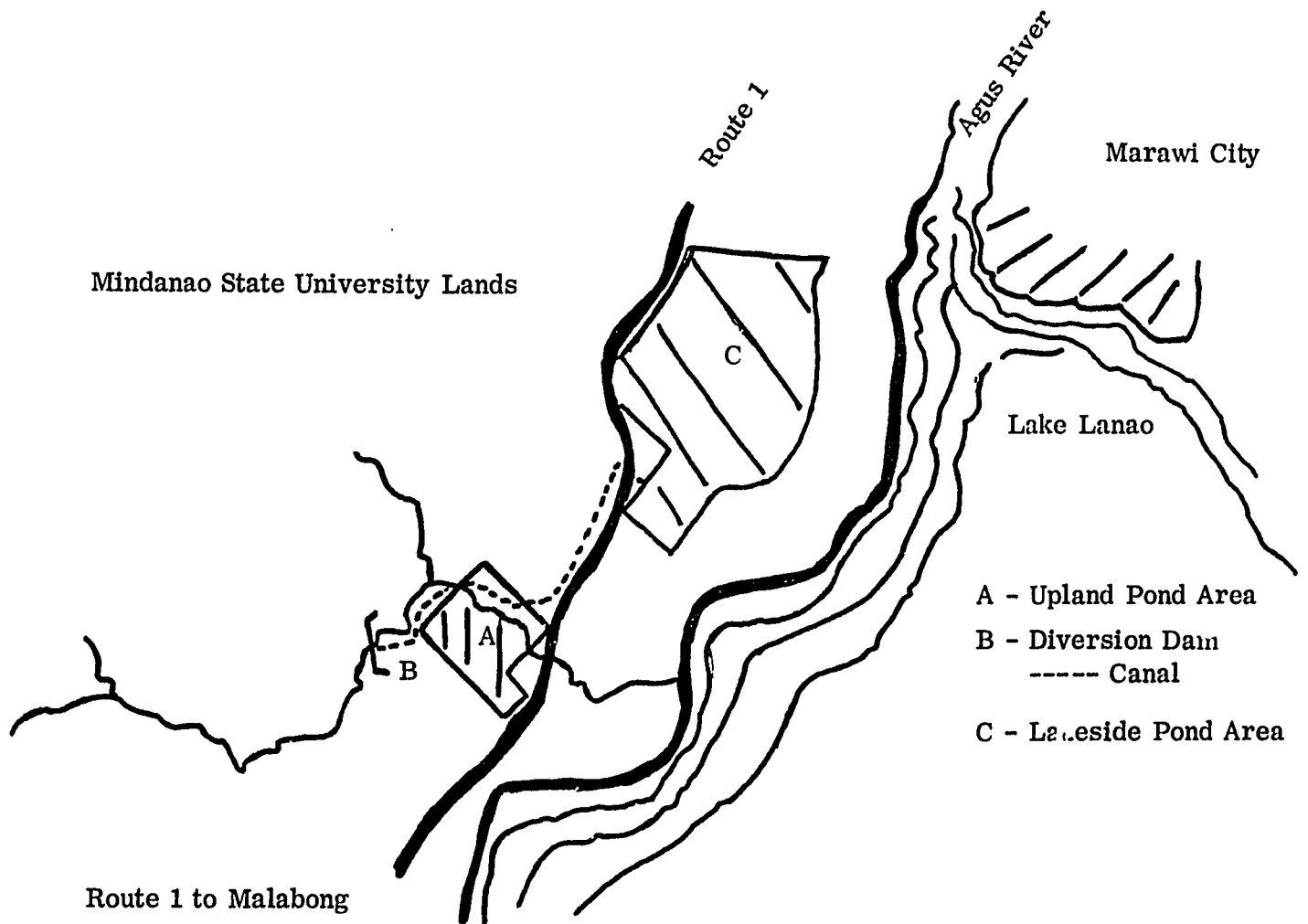
Development Bank of the Philippines

This organization has specialists in milkfish culture who appraise and plan pond construction, and advise fishfarmers on management to help insure repayment of loans for fishculture development. These specialists could be used effectively under Phase III by giving them adequate training at the proposed research stations in new and improved methods of fishculture.

Proposed Freshwater Pondculture Station

Original recommendations in the October 10, 1967, proposal included construction of ponds in two areas at Mindanao State University (Marawi City): the Upland Pond Area for intensive testing and research and the Lakeside Pond Area for commercial-scale research and demonstration. The sales of fish from the

latter area could pay for a considerable part of the annual costs of operation. In May, 1968, we were asked to submit plans that would reduce the capital expenditures by approximately 50 per cent. Because of this, the final recommendations dated May 20, 1968, no longer included the Upland Pond Area, but with all ponds to be constructed on the Lakeside Pond Area. However, the plans for the Upland Pond Area are also included in this report for future reference. Below is a map showing the location of the 24-hectare (10.4 hectares in ponds) Upland Pond Area and the 35-hectare (24.4 hectares in ponds) Lakeside Pond Area.



The Upland Pond Area would accommodate 11 hectares of ponds and the Lakeside Pond Area would accommodate space for 20 to 25 hectares of ponds.

A diversion dam approximately 500 meters upstream from the Upland Pond Area would impound water to an elevation of 730 meters. Water would pass by a 20-inch pipe through the dam at an elevation of 727 meters into the concrete-lined main canal carrying water to the southwest corner of the upper research ponds at an elevation of 725 meters. These ponds would each receive water through pipes from the canal system. At an elevation of 725 meters, water could be diverted across the stream and into a water canal at an elevation of 718 meters and pass over the hill by gravity to the Lakeside Pond Area at an elevation of 705 meters, or water could be supplied to the Lakeside Pond Area by pipes or canals from Lake Lanao.

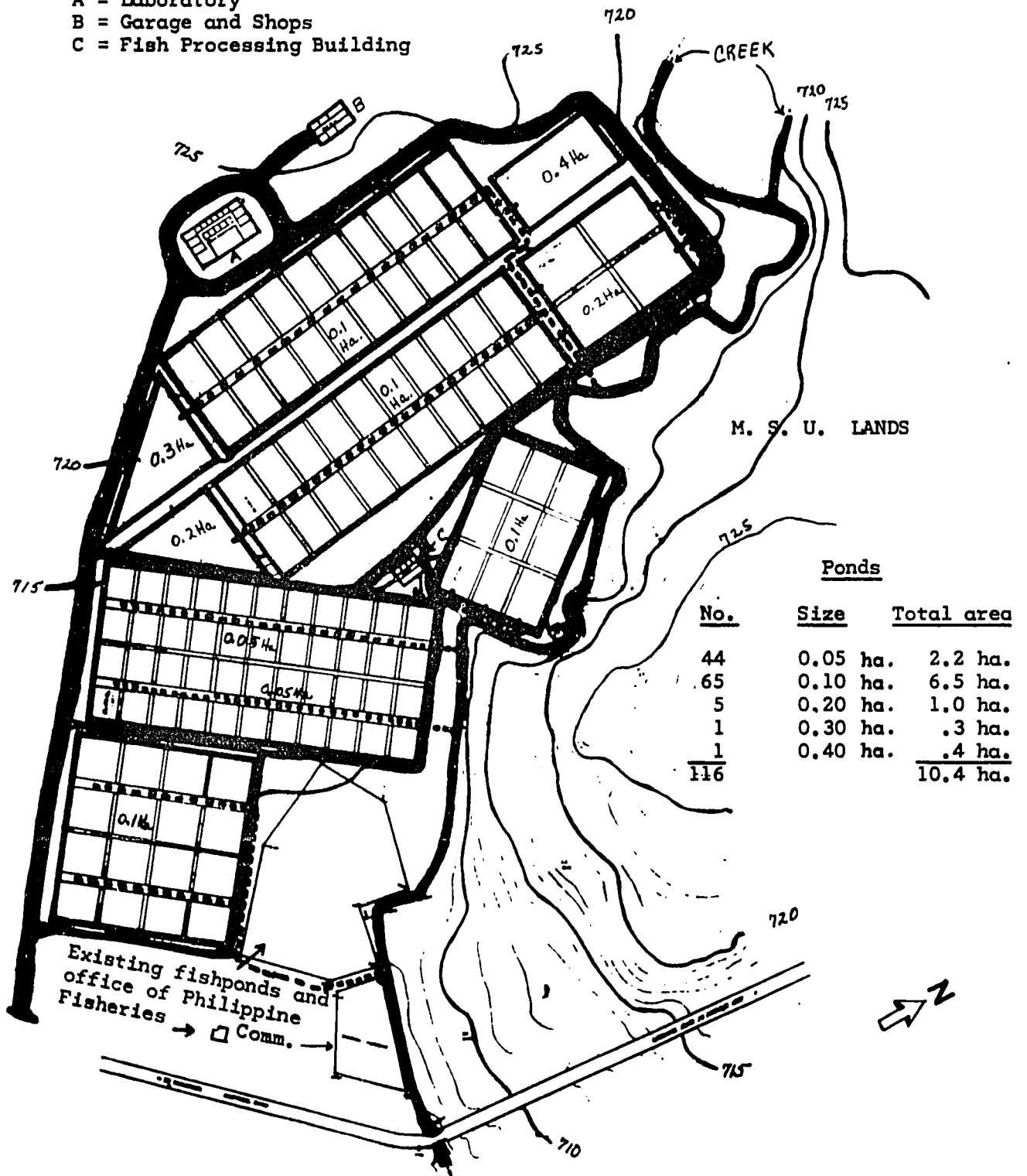
The flow in the stream at the point of diversion on October 3 was estimated at 12,000 gallons per minute. This was during the rainy season. The maximum requirements during the driest part of the dry season were estimated to be 50 gallons per minute per hectare of pond area, and maximum requirements for both areas during the driest part of the dry season were estimated at 2,000 gallons per minute. Construction of additional upstream impoundments may be necessary to supply adequate water during driest periods.

#### Construction on the Upland Pond Area

The layout of ponds, drains, roads, laboratory, service sheds, and fish processing house are shown on the following page.

The construction of ponds can be best done with crawler-type tractors with angledozer or bulldozer and carryall. An economical method would be to purchase

A = Laboratory  
 B = Garage and Shops  
 C = Fish Processing Building



Upland Site of Proposed Freshwater Fishery Research Station,  
 Mindanao State University, Mindanao Island, Philippines



two tractors - a D-6 with bulldozer and a D-7 with carryall pan - for the project. The personnel sent from Auburn University and engineering staff of Mindanao State University could supervise construction using local labor. This would require approximately 3 years for the construction, but would leave the project with two usable tractors for station maintenance in subsequent years. An alternate possibility, suggested by Mr. P. W. Ruppert, was that the army might be persuaded to construct the ponds with their equipment.

The building construction can be contracted locally. The cost estimates were based on work at the University done by contractors. If ponds were constructed on the Lakeside Pond Area, it is suggested that the laboratory be located there as it would be more centrally located with respect to the University.

The costs of pond construction on the Upland Pond Area were estimated as follows:

Costs of Experimental Pond System	
Water Supply Diversion Canal and Dam	\$ 21,178.00
Leveling of Pond Site Area	33,750.00
Construction of Experimental Ponds	82,240.00
Water Supply Pipes and Lines	12,570.00
Water Drain Pipes and Lines	4,223.00
Labor	<u>36,000.00</u>
Total	\$189,961.00

#### Construction on the Lakeside Pond Area

A second site was selected between the shore of Lake Lanao and Federal Highway 1 to Marawi City. This area has excellent clay soils and a water table very close to the surface. It is presently in rice paddies. The total area available for pond construction is approximately 35 hectares, allowing space for approximately 24 hectares of ponds. Effective operation of ponds during the driest part

of the dry season would require a water flow of approximately 1,000 gallons per minute; but for most of the year, rainfall would be sufficient to take care of evaporation plus seepage.

Three springs in the area supplied only a combined total of 200 gallons per minute. There are only two other sources capable of supplying adequate water - pumping from the lake or diversion of water from the stream at the proposed Upland Pond Area over the hill to the Lakeside Pond Area.

It was estimated that a 500-meter pipeline to a water canal would be necessary to divert water from the lake to the nearest ponds on the Lakeside Pond Area. An 18-inch pipe would be necessary to carry the desired amounts of water from the lake to a cement-lined canal using a 50- to 70-hp electric or diesel pump. An open earthen ditch would not be feasible for a water channel because of a difference in elevation of 3 meters from the lake to the highest level of the pond area, and because of the acid water that would enter the ditch from the swamp.

The lake edge nearest the Lakeside Pond Area is shallow which keeps the water muddy, and prevailing wind concentrates water hyacinths in the area. Consequently, it would be desirable to obtain water 100 meters or more from shore and an intake structure would have to be constructed there.

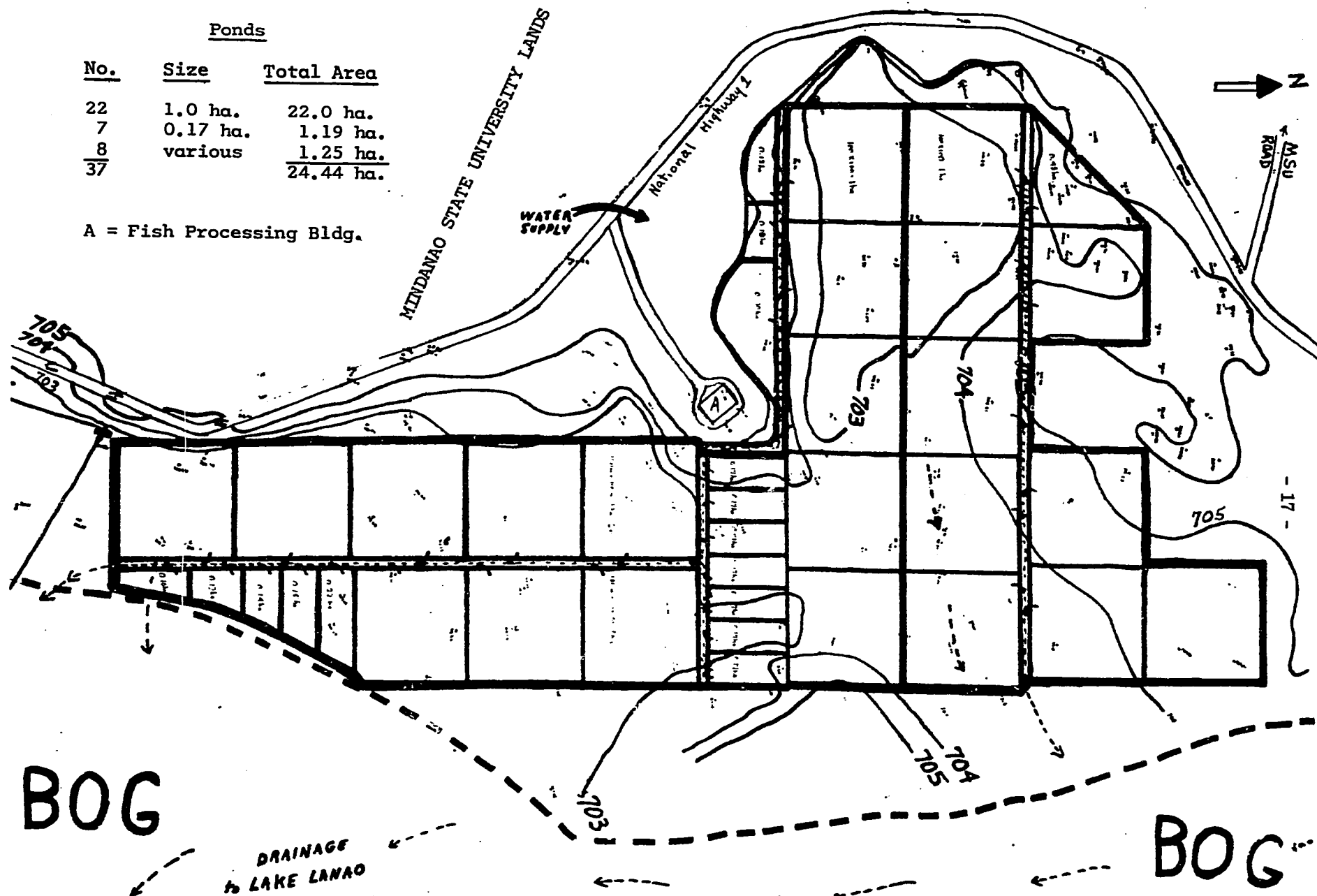
An alternate method would be to construct a wide, open ditch from the lake to the edge of the swamp, with a pipeline or cement-lined ditch carrying the water across the swamp to the edge of the pond canal system where it would be pumped vertically approximately 2 meters into the latter.

The following map shows the pond layout for the Lakeside Pond Area originally recommended to supplement the Upland Pond Area.

Ponds

<u>No.</u>	<u>Size</u>	<u>Total Area</u>
22	1.0 ha.	22.0 ha.
7	0.17 ha.	1.19 ha.
8	various	1.25 ha.
37		24.44 ha.

A = Fish Processing Bldg.



Supplementary Lakeside (Commercial) Freshwater Fishery Research Station, Mindanao State University, Mindanao Island, Philippines

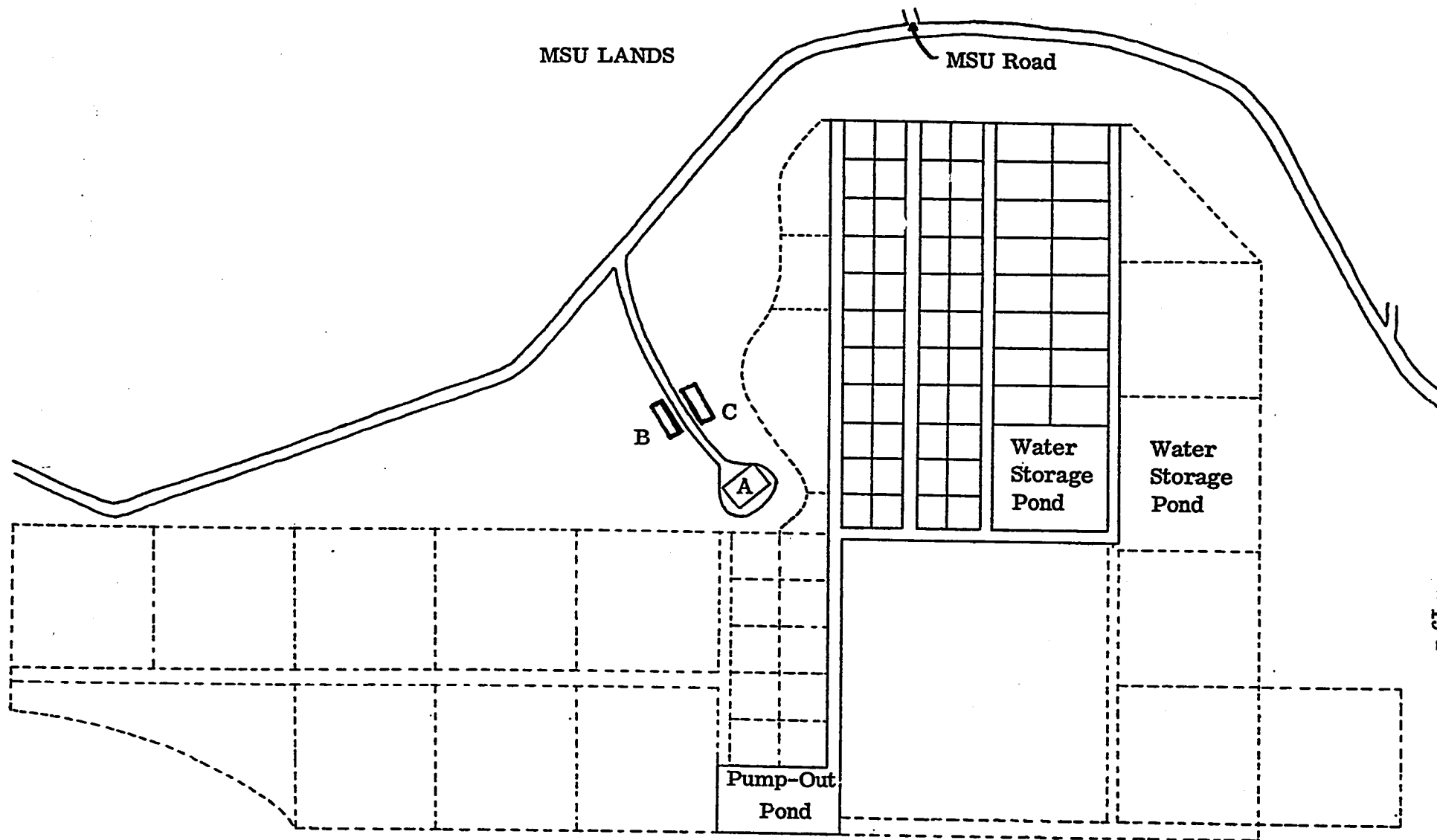
The estimated capital costs of construction for the 37 ponds illustrated were:

Summary Total Cost of 37 Ponds and Facilities	
Unskilled Labor	\$ 18,000.00
Dam Construction	47,020.00
Drains and Water Supply Lines	57,185.00
Water Diversion	35,500.00
Deep Well and Pump	2,000.00
Fish Processing Building	5,000.00
Transformer and Electrical Service	<u>2,000.00</u>
 Total	 \$ 166,705.00 (P 669,000)

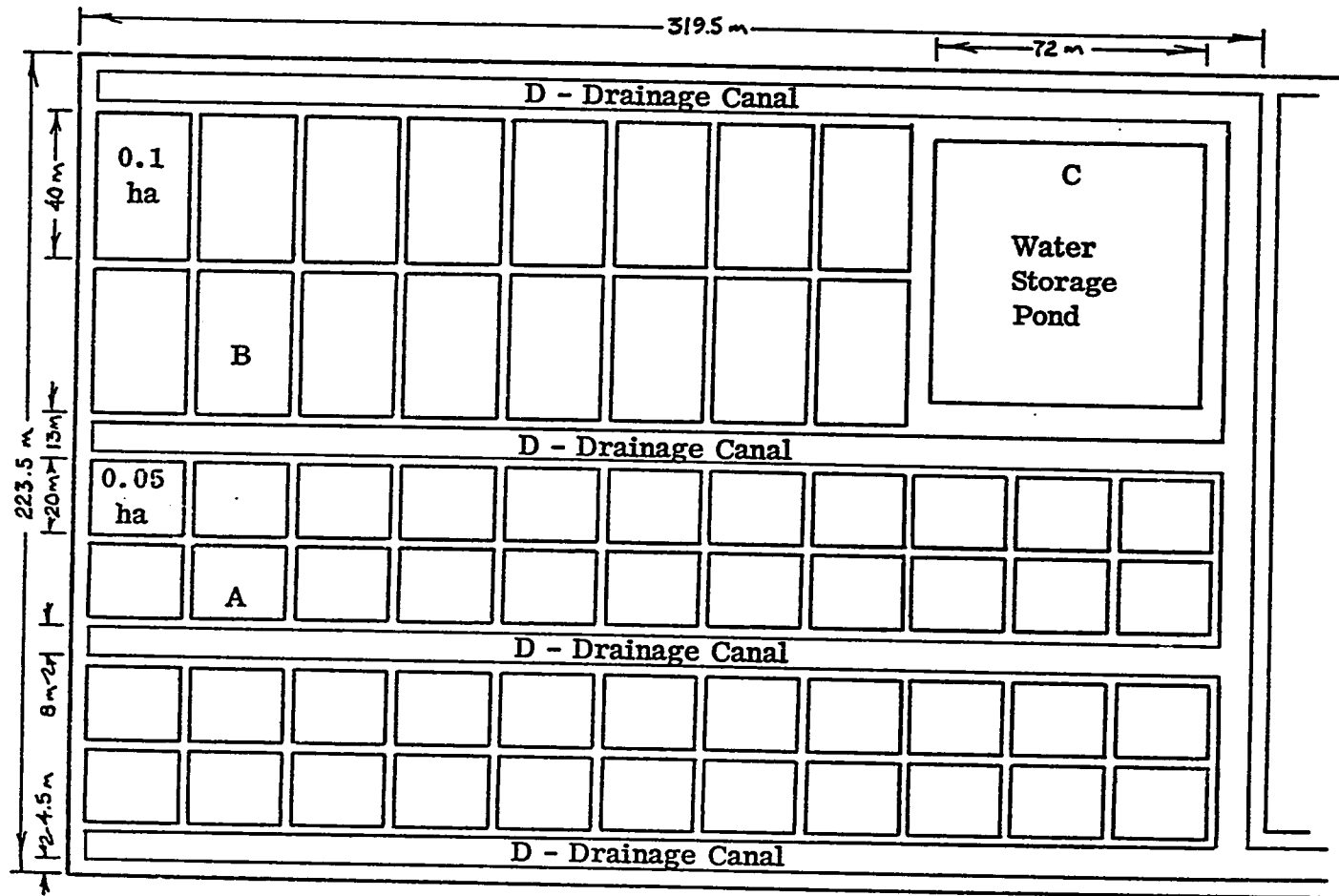
As mentioned previously, the revised recommendations of May 20, 1968, eliminated the Upland Pond Area to reduce capital costs. Consequently, the plans for the Lakeside Pond Area were revised to fit the reduced budget.

The following maps show the layout of ponds in the final proposal of May 20, 1968. These include 44 ponds (0.05 hectare each) and 16 ponds (0.1 hectare each) for a total of 60 ponds with a surface area of 4.3 hectares. An additional 20 hectares of ponds may be constructed in the area shown by the dotted lines on the plan.

The estimated costs of construction of the 60 ponds and water supply facilities, costs of the laboratory, other required facilities and annual costs for operating the Freshwater Fishery Station are given in the following tables.



Overall plan of freshwater fishery station recommended for Mindanao State University showing experimental pond complex (solid lines) and larger demonstration ponds (dotted lines) proposed for later construction: (A) - Laboratory and Office Building, (B) Garage and Shops, (C) - Fish Processing Building.



Plan of freshwater research station proposed for Mindanao State University showing 60 experimental ponds and water storage pond with total surface area of 4.3 hectares: (A) - 44 ponds, each with surface area 0.05 ha (20 x 25 m), (B) - 16 ponds, each with surface area 0.1 ha (25 x 40 m), (C) - Water Storage Pond with surface area 0.52 ha (72 x 72 m), and (D) - Drainage Canals (8 m).

**I. FRESHWATER FISHERY STATION\***  
**Capital Costs**

ITEM	<u>Year I</u>		<u>Year II</u>		<u>Total</u>	
	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>
<b><u>Pond Construction</u></b>						
Constructing Pond System	126,000	2,000	126,000		252,000	2,000
Water Supply Canal	<u>120,000</u>	<u>5,000</u>			<u>120,000</u>	<u>5,000</u>
<b>TOTAL</b>	<b>246,000</b>	<b>7,000</b>	<b>126,000</b>		<b>372,000</b>	<b>7,000</b>
<b><u>Buildings and Other Facilities</u></b>						
Laboratory	88,400				88,400	
Fish Processing House			30,000		30,000	
Refrigeration and Storage Room			20,000		20,000	
Residences	128,000		128,000		256,000	
Service Buildings	16,000				16,000	
Other Facilities	4,000	7,000	4,000		8,000	7,000
Graveling Roads	4,000		4,000		8,000	
Research Equipment		10,000		10,000		20,000
Office Equipment	10,000		10,000		20,000	
Car and 2 Trucks		9,000				9,000
Tractor-Mower		<u>3,000</u>				<u>3,000</u>
<b>TOTAL</b>	<b>250,400</b>	<b>29,000</b>	<b>196,000</b>	<b>10,000</b>	<b>446,400</b>	<b>39,000</b>
<b>GRAND TOTAL CAPITAL COSTS</b>	<b><u>496,400</u></b>	<b><u>36,000</u></b>	<b><u>322,000</u></b>	<b><u>10,000</u></b>	<b><u>818,400</u></b>	<b><u>46,000</u></b>

\* Proposed 60 EXPERIMENTAL PONDS: 44 ponds - 0.05 ha; 16 ponds - 0.1 ha with additional 25 ha of land for expansion. Revised May 20, 1968. Recommended location - Mindanao State University, Marawi City, Mindanao.

I. FRESHWATER FISHERY STATION\*  
ESTIMATED ANNUAL OPERATING COSTS

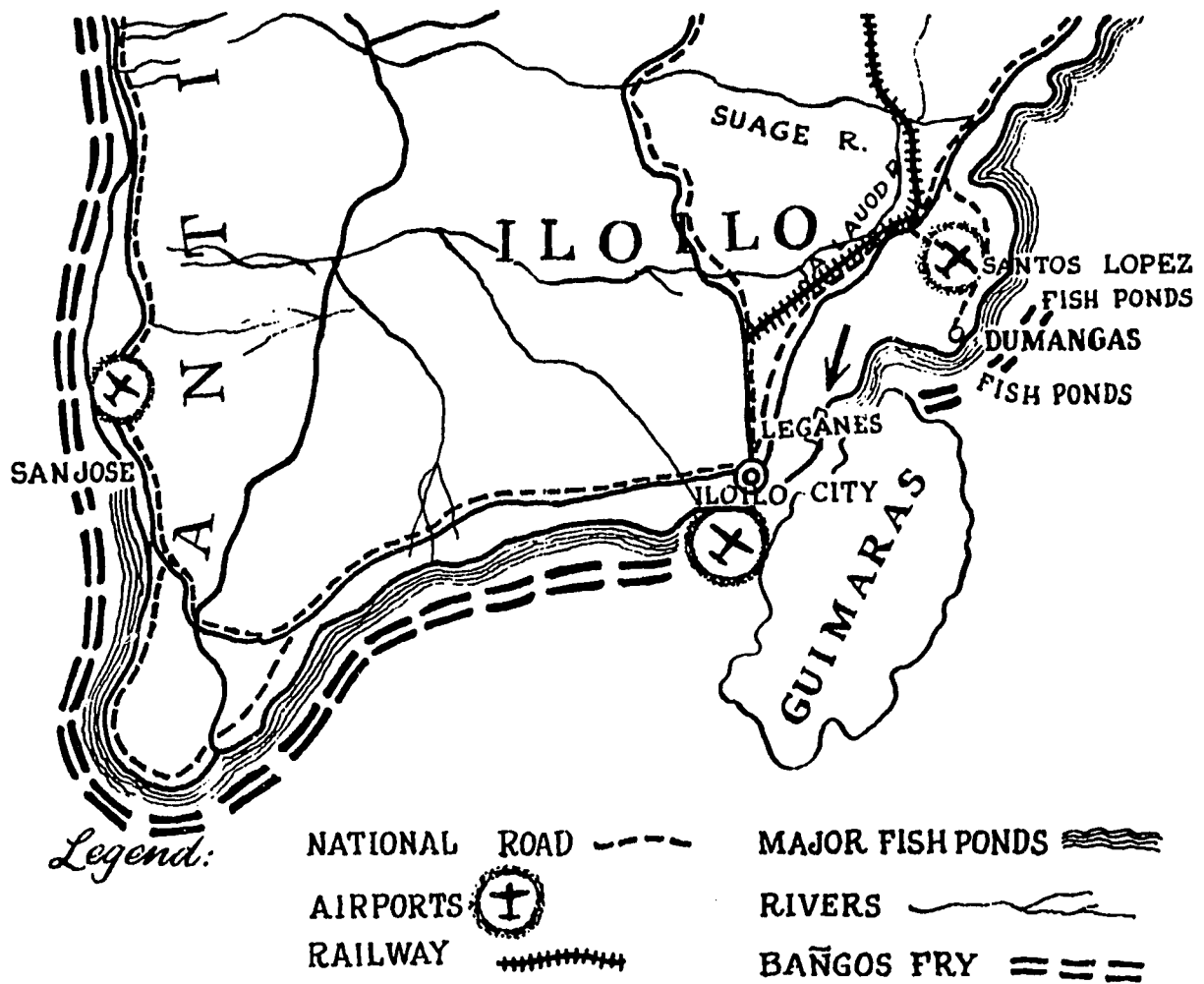
ITEM	Year I	
	<u>Pesos</u>	<u>Dollars</u>
<u>Maintenance</u>		
Fertilizers	2,000	
Feeds	16,000	
Ponds and Building Maintenance	20,000	
Utilities	10,000	
Transportation	4,000	
Equipment and Supplies	16,000	6,000
<u>Local Travel</u>	<u>4,000</u>	<u>        </u>
TOTAL	72,000	6,000
<u>Personnel</u>		
Philippines Staff		
Pond Superintendent	4,000	
Research Biologists (4)	26,000	
Drivers (2)	7,000	
Graduate & Student Assistants	12,000	
Typist	3,500	
Clerk	3,500	
Laborers (20)	<u>36,000</u>	
TOTAL	92,000	
GRAND TOTAL OPERATING (ANNUAL) COSTS	<u>164,000</u>	<u>6,000</u>

\* Proposed 60 EXPERIMENTAL PONDS: 44 ponds - 0.05 ha; 16 ponds - 0.1 ha with additional 25 ha of land for expansion.  
Revised May 20, 1968. Recommended location-Mindanao State University, Marawi City, Mindanao.



### Proposed Brackishwater Pondculture Station

The area selected was at Leganes about 6 miles from Iloilo on Panay Island as shown on the following map. A concrete-asphalt road connects Iloilo City to the town of Leganes, with a provincial road 3 miles from Leganes to the area as shown below.



The site contains approximately 140 hectares already developed into ponds and leased by the municipality of Leganes on bids for 5-year periods. The present lease expires December 31. The rent amounted to P 22,000 per year. The Municipal Council of Leganes executed a signed document October 10, 1968, informing the Fisheries Commission, College of Fisheries of the University of the Philippines and USAID that the Council would make available 50 hectares of the area for a fisheries research station.

Although the area is now covered by ponds, there is no orderly layout and existing ponds are the wrong sizes and depths for effective testing and research. The map on page 26 shows the proposed layout of ponds on the 50-hectare area.

Highest and lowest tides at Iloilo are 6.6 feet and 1.2 feet. This is ideal for efficient operation of water-flow systems for brackishwater ponds. Rainfall and temperature records are from the Weather Bureau at Iloilo. The averages for a 10-year period were:

<u>Month</u>	<u>Temperature in ° C</u>			<u>Rainfall</u>
	Maximum	Minimum	Mean	(mm)
January	30.60	21.12	25.59	35.5
February	30.47	21.27	25.64	16.0
March	32.09	21.97	26.67	32.8
April	33.18	22.77	27.94	50.1
May	33.53	23.27	28.33	113.8
June	32.88	23.65	27.73	250.2
July	32.41	22.29	27.30	317.9
August	32.19	21.91	27.06	371.7
September	31.81	22.56	27.05	308.5
October	32.22	22.49	27.18	216.3
November	31.63	22.01	26.82	163.6
December	30.77	21.78	26.30	75.1

### Construction of Ponds

Ponds would be constructed with water depths of 0.6 to 1.2 meters with a concrete gate at the deepest area of each pond. All ponds would have a freeboard of 0.5 meters. Width of dam tops would be 2 meters for the 0.05-hectare ponds and 3 meters for the rest. The slope of all dams would be 1.5:1.

The main canal from tidal creek to river would have a bottom width of 8 meters with a 1.5:1 slope to the top of the dam, a 1.5 meter water depth, and a 0.5 meter freeboard.

The perimeter dams would be 2 meters high above ground level, with the top 3 meters wide and a 1.5:1 slope. Perimeter canals would have a 3 meter bottom width with 1.5:1 slope to the top of the perimeter dam and a 1.2 meter water depth.

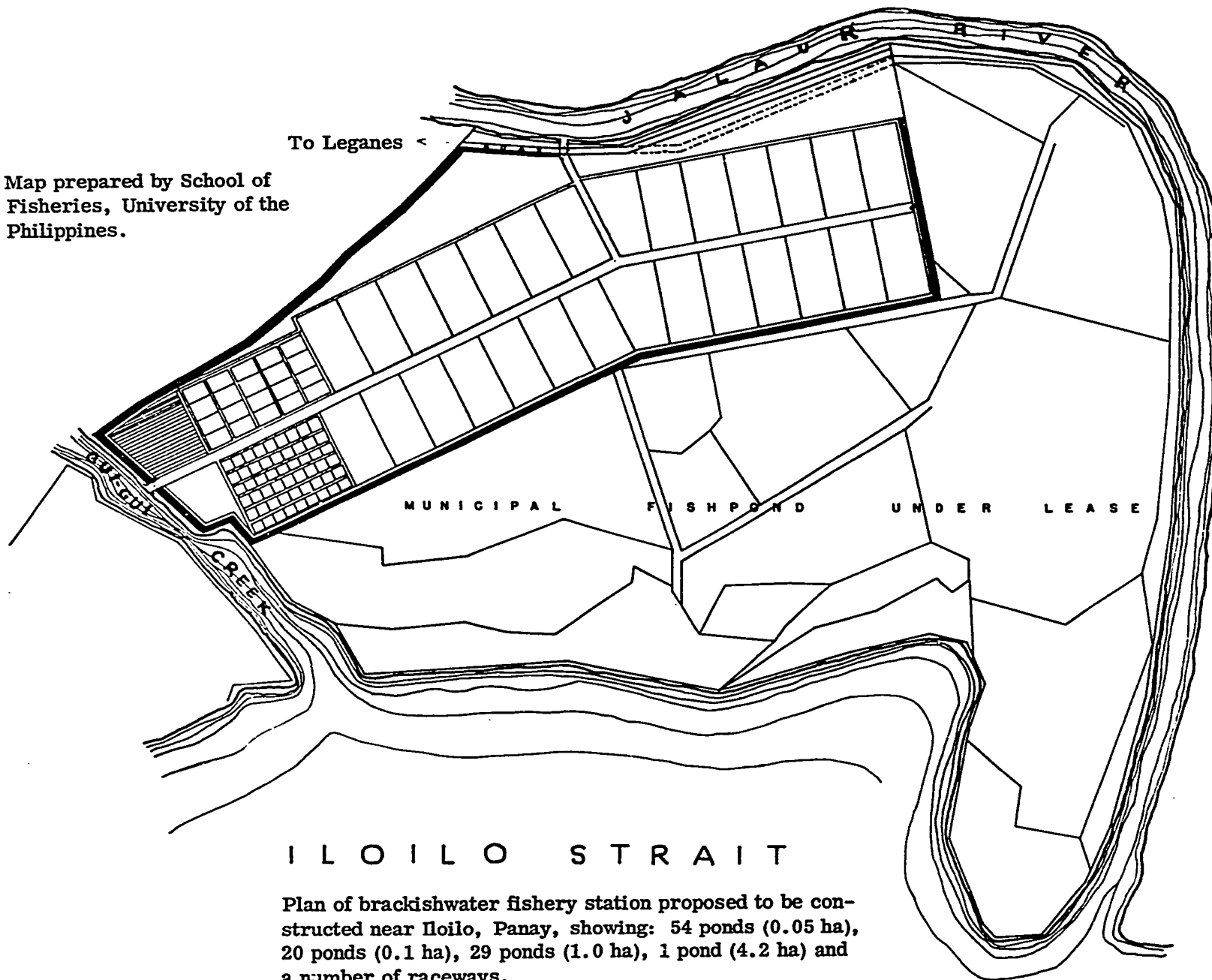
Canals to the 0.05-hectare ponds would have a 2 meter bottom width and 3 meters width for all other ponds and a 1.5:1 slope for all; water depth would be 1.2 meters; freeboard would be 0.5 meter.

Raceway canals would be approximately 200 meters long, 3 meters or 6 meters wide, 1.5 meters deep with board or concrete sides. Walkways between raceways would be 2 meters. Approximately 20 raceways would be built.

Canal gates would be concrete with water levels regulated by shiplapped boards.

The following map shows the layout of ponds proposed for brackishwater fishery station. These include 54 ponds (0.05 hectare each), 20 ponds (0.1 hectare each), 1 pond (4.2 hectare) and approximately 20 raceways. The estimated costs of construction of the 104 ponds with a surface area of 37.9 hectares and annual operating costs for operating the station are given in the following tables.

Map prepared by School of Fisheries, University of the Philippines.



Plan of brackishwater fishery station proposed to be constructed near Iloilo, Panay, showing: 54 ponds (0.05 ha), 20 ponds (0.1 ha), 29 ponds (1.0 ha), 1 pond (4.2 ha) and a number of raceways.

**II. BRACKISHWATER FISHERY STATION\***  
Capital Costs

ITEM	<u>Year I</u>		<u>Year II</u>		<u>Year III</u>		<u>Total</u>	
	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>	<u>Pesos</u>	<u>Dollars</u>
<b><u>Pond Construction</u></b>								
Constructing Pond System	80,000		80,000		80,000		240,000	
<b><u>Buildings and Other Facilities</u></b>								
Laboratory	117,000						117,000	
Fish Processing House	39,000						39,000	
Refrigeration & Storage Room	39,000						39,000	
Residences	50,700		101,400		100,000		252,100	
Service Buildings	15,600						15,600	
Other Facilities	62,400						62,400	
Graveling Roads	5,000		2,000		2,000		9,000	
Research Equipment		10,000		10,000		10,000		30,000
Office Equipment		5,000		5,000				10,000
Car and 2 Trucks		5,000		4,000				9,000
Tractor-Mower		3,000						3,000
<b>TOTAL</b>	<b>328,700</b>	<b>23,000</b>	<b>103,400</b>	<b>19,000</b>	<b>102,000</b>	<b>10,000</b>	<b>534,100</b>	<b>52,000</b>
<b>GRAND TOTAL CAPITAL COSTS</b>	<b><u>408,700</u></b>	<b><u>23,000</u></b>	<b><u>183,400</u></b>	<b><u>19,000</u></b>	<b><u>182,000</u></b>	<b><u>10,000</u></b>	<b><u>774,100</u></b>	<b><u>52,000</u></b>

\* Proposed 104 Ponds on a 50 ha area.

Revised May 20, 1968. Recommended location - Iloilo, Panay

II. BRACKISHWATER FISHERY STATION\*

ESTIMATED ANNUAL OPERATING COSTS

ITEM	Year I	
	<u>Pesos</u>	<u>Dollars</u>
<u>Maintenance</u>		
Fertilizers	4,000	
Feeds	20,000	
Ponds and Building Maintenance	20,000	
Utilities	8,000	
Transportation	4,000	
Equipment and Supplies	40,000	10,000
<u>Local Travel</u>	<u>3,900</u>	_____
TOTAL	99,900	10,000
<u>Personnel</u>		
Philippine Staff		
Pond Superintendent (1)	5,000	
Research Biologists (4)	26,000	
Drivers (2)	7,000	
Graduate and Student Assistants	12,000	
Typist (1)	3,600	
Clerk (1)	3,600	
Laborers (30)	<u>72,000</u>	
TOTAL	129,200	
GRAND TOTAL OPERATING COSTS (ANNUAL)	<u>229,100</u>	<u>10,000</u>

\* Proposed 104 ponds on a 50 ha area.

Revised May 20, 1968. Recommended location - Iloilo, Panay.

## APPENDIX

Locations in the Philippines Investigated as Possible Sites for  
Fisheries Research Stations

Freshwater Locations

Luzon

Laguna de Bay Area

Limnological Station

Calamba Demonstration Farm - Bukol Spring

Santo Domingo Demonstration Farm

Tanay Central Luzon Demonstration Farm

Lumban Area

Immediately below Caliraya Electric Plant

Downstream near Laguna de Bay

Los Banos

College of Fisheries, University of the Philippines, Diliman

Sibul Spring Area

Mindoro

Lake Naujan

Mindanao

Mindanao State University, Marawi City

Agus River

Lake Buluan

Lanao Freshwater Demonstration Fish Farm

Lake Lanao

Brackishwater Locations

Luzon

Dagat-Dagatan

Sto. Tomas, Lingayen Gulf

Malabon



Mindoro

Naujan Sabalo Hatchery Project

Mindanao

Cotabato - Parang Area

Lala - Northern Mindanao Demonstration Fish Farm

Iligan Area

Panay

Iloilo

Western Visayas Demonstration Station

Leganes Area

## Freshwater Locations

### Luzon

1. Laguna Limnological Laboratory at Los Banos. This research station was established with FAO cooperation and consists of a large, well-constructed building on the shore of Laguna de Bay near Los Banos. It is now operated solely by the Philippine Fisheries Commission. It is staffed by six biologists, four women, two men and one chemist. It appeared to lack sufficient funds for proper operation and maintenance. Two ponds were constructed back of the laboratory along the lake and were used for holding miscellaneous fishes. Some work is being conducted on breeding Arius, a species of catfish that is apparently disappearing from the lake. Some research is being started on shrimp. Chemical studies on the lake consist principally of determination of oxygen, carbon dioxide and alkalinity. The chemical equipment is rather meager. Probably very little can be learned by continuing the above analyses unless they are related to definite experimental procedures. The general chemistry of a lake does not change materially from year to year.

Since the principal limnological features of a single lake are soon established, it was intended that the personnel of this laboratory form a traveling team to investigate and compare the limnological features of lakes generally throughout the Philippines. This proposal would have enabled better understanding of differences in lakes in various locations, but the expense of such research has prevented its implementation.

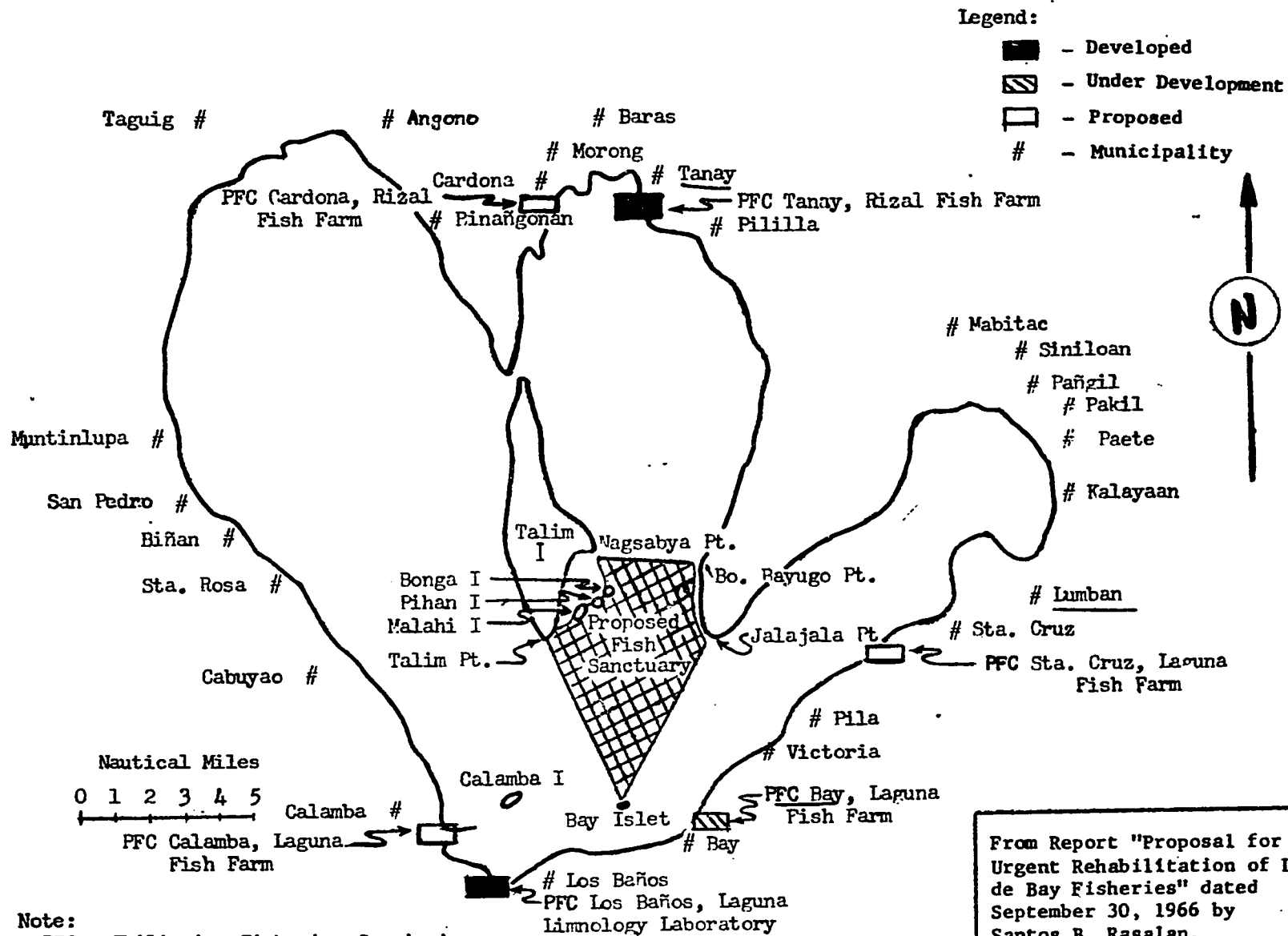
The area was examined with the idea of establishing the Freshwater Pond-culture Station nearby, thus making use of the laboratory and its facilities. No

suitable sites could be found. The location of this Station and other nearby sites investigated are given on the following map.

2. Calamba PFC Demonstration Farm. This area has not yet been developed into ponds. It is northwest of the limnological laboratory along the lakeshore. Water comes to the area from Bukol Springs, but most of this is diverted into rice fields and marshy areas before reaching this site. Use of water from the lake would be difficult and require pumping. There is no usable road to the area and its remoteness would make highly questionable its value as a demonstration fish farm.

3. PFC Bay - (Santo Domingo Demonstration Fish Farm). This is a location similar to the Calamba area, but has been partly constructed, having a house and two ponds. The area is 10 hectares. Water is available from an irrigation ditch, but this supply is inadequate for a good pondculture research station. Water could be pumped out of the lake, but would be expensive. The area presently available was inadequate. Difference in water level of the lake was 2 meters, making necessary very high freeboard on dams of small ponds. The area is too remote to be a demonstration farm as it is on a poor road, with few people in the immediate vicinity.

4. Tanay Central Luzon Demonstration Farm. Tanay is directly across Laguna de Bay from the limnological laboratory (see map). This farm has 11 ponds totalling about 2.5 hectares. Water supply is principally from a well using a diesel operated pump. It supplies insufficient water during dry periods for the present pond areas. Expansion is contemplated if nearby farm lands can be purchased (asking price was P 50,000 per hectare). This station conducted experiments



Note:

PFC = Philippine Fisheries Commission

Fisheries Development Map of Laguna de Bay

From Report "Proposal for the Urgent Rehabilitation of Laguna de Bay Fisheries" dated September 30, 1966 by Santos B. Rasalan.

raising fish and rice together in rice paddies. They obtained an average of 90 kg per hectare in 120 days using tawes and carp at 5,000 per hectare. This is now discontinued. The station also has a series of concrete ponds. There are three fisheries technicians, a caretaker and four laborers at the station.

There was no room here for construction of an adequate research station and insufficient water supply for even the present area. This station could be an effective demonstration area for Phase III.

5. Lumban Area. One location that appeared promising was immediately below the Calariya Electric Plant, where a large volume of water flows through the turbines downstream in a canal. However, to use this area would require pumping the water to a height of approximately 10 feet above the stream level. Also, it was found that the turbines are shut off in August and September as the reservoir in the mountains is then at a low level and the canal is low in water. The generators run, however, for several hours each evening to help supply peak needs. This water supply is used by rice farmers downstream.

A second location was farther down the valley just above PFC Sta. Cruz. A 152-hectare area there is leased by a corporation but has never been developed into ponds. It was indicated by local people that this could be available for a research station. However, before reaching this area, the water upstream has been diverted to rice fields to such an extent that insufficient water would be available for a large number of ponds and when the electric plant was not operating, none would be available unless pumped from the lake. The soils were not examined as the area did not appear highly desirable.

6. Los Banos. The Rice Institute was visited, but due to conflicting appointments of Director Chandler, no interview was possible. The problem of simultaneous rice and fish culture in rice fields is intriguing. Much has been published about how to do it, but it is practiced only locally in a few areas. Modern rice culture with high yields from use of fertilizers and insecticides, many of which are toxic to fish, will probably reduce this practice further. It is of interest in this connection that Mr. Chen of the Taiwan Fisheries Commission informed us that the use of insecticides had eliminated rice-fish culture in his country.

To solve this problem would require cooperation in testing insecticides between entomologists or chemical corporations and fisheries research personnel. Since time was short, no further attempts were made to explore cooperative tests with the Rice Institute.

Other areas in the vicinity of Los Banos were viewed, but no suitable sites for a station were located.

7. College of Fisheries, University of the Philippines, Diliman. A few small ponds have been constructed behind the College of Fisheries building, using city water supplies. Suitable water supplies and areas were lacking to establish experimental ponds at this location.

Professors Yapchiongco, Juliano and Director Pidlaoan of the Institute of Fisheries Development and Research were interviewed to find if the University or the Institute had lands suitable for the research station, but none was available.

8. Candaba Swamps. These swamps are near Candaba City north of Manila on the flood plain of the Pampanga River. When this river is in spate during the rainy season, it floods 32,000 hectares of fertile soil and the area remains covered with water until the dry season (October - December). It remains flooded long enough (7 - 8 months) to produce a crop of fish. Subsequently, after drying, the land is used to raise melons and rice. The Lumjoco family has constructed a 550-hectare pond to raise freshwater fish on this flood plain. It was stocked by river fishes entering the pond along with the water as the river flooded, with carps and possibly some milkfish being added by the operator. When the river water recedes, nets will be placed below the pond outlet and all fish harvested and sold. It is in its first year of operation. This area could be developed for intensive fishculture and could be managed to yield at least two tons fish per hectare. If only half the area were utilized in this manner, it could produce over 32,000 tons of freshwater fish annually. A research station could be constructed in this area, but would lack water for a three-month period. It might be possible to pump water during this period from the river if the station were located nearby.

The remoteness of the area, its political instability and lack of water from October to December made this location less desirable.

9. Sibul Springs Upland Pond Area. The Mario Santos farm in this area was visited to see the freshwater pond constructed by building a dam across a watershed between two hills, similar to those constructed in Southeastern U. S.

This freshwater pond was stocked with milkfish, Chinese carps and Indian carps under the supervision of Mr. Tang, FAO fisheries specialist. The pond was fertilized with chicken manure and inorganic fertilizer and the fish were fed rice

bran. Production at the end of one year was approximately 1,600 kilos per hectare with over half the weight due to milkfish and the Chinese silver carp. This is an illustration of commercial possibilities in freshwater ponds.

The area here was unsuitable for a research station because of insufficient water and impoundment areas for a large station.

### Mindoro

Lake Naujan. This freshwater lake was visited to see if possibilities existed for construction of a freshwater research area in connections with the Naujan Sabalo Hatchery Project, which is reported under the brackishwater section. No areas nearby appeared suitable without pumping water on the upland areas. The remoteness of the area made establishment of a large research station at this location unfeasible.

### Mindanao

1. Mindanao State University. Two suitable areas were selected here for a freshwater station and are discussed in detail elsewhere.

2. Agus River below Lake Lanao. An area on the watershed below Marawi City was examined, but water could not be diverted economically to the area by gravity and pumping would be prohibitive.

Areas farther downstream appeared very limited because of the rapid descent of the river towards the sea.

3. Bubong Area. Several beautiful valleys in this area east of Marawi City and along Lake Lanao appeared very suitable. Springs and streams came out of the nearby mountains in many areas. The valleys were in rice production but the land was communally owned by the Moslem people. Their leaders were



willing to donate some for a research station. However, sites nearer MSU campus made this location less desirable. In these valleys, the results of research can be put to use as pond sites are available and the diet of the local people is deficient in protein.

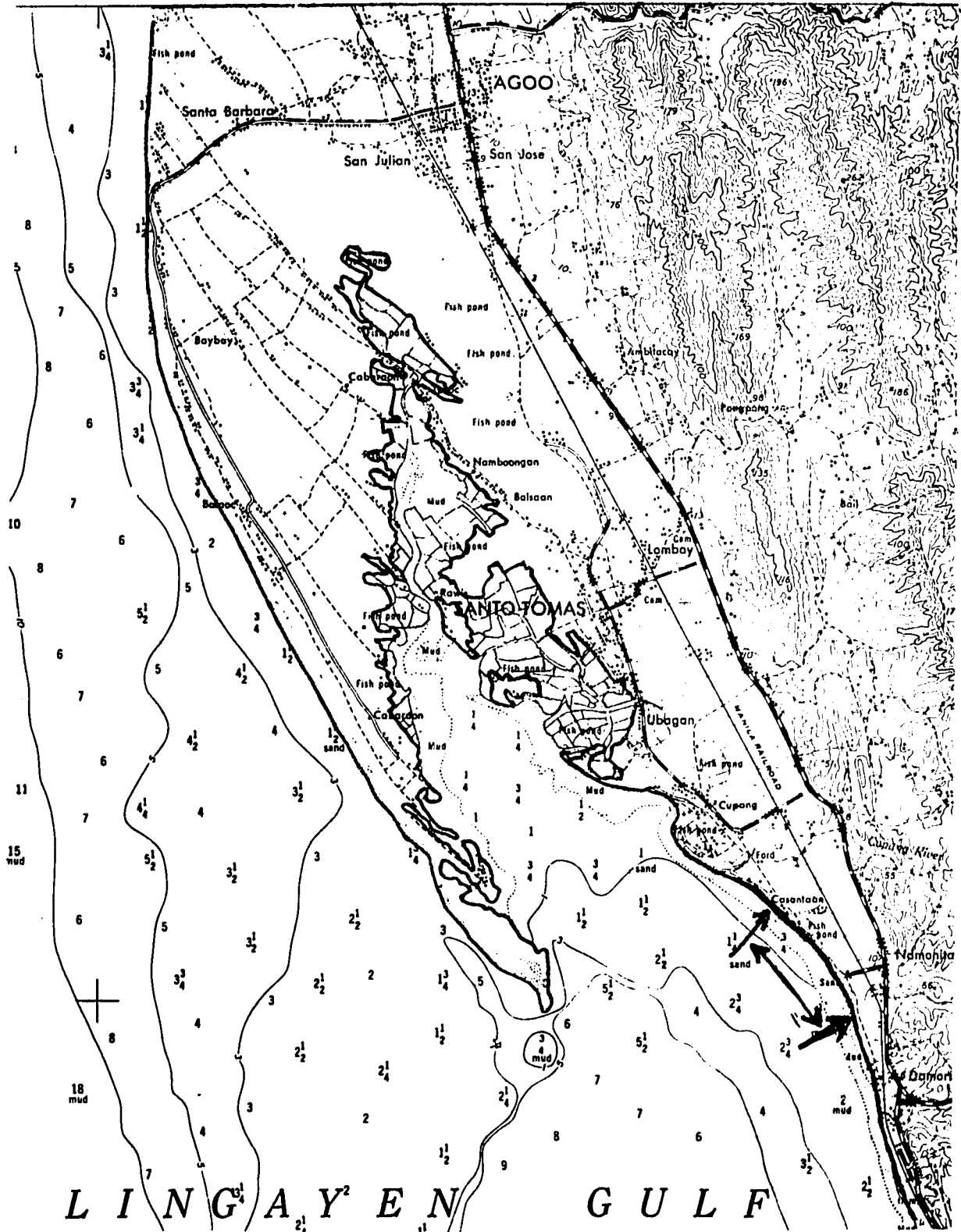
### Brackishwater Locations

#### Luzon

1. Dagat-Dagatan. This research station of the Philippines Fisheries Commission at Malabon, a short distance northwest of Manila, was established about 1950. Its effect upon Philippine methods of milkfish culture has been extremely slight as it did no consistent research on the development of management methods to increase production. It has 10 hectares in two small and six large ponds. However, the ownership of four hectares has been under litigation for the past eight years and these are still under management by the contestant and are not available for demonstration.

This area had no room for expansion and was considered a poor site for development of the proposed Brackishwater Research Station.

2. Lingayen Gulf near Santo Tomas. This site is located on a map on the following page. It is in the gulf at high tide and exposed at low tide. It is exposed to storms sweeping inland from the gulf. The area was occupied previously by milkfish ponds which were completely demolished by a typhoon. It would be possible to construct a research station there, but a heavy and expensive seawall would be necessary to protect the ponds during storms. Also, only gulf water is available as there are no streams at the site. This would prevent studies of the



Map of Lingayen Gulf Area

effect of water of various salinities upon food production, control of aquatic weeds and upon growth of fish. No soil borings were made because the area was visited at high tide.

3. Raos Demonstration Oyster Farm. This station is located also in Lingayen Gulf on a protected cove between Santo Tomas and a peninsula extending into the gulf. The farm is a plot in the gulf with oysters grown by the hanging line method, with oyster shells spaced at intervals on a plastic line or wire suspended vertically from parallel bamboo poles. No records were kept of the area of the experimental plots, the production obtained or the costs of production. Its remoteness prevented its usefulness for demonstration. This area is close to that described above and was not suitable for development of a research station.

4. Malabon. This area along Manila Bay near Manila has many milkfish ponds. This tidal creek was heavily polluted by industry to such an extent that oyster, crab and fish are no longer found in commercial amounts in that area. The encroachment of industry and demand for house sites has resulted in some ponds being converted into housing and industrial sites. The area was not suitable for development of a research station.

Fish farmers in the area were beginning to fertilize ponds and feed milkfish. Rice bran and corn bran were used as feeds. One grower reported death of fingerlings which he attributed to inadequate nutrition because the fish were emaciated. Another believed the trouble was caused by fish parasites. Without research to develop good diets for fish and without experts who can determine causes of mortality and their prevention, occasional severe losses of fish are to be expected.

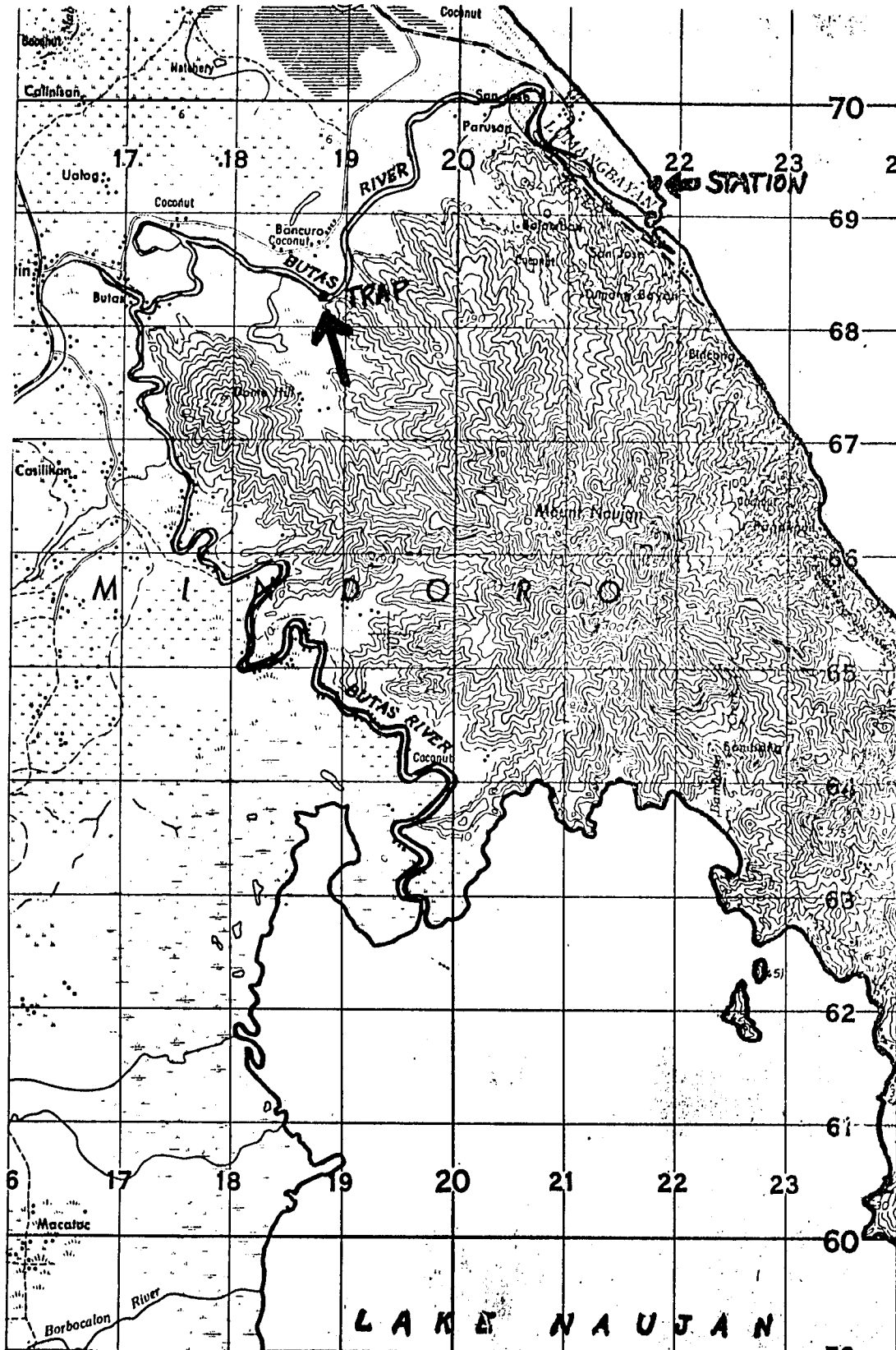
Water in these ponds becomes twice as salty as sea water during dry periods. No freshwater streams were available to reduce the salinity. At such times, milkfish were reported to grow at a much reduced rate.

### Mindoro

Naujan Sabalo Hatchery Project. This station is located on a volcanic sand beach near the mouth of the Butas River which flows from Lake Naujan to the sea (see map on following page). In the estuarine area, the name changes to the Lumangbayan River. Chanos reared in ponds are called bangos or milkfish, while those from the sea are locally called Sabalo, although they are the same species. Sabalo, eight to ten inches in length, migrate from the sea up the Butas River to feed in freshwater Naujan Lake. Large milkfish (three to five kg) migrate seaward down the river in November to February.

Unfortunately, a trap operated on the Butas River intercepts and captures most of the seaward migrants. The right to operate the trap on the river and to harvest fish over 100 meters offshore in Lake Naujan is sold to the highest bidder every five years by the Naujan local government. The revenue realized is about P 140,000 per year. Gray and red snappers and mullet also migrate into and out of this freshwater lake. The catch is reported to be about 150 tons of fish yearly at the trap. While unfortunate for migrating fish, the trap should facilitate the work of the laboratory in obtaining milkfish for experiments.

Spawning only takes place after the adult milkfish spends some time at sea. The large fish migrating out of the freshwater lake were never found with mature eggs. Spawning begins in March offshore in the sea and the peak of fry collection



Map showing Lake Naujan, Butas River, and location of Naujan Sabalo Hatchery Station

along the beaches is in June and ends in July. Laboratory personnel observed Sabalo apparently in the spawning act in offshore areas. Twenty were captured by using gill nets, but only three lived and these are now held in a brackishwater pond. The laboratory there appears to be located in an area where effective research on spawning might be carried on.

About one year ago part of the laboratory building was destroyed by an earthquake. It is being slowly repaired and enlarged by using local labor. Unfortunately for the future of the station, the sea is constantly eroding away the exposed black volcanic sand beach. Old timers say the land there used to extend one kilometer out into the sea. The last storm washed sand to the laboratory site. An expensive seawall would be necessary to protect the laboratory's investment. The beach slope is steep and at low tide, a vertical drop of five feet exposes about 100 meters or less of beach.

Because of the unprotected exposure to erosion by the sea, the future of the laboratory is quite uncertain. The location was thus considered unsuitable for establishment of a research station.

The principal advantage of spawning the milkfish under hatchery conditions is that this would allow selection of superior brood fish and development of improved strains for fishculture. The catching of Sabalo at sea in a mature condition and spawning them in a hatchery instead of at sea would not appear to be especially important under Philippine conditions where abundant fry can be collected along the beaches.

The fish should be raised from fry to brood size under conditions whereby superior individuals could be identified and used as brood fish and where the

condition necessary for development of eggs and spawning could be studied on an experimental basis.

### Mindanao

1. Cotabato - Parang Area. In this area, mangrove swamps along the coast and adjacent to estuaries of river are being converted into brackishwater fish ponds. Santos ponds covered 2,000 hectares and Sarmiento Enterprises was building a 750-hectare fish farm. Costs of construction for gates on the canals from the sea and from the river were approximately \$1,700 each. The cost per hectare of converting swamp to ponds of 4- to 10-hectare size was approximately \$1,225 with wooden temporary gates to each pond. The installation of concrete gates was estimated at \$200 each.

Construction of water canals and dams was principally by use of a crane with a 30-foot boom clam shell bucket. A barge 18' x 24' was used to transport this crane. The total cost of operation of the crane was estimated at approximately \$20 per 8-hour day.

The swamp areas are owned by the government and leased to individuals or companies for development into fish ponds. Many sites were still available, but the remoteness of the area made it undesirable for a research station.

2. Lala Area. This location is along Panguil Bay approximately 60 kilometers from Iligan. The Northern Mindanao Demonstration Fish Farm of the Philippines Fisheries Commission is located here. The station has 12 hectares, with 7 hectares in ponds. Private fishfarmers in this area operated from 20 to 1,000 hectares of ponds. The area was considered too remote and difficult for access for

a research station. One individual had lost over 60 per cent of his ponds during an earthquake in 1955.

Panay

1. Western Visayas Demonstration Station. This station was in the edge of Iloilo and could serve a useful purpose for demonstration of advanced fishculture practices. In fact, it was presently trying out a modified Taiwan system of management. This area was leased from the city, which wanted to reclaim part of the station land.

2. Leganes Area. The municipality of Leganes, about 10 miles from Iloilo, owns 180 hectares of land which it leases to fishpond operators, but was willing to give a long-term lease for a research station. This was the best site for the Brackishwater Research Station found and is described in detail elsewhere in this report.



FIELD STATIONS OF THE PHILIPPINE FISHERIES COMMISSION  
FRESHWATER FISHERIES DIVISION

1. Central Luzon Demonstration Fish Farm and Nursery  
Tanay, Rizal
2. Magsaysay Memorial Fish Farm and Nursery  
Looc, Castillejos, Zambales
3. Bay Demonstration Fish Farm  
Sto. Domingo, Bay, Laguna
4. Sta. Cruz Demonstration Fish Farm  
Sta. Cruz, Laguna
5. Calamba Freshwater Demonstration Fish Farm  
Calamba, Laguna
6. Abra Demonstration Fish Farm  
Kirmay, San Isidro, Abra
7. Cagayan Demonstration Fish Farm  
Camalanuigan, Cagayan
8. San Pablo Freshwater Demonstration Fish Farm  
San Pablo, Isabela
9. San Mateo Freshwater Demonstration Fish Farm  
San Mateo, Isabela
10. Banaue Freshwater Demonstration Fish Farm  
Benguet, Mt. Province
11. Agusan Freshwater Demonstration Fish Farm  
Kitcharao, Agusan
12. Lanao Freshwater Demonstration Fish Farm  
Kialdan, Marantao, Lanao del Sur
13. Cotabato Freshwater Demonstration Fish Farm  
Buluan, Cotabato
14. Laguna de Bay Limnological Unit  
Los Baños, Laguna
15. Limnological Station  
Lanao del Sur
16. Naujan Sabalo Hatchery Project  
Naujan, Mindoro

FIELD STATIONS, BRACKISHWATER FISH CULTURE SECTION  
ESTUARINE FISHERIES DIVISION

1. Northern Luzon Demonstration Fish Farm  
Claveria, Cagayan
2. Dagat-dagatan Salt Water Demonstration Fish Farm  
Malabon, Rizal
3. Sorsogon Demonstration Fish Farm  
Sorsogon, Sorsogon
4. Bohol Demonstration Fish Farm
5. Western Visayas Demonstration Fish Farm  
Molo, Iloilo City
6. Northern Mindanao Demonstration Fish Farm  
Lala, Lanao
7. Leyte Demonstration Fish Farm  
Leyte, Leyte
8. Nalvo Lake Demonstration Fish Farm  
Pasuquin, Ilocos Norte
9. Raois Demonstration Oyster Farm  
Sto. Tomas, Lingayen Gulf

U.P. INSTITUTE FOR FISHERIES DEVELOPMENT AND RESEARCH

REPUBLIC ACT NO. 4514

AN ACT TO ESTABLISH AN INSTITUTE OF FISHERIES DEVELOPMENT AND RESEARCH WITHIN THE COLLEGE OF FISHERIES OF THE UNIVERSITY OF THE PHILIPPINES TO PROVIDE FOR ITS ADMINISTRATION AND MAINTENANCE, AND FOR OTHER PURPOSES.

Be it enacted by the Senate and House of Representatives of the Philippines in Congress assembled:

SECTION 1. It is hereby declared a national policy to encourage basic as well as applied research and advanced technical training in fisheries for the proper development and utilization of our fishery resources which are vital to the economic well-being of the Filipino people.

SECTION 2. Pursuant to the national policy enunciated in the preceding section, the University of the Philippines is hereby authorized to establish an Institute of Fisheries Development and Research within its College of Fisheries, hereinafter to be known as the Institute, which shall consist of:

(a) Suitable physical facilities for conducting researches in the major fields in fisheries, namely, marine fisheries, inland fisheries, and fisheries technology;

(b) Accessory physical facilities, such as library, museum, aquaria, and for related activities as dissemination of information, communication, transportation, and collaboration with fisheries organizations, scientists, and scholars.

(c) Regular staff of research scientists, including foreign fisheries experts, technicians and administrative personnel, to be augmented as circumstances require.

SECTION 3. The Institute shall discharge the following functions:

(a) To undertake basic and applied research in the major fields in fisheries, namely, marine fisheries, inland fisheries and fisheries technology, for the purpose of enriching and applying the knowledge obtained to the fisheries industry;

(b) To disseminate the results of these researches and to encourage their application to and adoption by the fisheries industry;

(c) To provide assistance on request and when feasible to government and private fishery agencies and individuals;

(d) To provide technical manpower training for the development of our fishing industry and to recommend deserving citizens for training, for government and private grants, and for scholarships both in the Philippines and abroad;

(e) To collaborate on request and when feasible with fishery schools, government agencies, particularly the Fisheries Commission, private organizations or individuals in the furtherance of knowledge in fisheries.

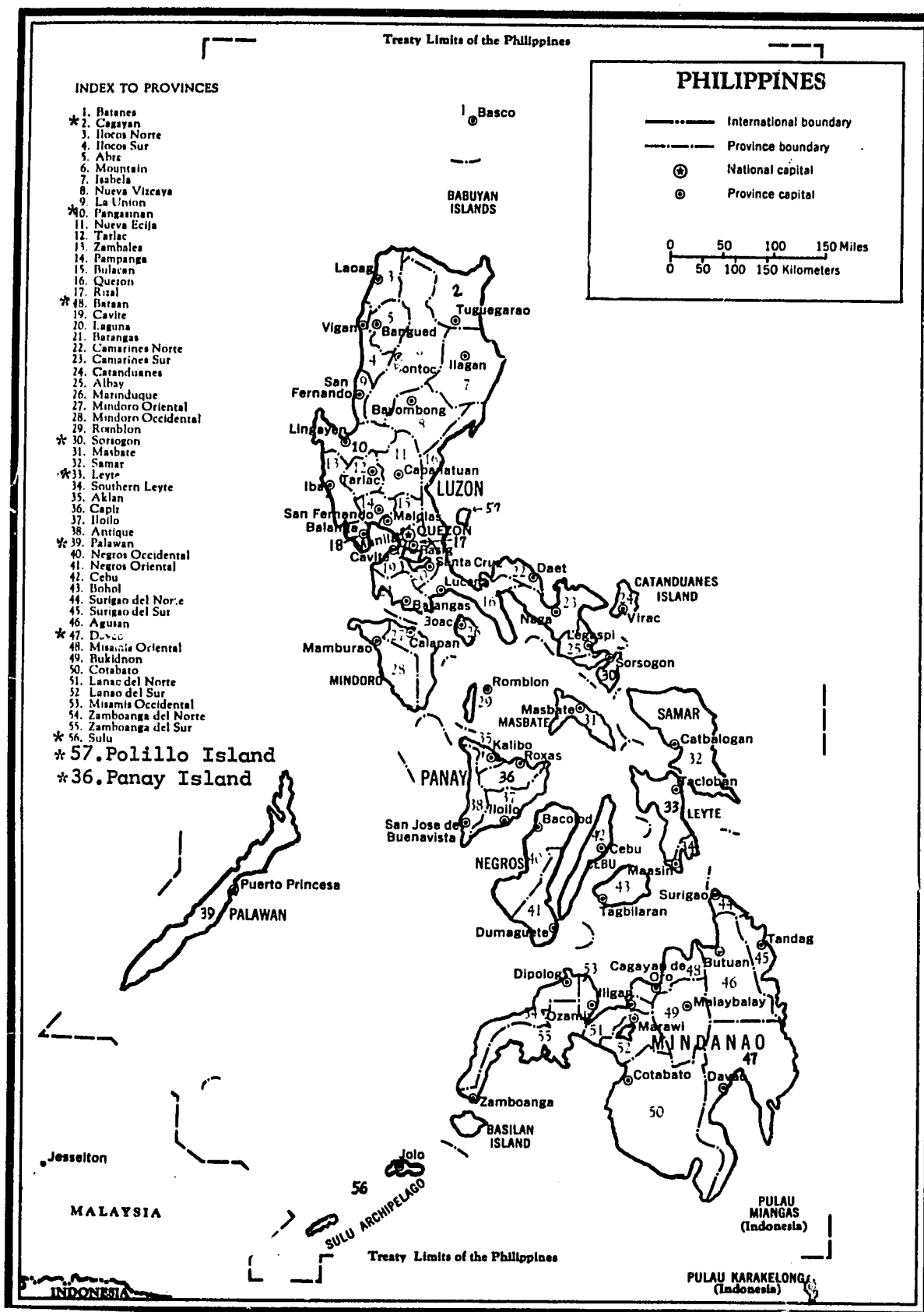
SECTION 4. An Advisory Council is hereby created composed of the Dean of the College of Fisheries, as Chairman, the Fisheries Commissioner, and three other members appointed by the Board of Regents on recommendation of the President of the University, who shall represent the marine industries, including fishing and canning of marine products. The Council shall advise the Institute of technical and policy matters.

SECTION 5. The Institute is authorized to maintain experiment and demonstration stations with field offices at suitable places in the Philippines. The Director of Lands shall, within one year from the effectivity of this Act, convey, cede, and transfer in full ownership to the University of the Philippines suitable parcels of public land along the coast not otherwise reserved and not exceeding five hundred hectares per parcel in each of the following places: Rizal, Bataan, Sorsogon, Cagayan, Pangasinan, Polillo Island, Panay Island, Palawan, Sulu, Leyte and Davao, for the use of the Institute in carrying out the purpose of this Act.

SECTION 6. The University of the Philippines may seek or obtain the services of any professional or technical personnel of any agency of the Philippine Government to provide instruction, perform research, and such other activities as may be necessary for the Institute. Such personnel may be given additional compensation in the form of honoraria to be determined by the University of the Philippines upon recommendation of the Institute, any law to the contrary notwithstanding.

SECTION 7. To provide physical facilities for the Institute, such as buildings, laboratories, pilot plants, fishponds, fishing boats, etc., the sum of two million pesos is hereby authorized to be appropriated out of any funds in the National Treasury not otherwise appropriated. Thereafter, an annual appropriation of such sums as may be necessary shall be included in the annual General Appropriations Act for the operation of said Institute.

SECTION 8. This Act shall take effect upon its approval.



Map showing provinces in which proposed marine stations are to be established by the Institute of Fisheries Development and Research. (Asterisk indicates provinces.)

Approved, June 19, 1965

**FERDINAND E. MARCOS**  
President of the Senate

**CORNELIO T. VILLAREAL**  
Speaker of the House of  
Representatives

Finally passed by the Senate  
on May 18, 1965

This Act, which originated  
in the House of Representatives,  
was finally passed by the same  
on May 20, 1965.

**REGINO S. EUSTAQUIO**  
Secretary of the Senate

**INOCENCIO B. PAREJA**  
Secretary of the House of  
Representatives

Approved:

**DIOSDADO MACAPAGAL**  
President of the Philippines

TRUE COPY