BASIC DESIGN STUDY REPORT ON ESTABLISHMENT OF FRESHWATER AQUACULTURE TRAINING AND LABORATORY COMPLEX, FRESHWATER AQUACULTURE CENTER, CENTRAL LUZON STATE UNIVERSITY, REPUBLIC OF THE PHILIPPINES

SEPTEMBER 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

(J I C A)

Preface

In response to a request of the Government of the Republic of the Philippines, the Japanese Government decided to conduct a survey on the Basic Design for the Construction Project of Freshwater Aquaculture Training and Laboratory Complex, Freshwater Aquaculture Center, Central Luzon State University and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to the Philippines a survey team headed by Dr. Masaru Fujiya from June 24 to July 14, 1981.

The team had discussions with the authorities concerned of the Government of the Philippines on the establishment of the Center and conducted a field survey in Central Luzon State University, Muñoz, Nueva Ecija. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

September, 1981

Keisuke Arita,
President,
Japan International Cooperation Agency

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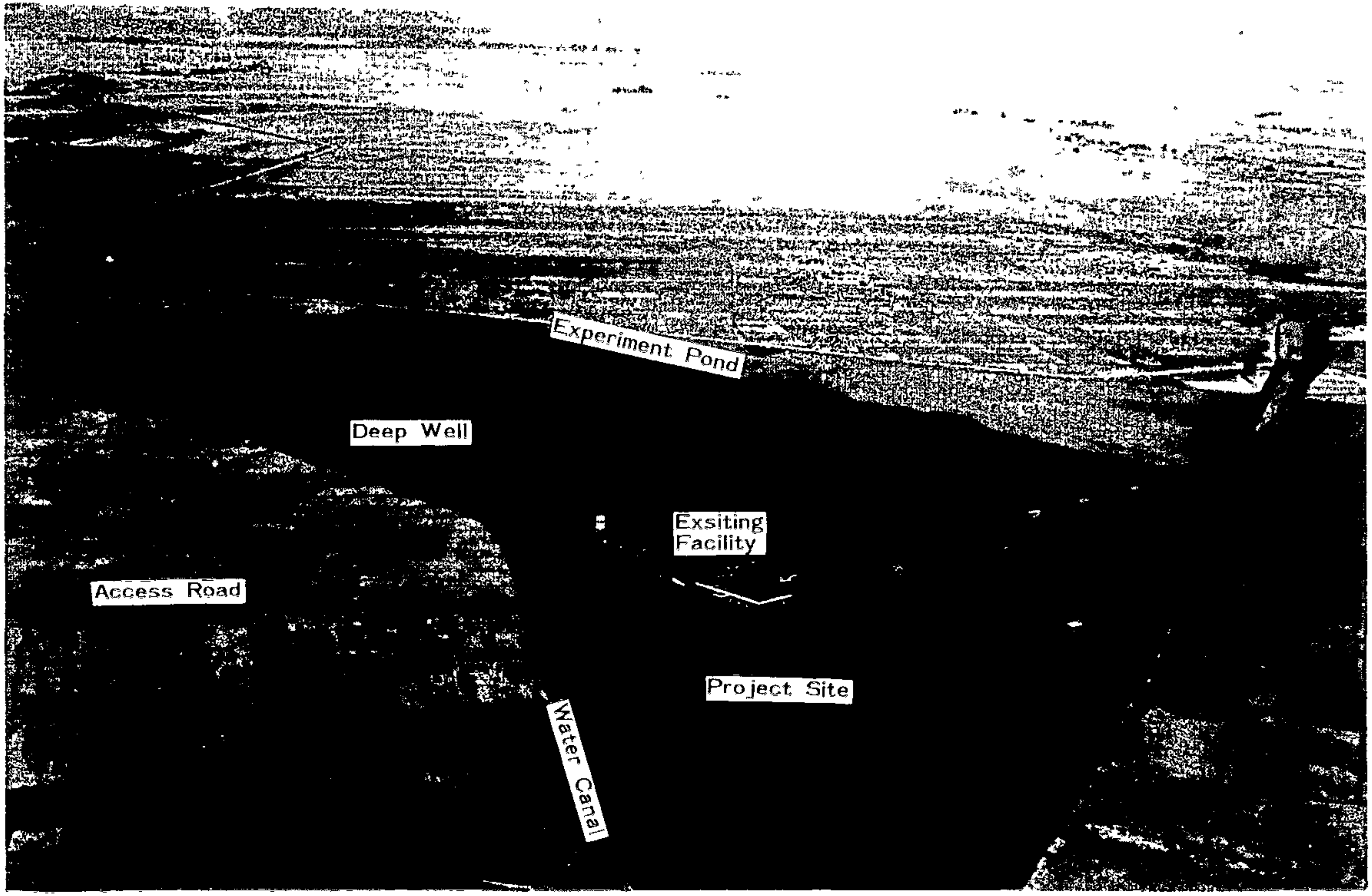
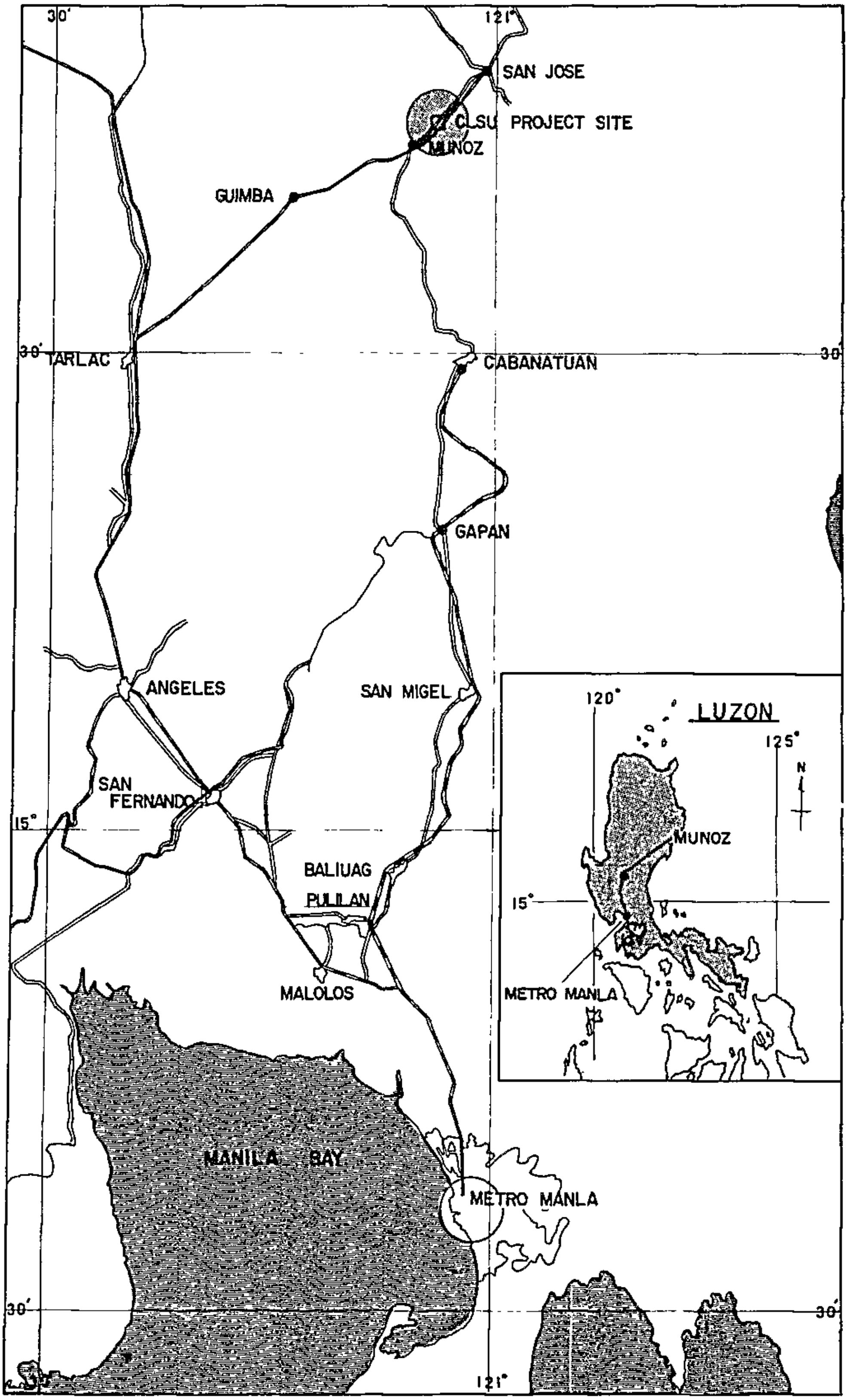
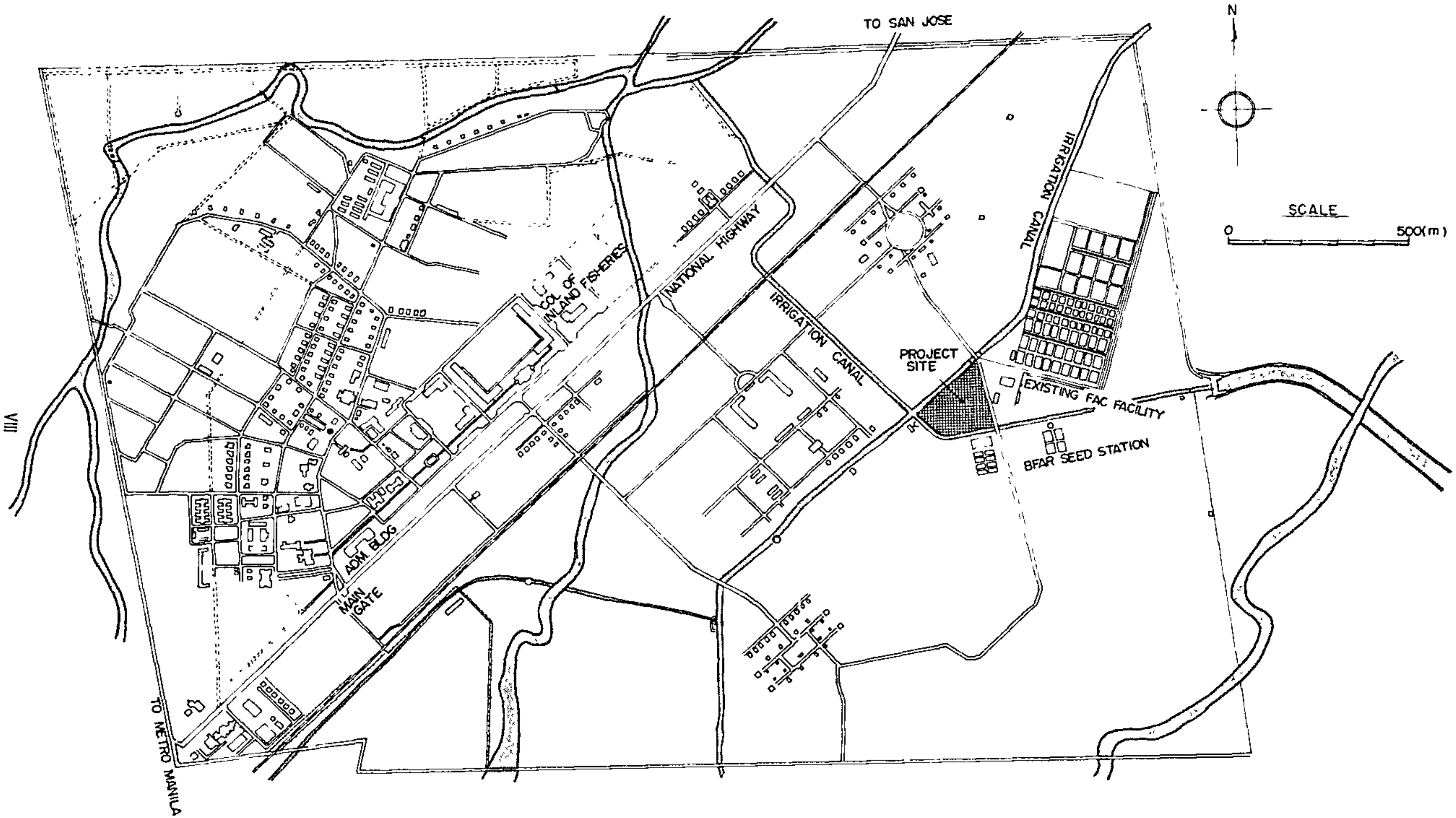


Aerial View of the Project Site



MANILA - MUÑOS



CAMPUS MAP – CENTRAL LUZON STATE UNIVERSITY

SUMMARY

1. For promoting aquaculture, the Government of the Philippines is at present constructing a Seed Production Station for freshwater fish species in Nueva Ecija, Central Luzon in order to maintain a stable supply of fry. In line with this project, the Government has also been studying to enlarge the Freshwater Aquaculture Center of Central Luzon State University (CLSU) to strengthen the research and training structure in the field of freshwater aquaculture and has requested a Grant-in-Aid from the Government of Japan.

2. The Freshwater Aquaculture Center of CLSU was originally founded to support the "Inland Fisheries Project" undertaken by the Philippine Government. The Center is at present housed in 4 buildings; its fish pond area covers some 11 hectares and has water supply facilities from both deep and shallow wells. Its faculty is drawn from the University's College of Inland Fisheries.

3. CLSU is located about 3 kilometers north of the city of Munoz, Province of Nueva Ecija, on national highway route 5. It is about 140 kilometers north of Metro-Manila. The Freshwater Aquaculture Center occupies the eastern section of the campus spreading over 658ha. The proposed site for the present project is on flat, university-owned land adjacent to the existing facilities.

   With regard to site preparation, some cutting of shrubbery on parts of the site and slight banking may be necessary but other logistics are superb and basic facilities such as power, water supply and drainage, and access roads are all available.

4. Based on consideration of various conditions--e.g., existing facilities and research activities, management systems, future plans, site conditions, and relations with public agencies--, it would be appropriate to expand the facilities, as summarized below:

	Category	Type of Facility	Number
1.	Buildings	A. Research Building-- 1-story, reinforced concrete to house various research labs: e.g., Fish Pathology, Fish Nutrition, Aquatic Ecosystem; a centralized room for measuring equipment; a room for thermal equipment; etc.	1 building
		B. Training and Administrative Building-- 2-story, reinforced concrete to house Director's office; Assistant director's office; other offices; conference room; library; classrooms; cafeteria; etc.	1 building
		C. Wet Laboratory Building-- 1-story steel frame to house Feed development and fish processing lab; Culture tank room; Concrete tanks; etc.	1 building
		D. Other-- 1-story steel frame ... Generator room; ... Pump room	1 building

2. Facilities	... Ground water intake system	1 system
	... Air supply facilities using air blowers	1 "
	... Small prefabricated refrigerator for preserving bait and feed	1 "
	... Emergency generator to assure electrical supply to essential facilities in the event of a power stoppage	1 "
3. Equipment	A. For Research and Training:	1 set
	... Animo-acid analyzer	
	... Microscopes	
	... Gaschromatography	
	... PH meter	
	... Scale	
	... Flowmeter	
	... Central lab tables	
	... Draft chamber	
	... Working desks and chairs	
	B. Audio-visual Equipment	1 set
	... Slide projectors; VTR	
	... Overhead projectors; tape recorders	
	C. Other	1 set
	Plastic tank; 4-wheel drive vehicle; Small boat; Repair tools, etc.	

5. If the project were implemented, the estimated period of construction, including detail design stage, would be in the order of 15 months.

6. With regard to operation of the new facilities upon completion, judging from the existing management set-up at Freshwater Aquaculture Center which has been operating the Center for more than 7 years since its foundation, with at present 23 senior staff included in the organization, and from the Center's practicable future plan to recruit 6 technical proffesionals by 1985, personnel resources appear to present no problem.

   With respect to operating funds, the increase in the total administrative budget occured in connection with the facilities expansion will amount to roughly 300,000 Pesos per year which represents some 15% to 17% of the total yearly budget for the Center. However considering the fact that the Center has secured for the past few years a 15%-20% increased operation budget yearly, no major problem with continuing funding will be anticipated. Nevertheless, since there will be considerable budgetary dependence at present on the Governmental agencies such as the National Science Development Board to supplement the University's own budget, it would be helpful if University officials could make a concentrated effort to assure a fixed annual operational budget for the Center.

7. The present project under study has been evaluated with an outlook which anticipates an increasingly important role for freshwater aquaculture in Philippine rural development. If the Grant-in-Aid from the Government of Japan for this project is successfully fused with the active interest of the Philippine Government in implementing the project and a continuous Center management effort on the part of CLSU, this project will no doubt make a major contribution to the development of freshwater aquaculture fisheries in the Philippines.

SECTION ONE

OUTLINE OF THE STUDY

1-1 Background of the Study

As may be seen with the brackish water cultivation of milkfish, aquaculture in the Philippines has had a long history. But with regard to freshwater cultivation, the history is quite short. The reasons for this are as follows: first, the distribution of animal genii in the Philippine archipelago shows distinct difference from Asian-type and Australian-type. Secondly, generally speaking, animal species in an island setting are said to be smaller than closely related continental species. And thirdly, few of the traditional freshwater species available in the Philippines are suitable to aquaculture.

However, in 1960, Tilapia (T. mossambica) was introduced from Thailand, and since then interest in freshwater aquaculture of this species along with common carp and catfish has grown apace. At the same time, research has progressed on Tilapia sex reversal, rice fish cultivation techniques, techniques for polyculture with domestic fowl and livestock, agricultural chemicals and feeds, and many specific accomplishments have been recorded in the field of freshwater aquaculture.

The total fish catch in the Philippines in 1977 was 1.5 million metric tons; in 1978 1.58 M/T. The 1979 total showed little change at 1,581,000 M/T, but started to turn up again in 1980, at 1.67 million M/T. The expected catch in 1981 is expected to be slightly higher than the 1980 figure. Looking at a breakdown of the above catch totals, it will be seen that the catch landed by commercial vessels of 3 tons or over--the commercial fishing sector dropped from 518,000 M/T in 1977 to 488,000 M/T in 1980 reflecting the fact that this sector was hit hardest by the sharp increase in fuel prices following the second oil crisis. In contrast to this declining trend, the municipal fishery--mainly using bancas with outboard-powered engines or unpowered-- as well as the aquaculture sector both showed gains-- the former from

875,000 M/T in 1977 to 1,049,000 in 1980; the latter from 116,000 M/T to 136,000 M/T over the same period. However, it is now feared that production from the outboard powered boats within the municipal fishery will begin to stagnate, owing to the fact that recently gasoline prices have climbing at a faster pace than diesel fuel. As a non-petroleum country, the Philippine Government has been taking various measures to develop fishery production with a lesser dependence on fuel. In this connection, it is putting considerable effort into expanding the aquaculture sector, which is felt capable of contributing a larger output based on efficient use of the existing production base.

Freshwater aquaculture, in particular, is an important element in supplying animal proteins and fats to the country's rural population and is an activity that can mobilize effectively the existing land, human, and water resources within the agricultural development program aimed at expanding and diversifying agricultural production. As such, aquaculture is expected to play an ever increasing role in Philippine rural development. Aquaculture is not just being promoted as an independent sector but is being increasingly as a part of planning for integrated agricultural development and food and nutritional planning.

The management of the nation's marine resources, the granting of fishing permits, and training--including the freshwater fishery sectors--are all jointly administered by the Bureau of Fisheries and Aquatic Resources (BFAR) within the Ministry of Natural Resources. However, in addition to this agency, there are other organizations at the national level concerned with aquaculture. In the field of brackish water aquaculture, there is a Brackishwater Aquaculture Center within the University of the Philippines; and, in the area of freshwater aquaculture, there is a Freshwater Aquaculture Center at Central Luzon State University (CLSU). The BFAR, in an effort to establish a structure for seed supply, which has been a bottleneck to the development of freshwater aquaculture in the Philippines, has decided to construct a Seed Production Station for freshwater fisheries, with the first such facility to be situated adjacent to the Freshwater

Aquaculture Center at CLSU. It is now just a matter of waiting for this operation to come on stream. The initial annual production targets are: Tilapia nilotica--15 million fish; and common carp--5 million fish. Consideration is being given to the possible construction of two additional seed stations.

In response to the Philippine Government's efforts to strengthen programs in the area of aquaculture production, there is an obvious need to expand facilities at the Freshwater Aquaculture Center, which is charged with the responsibility of research and training in this area. Representatives of CLSU and the various governmental agencies concerned have been discussing this program for some time, and the Government of the Philippines has decided to ask the Government of Japan for a grant-in-aid to help implement this project. In response to this request, the Japan International Cooperation Agency dispatched a Basic Design Study Team in connection with the subject project.

The Basic Design Study Team comprised seven members under the leadership of Dr. Masaru Fujiya, Counsellor, Research Dept., Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, and afterward the draft report explanation team comprising three members was also sent to the Philippines. The composition of the Team is provided in Appendix IV at the end of this report.

1-2 Survey Itinerary

The basic design survey was conducted over a 21-day period, extending from June 24 through July 14, 1981, and the draft report explanations were made over a 6-day period, extending from August 31 through September 5, 1981. Schedule of the activities of the Teams is provided in Appendix VI at the end of the report.

I-3 Discussants

A list of discussants is provided in Appendix V at the end of the report.

I-4 Minutes of Discussions

Minutes of Discussions were signed and exchanged in English by and between the Executive Vice President of Central Luzon State University and the Team Leader on July 3, 1981. A copy of the Minutes is provided in Appendices I and II at the end of the report.

SECTION TWO

BACKGROUND OF THE PROJECT

2-1 The Fishing Industry

The Philippine Islands are composed of more than 7,000 large and small islands, which are linked by a submerged land bridge with the Asian and Australian continents. Above this land bridge flow the South China and Java Seas. Most of these islands are of volcanic origin and so their topography, including sea-bed topography, is highly complex, with deep trenches and basins, exhibiting unique formations of mountain ranges and volcanoes. Owing to the large number of islands, the Philippines' extended coastline is quite long, running 17,460 km. However, the continental shelf--up to 200 meters depth--is not particularly large at 184,600 square km. Wind direction changes between the northeast monsoon season, running from October through April, and the southwest monsoon season between May and September. However, wind velocity is not such as to impede fishing production. In November, 1978, the Philippine Government established a 200-mile exclusive economic zone.

Many species are found in Philippine waters but, given the paucity of upwelling and estuary the waters are generally not overly productive. Some 100 species are commercially exploitable, among which high catches (based on 1979 catch data) were recorded for: (in thousand tons) Roundscad 146.2 M/T; Indian sardine 106.4 M/T, Frigate mackerel 79.9 M/T, Anchovy 70.5 M/T, and Slipmouth 70.4 M/T, Yellowfin 49.2 M/T, Bigeye scad 47 M/T, and Skipjack 45.1 M/T. These catches are administratively distributed between two categories of fishery: commercial fisheries, using vessels of 3 GT or over, licensed by the BFAR within Ministry of Natural Resources to fish in depths of 7 fathoms or more; and municipal fisheries (including oyster and mussel aquaculture), licensed by local authorities to operate with vessels of less than 3 GT or without any vessels. In addition to the above, there is production from aquaculture operations, but we will defer discussion of this sector to a later section. The 1979 catch by major species is given below.

Catch by Major Species

(Unit: 1,000 M/T)

Species	Scientific name	1976	1977	1978	1979
Round scad	Decapterus spp.	224.7	182.7	142.6	142.6
Indian sardine	Sardinella spp.	61.7	127.7	146.7	106.4
Indian mackerel	Auxis spp.	28.3	43.0	50.9	79.9
Anchovy	Family Engraulidae	66.1	50.2	76.1	70.5
Slipmouth	Family Leioguathidae	82.7	72.8	68.2	70.4
Yellowfin	Neothunnus macropterus	44.5	63.1	47.0	49.2
Bigeye scad	Selar crumenophthalmus	42.5	56.0	46.5	47.0
Skipjack	Katsuwonus pelamis	29.1	55.1	49.7	45.1
Striped mackerel	Rastrelliger spp.	32.1	31.8	38.4	39.0
Butterfly-bream	Nemipterus spp.	53.4	51.6	36.8	32.5
Sharp-nosed sprat	Dussumieria spp.	44.0	60.8	35.8	24.0
Swimming crab	Portunus spp.	10.5	9.7	13.3	17.4
Shrimp	Penaeus spp. Metapenaeus spp.	41.0	25.7	24.4	23.7
Squid	Family Loliginidae Family Speiidae	26.4	27.1	32.4	29.3
Seaweed	Eucheuma spp.	-	-	85.8	105.4

Source: Fisheries Statistics of the Philippines, Vol. 29, 1979

Of the fishing vessels supproting the above catches, vessels over 3 GT in 1979 totaled 2,920, operated by 42,145 fishermen. The number of vessels in the commercial fishery totaled 2,904 in 1977 and 2,908 in

1978. Despite the expected slow-down in growth in the commercial fisheries sector, it may be noted that the bulk of their catch is accounted for by trawlers in the 20-50 GT class, purse seiners in the 50-100 GT class, and bag netters in the 10-20 GT class. The main vessel type used in the municipal fisheries is the banca, a traditional wooden boat equipped with outriggers. According to 1977 data, the number of banca was 214,797, of which some 38% (or 80,770 vessels) were powered, mostly with outboard motors in the 5-20 HP class. The number of fishermen participating in this fishery totalled 365,388.

Fish prices in the Philippines have been on a rising trend. The retail price index for fish products (comprising six species: striped mackerel, milkfish, butterfly bream, fusilier, round scad, and slipmouth), with 1972 as 100, rose to 199 in 1975, 235 in 1976, and 250 in 1977, generally outpacing the general consumer price index in all those years. In 1978, the increase was temporarily contained, but, in 1979, retail prices for the above six species rose on the average by 9.8 Pesos/kg, following by a rise of 11.79 Pesos in 1980 and 14.14 Pesos in the first quarter of 1981. As these figures show, the annual rate of increase has been consistently in the order of 20%. Given the low elasticity of consumption for fish products, it will be far from easy to arrest this trend.

Retail fish market in Manila

The Philippine fishing industry is grappling with many problems. Among the many problems besetting the Philippine fishing industry, one of the most serious is the increase in production costs resulting from the rapid escalation of fuel prices. Following the first oil crisis, the

Government of the Philippines adopted policies to hold down oil prices, but decided to pass on the OPEC increases starting in August, 1979 to domestic prices, which caused a major increase in those prices. These conditions may be seen in the following table showing wholesale prices for diesel fuel and gasoline.

Wholesale Prices for Diesel Fuel and Gasoline

(Pesos per liter)

Year (Month)	Gasoline	Price Index	Diesel Fuel	Price Index
1977	1.585	100	1.143	100
March, 1979	1.976	124.7	1.331	116.4
August, 1979	2.683	169.4	1.582	138.4
February, 1980	4.151	261.9	2.25	196.9
August, 1980	4.591	289.7	2.65	231.8

Source: Philippine National Oil Corp.

The annual volume of fuel oil consumed by the Philippine fishing industry is estimated at--

.... 665,000 kiloliters of diesel fuel by the commercial fisheries;

.... 135,000 kl. by the municipal fisheries; and

.... 25,000 kl. by the aquaculture fisheries.

The relative share of fuel costs in total production costs, by fishery sector, is estimated as shown in the table below.

•Fishery Sector	Percent of Fuel Costs in Total Production Costs
Commercial	40%
Municipal	38%
Aquaculture	5%

Source: The Fuel Component of Fishing Costs, Elizabeth D. Samson, "Fisheries Today", Vol. II, No. 4, Nov. 1979

The above values may seem low, in comparison with the present conditions in Japan, but they are drawn from various estimates and so may be taken as quite reliable.

In any event, the preceding analysis indicates that there are in summary three major problems which the Philippine fishing industry must solve:

1) improving the efficiency of fishery production;
2) development and promotion of fishery production that is less fuel dependent; and
3) counter-measures to handle the possible withdrawal of marginal fishermen from the fishing industry.

2-2 The Aquaculture Fishery

Brakish water cultivation of milkfish continues to represent aquaculture activity in the Philippines. Milkfish aquaculture relies on natural seed taken between February and December, with the prime season April-May. The milkfish fingerling are taken with a large scoope net in estuaries and beach where they have begun naturally to swum upstream. The fingerling gathered by assemblers are sold to pond owners as seed. Prices of seed in areas adjacent to milkfish ponds in 1981 were 40-50 Pesos per 1,000 units.

Most of the collectors of fingerling are small municipal fishermen, for whom the collection of natural milkfish seed has considerable socio-economic significance.

The aquaculture producers raise the fingerling bought from the seed collectors in their own ponds or ponds leased from the government. The fish mature in about 4-6 months, at which time they are collected and marketed through middlemen. The principle aquaculture method for milkfish is one that is widely used in Southeast Asia--viz., pond drying → fertilization → culture of green algae → discharge of fingerling → retrieval.

Production runs from 250 to over 1,000 kg per hectare, with a large variation among producers; the average is about 600 kg--not a particlarly high level. In addition, milkfish are being experimentally raised in freshwater areas, taking advantage of their physiological characteristic of being able to live in any degree of salinity, from fresh to salt water.

The domestic demand for milkfish is quite strong, and prices have been on a rising trend. As a result, there is a powerful incentive to produce this species. Recently, however, limits to the supply of natural seed have begun to surface, and so new methods of cultivation are being adopted, such as: improvement of seed collection methods, efforts to raise yields at the transport stage; and shipping the fingerling as seed once they have been raised in the pond.

Several efforts have been made to research the production of artificial milkfish seed but, at the present time, the most promising method is the following: raise pond cultured spawning parent fish aged 4-5 years or over--called sabaro--in a large fish cage in the sea; collect the eggs that have been naturally released by the parent fish and hatch them.

Another significant species being cultivated in brackish water aquaculture is shrimp. With the rapid rise in domestic price rises in recent years and the potential for export, shrimp cultivation, which had previously been a by-product of milkfish operations, is now tending to become a monoculture operation based on seed release. Usable shrimp species in the Philippines include: Indian prawns (Penaeus indicus), Giant tiger prawns (P. monodon), Banana prawns (P. merguiensis), King shrimp (P. latisulcatus), Grooved tiger prawn (P. semisulcatus), Brown prawn (Metapenaeus ensis), and Spotted shrimp (Family sergetione). But at present, the main species being cultivated is the Giant tiger prawn. Method of artificial seed production for Giant tiger prawn have been technically established but, in practice, owing to price and quantity problems, seeds taken naturally are mostly used. Compared to Giant tiger prawns, Indian prawns, Banana prawns, and Brown prawns--the so-called white varieties--yield more natural seed, while for purposes of producing artificial seed, it is easier to raise parent shrimp and hatch larvae. Thus, these latter species are expected to be examined for aquaculture application.

Other species being used for brackish aquaculture include: mud crab, mullet, rabbit fish, and giant perch, but none of these has yet reached a commercial stage of development. With regard to the technical development of milkfish and shrimp brackish water aquaculture, there is a trend toward more capital intensive operations.

Marine culture is confined almost exclusively to clams and seaweed, with fish aquaculture as yet undeveloped. Among the clam species, the largest production volume occurs in green mussels (Mytilus smaragdinus) and oysters (Crassontrea spp); based on 1979 data, production of the former totalled 2,947 M/T; the latter 789 M/T, but the true production is believed to greatly exceed the levels shown in the statistics.

Other clam species that have been traditionally used in the Philippines include placana (window shell) and mother of pearl. Since the technology of clam aquaculture is relatively easier to disseminate than that of fish aquaculture, while investment requirements are smaller, progress in clam cultivation techniques is anticipated in the Philippines.

Among seaweeds, Eucheuma spp is being of cultivated. This red algae becomes a basic algae extract-Carageenan which is widdly used in the food processing and cosmetics industries as a stabilizer, viscosity booster, and gel formative agent. In dried form, this term has been an important Philippine export, with 1979 exports totalling 15,652 M/T and going to such countries as Denmark, U.S., West Germany, Japan, and Spain. These exports brought in foreign exchange worth 57.14 million Pesos in that year.

The main species used in freshwater aquaculture are Tilapia and common carp. At the present time, 4 species of Tilapia have been introduced into the Philippines: Tilapia massambica, T. nilotica, T. aurea, and T. zilli. The T. mossambica variety was brought in from Thailand in the 1960's and quickly spread. But, as a result of its prolificness, stunted growth developed. To correct this problem, experiments have made on male sex reversal based on hormones, but the fact is that this species has not yet taken root as an acceptable aquaculture species.

Since being introduced from Israel in 1972, research on Tilapia nilotica has been carried out with a view to improving the Tilapia varieties through hybridizing. And, as the results of this research begin to show up in the technical development of rice-fish and polyculture, Tilapia aquaculture is once again beginning to thrive. Although Tilapia in the Philippines is a foreign-derived species, it is totally accepted by the consumer. On the Manila market, it is sold at prices only slightly below milkfish.

Although the carp genus has long been known to exist in the Philippines, virtually all varieties presently used in aquaculture have been introduced from abroad within the past 20 years. In the case of grass carp (Ctenopharyngodon idella), silver carp (Hypophthalmichtys mortrix), bighead (Aristichthys nobilis), and mud carp (Cirrhina molitorella)--socalled Chinese carp--, it has been difficult to achieve artificial spawning fertilization in the pond. By way of contrast, the Indian carps --rohu (Labeo rehito), mrigal (Cirrhina mrigal), and catla (Catla catla) --can be made to spawn in the pond with simple hormone injections, and so seed production experiments are taking place in various locations.

The above species have all been introduced to the Philippines from abroad but, owing to the lack of a seed supply structure, their use in aquaculture has actually not been widespread.

Common carp (Cyprinus carpio) was first introduced as fingerling from Hong Kong in 1915, and subsequently reintroduced in on several occasions. They were released into lakes and marshes and rivers in various parts of the country and allowed to multiply. This species is now widely taken by the inland fisheries. For this reason, carp aquaculture has been carried out for a relatively long period, and so this species would probably the easiest to popularize in the future.

The carp genus generally is herbivorous, omnivorous and feeds on plankton. It also exhibits a high tolerance toward environmental changes. Since it adapts relatively easily to mixed cultivation with other fish species and to any type of aquaculture method, the BFAR is actively attempting to propagate this species on the basis of strengthening the seed supply structure through an expansion of seed production facilities. There are two catfish species used in aquaculture: Clarias macrocephalus, a native species, and Clarias batrachus, which was introduced from Thailand. During the early 1970's, there was a brief boom in Clarias batrachus aquaculture, but this rapidly abated when it became clear that the most economical method of catfish cultivation was through high-density feeding.

Aquaculture experiments have been carried out with Giant freshwater shrimp (Macrobrachium idella and M. rosenbergii) and with freshwater bivalves (Anodonta woodiana), but only time will tell whether these species can be cultivated regularly on a commercial basis.
In addition to the 60 km^2 of fish ponds, the base for Philippine freshwater aquaculture includes: 1,260 km^2 of freshwater swamplands; 2,000 km^2 of lakes; and 1,300 km^2 of reservoirs. Considering the country's climatic conditions, such as temperature and rainfall, and the sociological conditions as evidenced by the growing consumption of fish, there would appear to be ample room for expansion of freshwater aquaculture.

2-3 The Agricultural Development and Food and Nutrition Plans

The importance of rural development in the Philippines began to be recognized with the realization of a growing gap between urban and rural areas starting in the late 1960's. A structure was developed within the central government for adjusting policies to achieve a comprehensive rural development, which led during the 1970's to increased production of agricultural commodities.

The largest volume items in Philippine agriculture are rice, corn, coconut, sugar, and cassaba. From 1972 to 1979, crops (including these items) increased by an average 1 million M/T annually. During this period, effective crop area expanded at about 4% per year, and this contributed considerably to the increase in output.

The combined production of rice, corn, coconut, and sugar in 1978/1979 totalled 31,026,000 M/T with an effective crop area of 11,192,000 ha. The projected production of these four items in 1989/1990 is 47,978,000 M/T, with an effective crop area of 12,322,000 ha.* This means that the average annual production increase during the 1980 decade is expected to be 1.5 million M/T, vs. the 1.0 million of the 1970's. But effective crop area in the 1980's is slated to grow at an annual rate of only 1%, against the 4% recorded during the previous decade. Seen in terms of production per hectare of effective crop area, the 2.77 MT/ha of 1978/79 must increase to a level of 3.89 MT/ha by 1980/90. An effort will be called for to increase productivity on a variety of fronts during the 1980 decade-- development of a more effective agriculture production base, improvement of varieties, strengthening of agricultural management and social development.

Production during the 1970's of livestock and fishery products-- the mainstays for increasing animal protein supply-- increased steadily. Livestock output rose from 2,166,000 MT in 1970 to 2,878,000 in 1979, with the most important items being pork and chicken. Production of the former totalled 616,400 MT in 1979; the latter, 247,300 MT. In addition, meat production registered 123,000 MT, carabao 127,600 MT, and eggs 178,000 MT.

Breaking down the production of pork, some 68,000 MT were produced by specialized large scale facilities utilizing swine yards; while small scale operations in which pork is a by-product of other agricultural operations contirbuted 390,000 MT. Large-scale production is expected to increase in the future, but this will require technical innovations to increase feed supply and reduce its cost. It is unlikely, therefore, that there will be any decrease in the proportion of supply from by-product farm operations using crude fiber feeds and agricultural by-products which the farmers themselves are capable of raising.

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* Integrated Agricultural Production and Marketing Project, Ministry of Agriculture, Agusut, 1980

Fish production during 1971-1973 averaged 1,116,000 MT annually, and this increased at an annual rate of 4.8% to 1,581,000 MT in 1979-- a higher rate of growth than for livestock products.

Looking at growth rates by fishery section, we see that the fastest growth occurred within the municipal fisheries-- 6.9% per year, followed by aquaculture (2.5%), and commercial fisheries (1.9%).

During this period, the rise in retail prices for both livestock and fishery products slightly outpaced that of all foodstuffs, as shown in the following table:

Retail Price Index for Foodstuffs (1977/78 = 100)

	1970/71--72/73 Average	1978/79	Annual Average Increase
Edible grains	51.0	102.7	12.4%
Livestock	47.7	103.3	13.7%
Fish	44.4	104.9	15.4%
All Foodstuffs	49.2	103.2	13.1%

Source: Philippine Food and Agricultural Development and Prospects for the 1980's: Ministry of Agriculture

Per-capita livestock consumption showed a declining trend during the 1970 decade, with fish consumption increasing to compensate for this decline. Reflecting the expected future rise in income levels, demand for both livestock and fish products is projected to strengthen, along with upward price pressures. Consumption of grains during the 1980's is expected to continue to expand, owing to increased supply based on rising productivity as well as the fact that from a policy standpoint, grain prices are easier to control.

The following table shows actual average Philippine per-capita consumption levels during 1976/77 and 1978/79 along with projections for 1989/90 for the above categories:

Per-capita Consumption

(unit: kg)

	1976/77--1978/79 Average	Projected 1989/90	Average Increase
Edible Grains	295.0	321.5	0.7%
Livestock	23.0	26.1	1.1%
Fish Products	30.3	40.8	1.7%

Source: Ibid.

In 1978, the Philippine Government conducted its first survey on national nutrition and developed a Food and Nutrition Plan setting national food and nutritional goals for the 1980 decade. This survey revealed that 38% of all households were receiving less than 80% of required nutritional levels and that low incomes were the prime contributing factor in this; that, to compensate for caloric deficiencies, it would be necessary to rely on rice and oils, in which the country was capable of achieving self-sufficiency; and that it was vital to sustain protein intake levels and increase iron and Vitamin A intake among low income groups.

Reflecting these survey findings, the Food and Nutrition Plan calls for a program of stimulating production in five areas: rice, corn and livestock, edible coconut oil, fish, and other edible crops. Fish has been accorded a key position as a vitally important source of animal protein. In the future, there will be a need to develop counter-measure to cope with the continuous increase in fish producers and to rationalize the fish distribution sector.

In particular, it will be necessary to increase fish supply via catch methods that are less fuel dependent. In this connection, inland fisheries are to be reevaluated, while small-scale aquaculture along with rice-fish culture must be promoted as a means of achieving the dual goal of increasing animal protein supply and raising incomes in interior areas. This indicates the need, from a societal standpoint, to come to grips with the problem of raising the standards of small-scale fishing enterprises. However, the problem of absorbing marginal fishery producers who find it impossible to continue operations in the face of rising fuel and gear prices will be difficult to solve within the framework of the fishing industry alone, so will probably have to be handled within the context of area development.

Rice is the most important food item for the Philippine people. Rice provides 58% of total calories and 43% of total proteins in the average Philippine diet. Among the lowest income groups, these ratios are close to 70% and 50% respectively.

In 1979, with cessation of rice imports, the country achieved 100% self-sufficiency in this commodity. However, production will have to be further increased to permit increased supply and an expansion of exports, so that the 1978/79 production of 6,068,000 MT has been targeted to expand to 8,785,000 MT by 1990. The attainment of this goal will require a variety of policies to increase productivity, such as producer price supports, production incentives, improved storage facilities, and irrigation. It will be important in this connection to help marginal rice producing areas switch over to other crops.

Target production levels for 1990 for the main foodstuffs are shown in the following table:

1989/1990 Production Target for Principal Foodstuffs

(In 1,000 MT)

Item	Actual Production 1978/79	Targeted Production 1989/90
Rice	6,068	8,758.3
Corn	3,167	4,789.0
Coconuts	11,405	23,628.0
Cassaba	928	1,293.0
Sugar Cane	2,363	4,624.0
Coffee	63.3	101.6
Pork (Live weight)	616.4	835.3
Poultry (Live weight)	247.3	424.7
Commercial Fishery	500.7	1,000.0
Municipal Fishery	737.6	750.0
Aquaculture	133.6	750.0

Source: Food and Nutrition Plan (Objectives and Strategies Dec. 1980)

As shown in these figures, the Philippine Government has, in its food policies, anticipated the need during the current decade of increasing both the demand and supply of fishery products. On the demand side, the main stimulative elements are expected to be: population increase, rising incomes, imporved nutrition, and controls on the imports of livestock. But if then factors are successful in boosting demand, they will also put strong upward pressure on fish prices. To cope with this, it will be even more necessary than in the past to lower production costs and expand production volume.

In the case of livestock, which, like fish, is a major source of protein, it will be difficult to achieve a rise in production without an accompanying increase in production costs, unless there is dramatic progress in feed and production technology. In the fish sector, however, attention is being given to inland and aquaculture fisheries, which already have a production base. It is anticipated that production increases can be achieved in these areas by employing production methods that are less fuel-intensive. In short, fishery products have been seized on in the Philippine Government's agricultural development policies and Food and Nutrition Plan as a food category for which demand and supply can be simultaneously increased.

2-4 Description of CLSU and the Freshwater Aquaculture Center

CLSU started as an agricultural school in 1907 and has developed with the goal of providing high-level education in support of rural development. In December, 1950, it became an agricultural college and, in June 1964, a university, but there has been no change in the founding principles of contributing directly to the socio-economic, cultural, and political uplifting of rural society.

At present, the University is divided into seven colleges: College of Agriculture, College of Arts and Science, College of Inland Fisheries, College of Education, College of Science and Industry, College of Engineering, and College of Veterinary Science and Medicine. There are, in addition, a graduate faculty and an affiliated high school.

Main gate of CLSU

The University is located some 140 km north of Manila in the city of Munoz, Province of Nueva Ecija. It is linked to Manila by the national highway Rt. 5 and by rail. In addition to the main 658 ha campus, there is an experimental ranch of 739 ha in Carranglan (in the same Province).

The total student body numbers some 5,000, almost entirely housed in 11 male and 6 female dormitories. There is also on-campus housing for faculty and staff,so that the University in realty comprises a single community. The faculty totals 340-- 19 at the doctoral, 93 at the master's and 230 at the bachelor's level.

220 students are enrolled in the College of Inland Fisheries, with the faculty of this College composed of 4 Ph.D's 4 MA's, and 5 BA's.

Campus of CLSU

The total University operating budget in 1979/80 was about 21,980,000 Pesos, of which 70.4% was covered by government subsidies and the balance by tuition and University activities.

Total expenditures in 1979/80 were 18,960,000 Pesos, of which 50.4% was absorbed by faculty and staff salaries., 31.2% by operating and maintenance costs, and 17.8% by fixed capital expenditures. Only 0.6% or so of the total budget was used for new purchases of supplies and equipment for research activities, which perhaps underscores the acute budgetary problems the University is facing.

The University's research activities include the Research & Development Center, the Freshwater Aquaculture Center, and a few specialized R&D projects.

The fulfill its goal of contributing to the development of rural societny, in accordance with the founding principles of CLSU, the R&D Center was established to develop "Technology Packages" which can be readily absorbed by small-size farms. It also maintains close relations with governmental and international research organizations.

A unique aspect of the R&D Center is that its R&D efforts are not just confined to technological agricultural research but give considerable weight as well to research in the areas of rural development, technical and adult education, in other words, research that is truly needed for the development of rural society.

The results of these research efforts have yielded many outstanding technological achievements, including the "Farm of the Future Project", development of rice-fish culture technology, sericulture, apiculture, and vermiculture, all designed to improve the effective use of land by improvement of irrigation methods, crop diversification, and balanced application of labor, as a means of raising farm incomes.

The Center has just completed a research on a subjects in the field of rural development including titled: "Responses of Small Scale Farmers to Agricultural Technology Changes." As of 1980, research on other 9 areas is continuing apace.

The Freshwater Aquaculture Center is administratively a part of the R&D Center but in practice operates almost independently.

The predecessor of the Freshwater Aquaculture Center was the Fish Culture Research Institute established on the basis of a joint proponent with the University of the Philippines as a subordinate project of the Government's "Inland Fisheries Project", inaugurated in 1971. In 1973, the establishment was reorganized into the present Center and, effective in 1977, under an agreement with the University of the Philippines, the entire operation of the Center was entrusted to CLSU.

All faculty and staff members of the College of Inland Fisheries participate in Center operations. In addition, the Center maintains its own full-time staff composed of 9 university graduates, all of whom are engaged in their own research projects.

The 1981 research budget at the Center was 1,688,000 Pesos, a figure which excludes employee and faculty salaries. Funds are derived from a variety of sources, taking the form of research grants on a project-by-project basis from the National Science Development Board (NSDB), the Philippine Council for Agriculture and Resources Research (PCARR), the Ministry of Natural Resources (MNR), ICLARM, and the Rockfeller Foundation.

The 1981 University budget for Center operation has not yet been fianlized, but it may be expected, on the basis of past experience, to run in the order of 300,000 - 350,000 Pesos.

Since the Center's inauguration in 1975, it has conducted a broad-based program of research on freshwater aquaculture. Achievements which have already been given practical application include; improvements in the techniques of rice-fish culture, Tilapia aquaculture, and the techniques of Tilapia sex reversal.

The rice-fish culture program has constituted a major research activity since 1974, and results have already been applied in the design of paddies, determination of suitable aquaculture species, stocking densities, and seed size.

In the area of paddy design for rice-fish cluture, a trench is dug one meter wide and 0.4-0.5 meters deep in the center of the paddy providing refuge for fish during periods of falling water levels.

The bank has a base witdth of 50cm and a height of 40cm, a bit higher than the regular banks.

In species development, results have been achieved on tilapia nilotica and common carp, whether as monoculture or polyculture. In the former case, the stocking densities for tilapia should be 5,000 fish/ha, for carp, 3,000-4,000; in the latter case tilapia -4,000 and carp -2,000 per ha.

In the area of seed size, it has been established that, given the relatively short rice cultivation period (80-100 days), seeds for tilapia should be 20-25 grams and those for carp a bit larger.

The results of the past 14 experiments of rice-fish culture in the Center, based on these methods, have resulted in catches, without benefit of feed, of a minimum of 78 kg/ha and a maximum of 293 kg/ha.

In actual commercial rice-fish culture operations, average yields have been recorded of 204 kg/ha for fish and 3,850-13,950 kg/ha for rice. It has been estimated on this basis that the marginal increase in farm income comes to 677 Pesos per/ha harvest.

Results of the Center's experimental paddy operations in 1977 were as follows;

Results of Rice-Fish Culture Examination

Rice Variety	Rice yield (kg) per ha	Fish Species	Stocking Density (per ha)	Average Fish Weight (g) at time of harvest	Catch/ ha (kg)	Number of Days Cultivated
IR-36	6,900	T.nilotica	5,000	52.0	110.0	94
IR-38	5,850	T.nilotica	3,000	60.9	135.0	110
IR-40	6,550	T.nilotica	4,000	47.5	(128)	
		C.Carpio	2,000	94.7	(165)	94
		(polyculture)			293.0	
IR-40	6,450	T.nilotica	5,000	51.3	151.0	104
IR-40	4,350	T.nilotica	5,000	32.7	133.0	72
IR-40	4,400	T.nilotica	5,000	41.9	176.0	72
IR-40	4,750	T.nilotica	5,000	47.6	211.0	72

Source: Improved Rice-Fish Culture in the Philippines; Rodolfo G. Arce/Catalino R. dela Cruz

In terms of species, the Center has conducted research on tilapia, carp, snakehead, milkfish, giant freshwater shrimp, Clarias, and Anodonta.

In terms of themes, subjects have included; techniques of rice-fish culture, polyculture, feed, agricultural chemicals, and hybrid. Research findings have been actively publicized, with some 30 technical papers and 5-10 academic treatises published each year. Members participate and give papers before international conferences concerning aquaculture technology. The Center, thus, is active on both the domestic and international level.

The thrust of the Center's R&D program is firmly in the direction of rural area development, with its twin objectives being the increase of fish production in inland waters through research and extension training and development of low-cost aquaculture techniques for increasing production yields. From this vantage-point, the Center is putting effort as well into the training of persons already active in the field of freshwater aquaculture, including government techniques, and extension instructors in cooperation with related government agencies.

A total of 920 man-days of training were given during 1979/80. The Center's staff travels the length and breadth of the country to give technical guidance centering mainly on rice-fish culture. In this manner, the Freshwater Aquaculture Center is taking an increasingly central role in R&D activity in the field of freshwater aquaculture. In this connection, the Center has divided the period through the year 2,000 into 4 sub-periods for future planning purposes. The first phase runs through 1985, with emphasis on developing new training and research facilities to cope with the need for increased training capacity and then strengthening of its educational and training function. Concomitant research efforts are slated in such new fields as feed, nutrition, pathology, food processing.

The second phase plans the expansion of experimental ponds, a Water Quality Center, and a Center for Agricultural Chemicals.

With 8 years now having passed since the start of the Center in 1973, it may be said that the Center has succeeded in firming up its foundations and determining the overall direction of its activities and is now preparing to greet the next stage in its development.

2-5 Review of Existing Facilities in the Field of Aquaculture Research

In addition to the above Freshwater Aquaculture Center, there are various other organizations engaged in the aquaculture research, including governmental, and, government-affiliated and university affiliated.

Presented below is an overview of the organizational structure, functions, and research activity and orientation of these various facilities in the hope that this information will help to anticipate the future directions of freshwater aquaculture research in the Philippines.

National Science Development Board (NSDB)

This is an organization which plans and executes scientific and technological policies. It assists in the development of science and technology, the training of personnel, liaison among research facilities and provides assistance to private research foundations.

The NSDB's R&D program is divided into five divisions; agriculture and natural resources, energy, industry, public services, and infrastructure and public utilities. It advises the Government through six research organizations directly linked to the NSBD and five others which maintain liaison primarily for purposes of coordinating their research directions and planning.

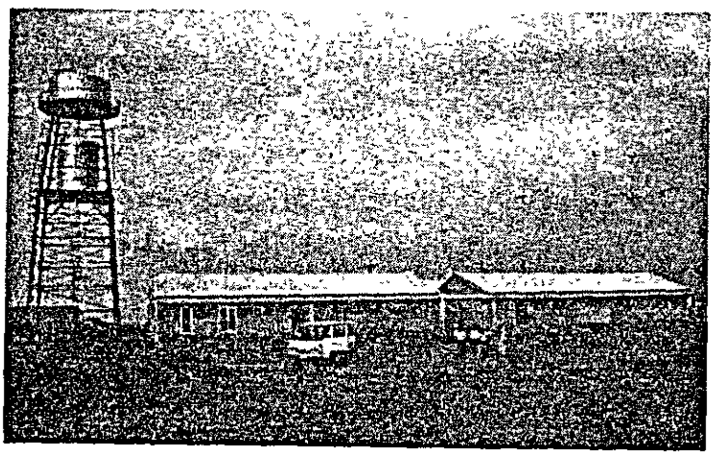
In the field of agriculture and natural resources, the major policy objective for scientic and technological development lies in the areas of self-sufficiency in agricultural, fishery and livestock production. With respect to self-sufficiency in fisheries, in order to attain the 1984 fish catch target of 2.1 million MT, it will be necessary to strengthen research activities in aquaculture, inland fisheries, and marine fisheries.

Bureau of Fisheries and Aquatic Resources (BFAR)

The Bureau of Fisheries and Aquatic Resources (BFAR), part of the Ministry of Natural Resources, is a government agency directly involved in the management and development of all fishery resources, the preparation of plans for fisheries development, fishing permits, research and training activities, and the enactment of fishery laws and regulations.

The BFAR is presently carrying out an Integrated Fisheries Development Plan, which incorporates a concrete plan for the aquaculture sector. This plan calls for technical training, selective investments for extension training personnel in selected areas, and use of these locations as centers for the training of extension personnel. The BFAR is also developing a plan called "Adaptive Inland Technology", involving the building up of a store of technical data on size, location, species, cultivation methods, and management methods for fish ponds, including freshwater ponds, as a means of measuring their productivity.

As a specific policy related to freshwater aquaculture, the BFAR is establishing Seed Production Stations. The first station has almost been completed on a site adjacent to the Freshwater Aquaculture Center of CLSU, so that large scale production of tilapia and carp fry should soon begin.



Seed Production Station of BFAR nearing completion at the next compound of FAC

These policies are being carried out on the basis of coordination and cooperation with other government agencies and international organizations. Many aspects of the program for freshwater aquaculture are being carried out in association with CLSU. In particular, the training of instructors in freshwater aquaculture is being largely done through this Center.

The Philippine Council for Agriculture and Resources Research (PCARR)

This government organization was founded in 1972 to coordinate R&D planning at the governmental level and effectively allocate research resources so that the results of government-funded research effectively contribute to true economic development.

PCARR secures research funds for studies geared to the advancement of agriculture, forestry, fisheries, and mining, determining areas of expenditure and setting research priorities. Through a network of existing research organizations in various fields, it coordinates and manages programs for the effective implementation of governmental R&D activity and develops policies in close coordination with the NSDB.

The nation's research administration agencies can apply to PCARR for aid, as and when the need arises, in the areas of personnel and facilities. In addition, the system requires that all governmental R&D programs be funded on the basis of vetting by PCARR.

For purposes of advising on and evaluating these R&D programs, PCARR is organized into the following research divisions: crops, fisheries, forestry, livestock, mining, socio-economics, soil and water resources, and applied communications.

The area of fisheries research is subdivided into three sections: aquaculture, inland waters, and marine fisheries.

Projects are carried out in these fields by forming research teams of 14-15 specialists drawn from governmental agencies, universities, and international organizations.

Research themes in the aquaculture area include: fingerling production for aquaculture species, catch of fingerling, fish pond management techniques, cage and pen culture, rice-fish culture, mollusk aquaculture, crustacean aquaculture, aquaculture engineering, feed and nutrition development, handling and processing, and socio-economic research related to aquaculture. These various research themes can be said to reflect the directions that PCARR is taking in the development of aquaculture research in the Philippines.

Brackishwater Aquacultural Center, University of the Philippines

As in the case of the Freshwater Aquaculture Center at CLSU, this Center was established at the University of the Philippines in 1973 as a subordinate project of the Inland Fisheries Project and currently operates as a research facility under the direct control of the University's College of Fisheries.

The Center's objective is to be active in all areas of brackishwater aquaculture, from research to extension training. Research is conducted at facilities in Leganes, Iloilo, which include a 30 ha experimental pond, a research building, and a wet laboratory building.

Most species-related research is on milkfish and Tilapia. Subjects include: pond fertilization, feed, polyculture, and bottom soil quality. Many of these projects are carried out with financial assistance from NSDB and SEAFDEC (cf. infra).

Since the research facilities belong to the University's College of Fisheries, they play an important role as a vehicle for brackishwater aquaculture research geared to graduate students. However, despite the advantages inherent in the close relationship in many areas that is maintained with SEAFDEC, whose lab facilities are adjacent to the Center, it cannot be denied that this very closeness impinges somewhat on the Center's freedom in selecting subjects for brackiswater aquaculture research.

Southeast Asian Fisheries Development Center (SEAFDEC)

SEAFDEC is an organization for regional cooperation operated by its six member nations. The aquaculture branch of this facility has been established in the Philippines. Major research achievements to date by this organization have centered on the brackishwater cultivation of milkfish and shrimp.

With regard to milkfish, research has been conducted on various levels, including: ecosystem, digestive physiology, inducement of spawning, feed and nutrition, broodstock, polyculture, and artificial seed production. Present efforts are being concentrated on artificial seed production which has not yet been established. The research approach is as follows: As a means of producing artificial milkfish fry the spawning parent fish is raised in the sea, with a large cage net; the naturally laid eggs are then recovered and hatched. If methods of detecting and recovering the naturally spawned eggs can be established, it is probable that subsequent technical problems can be solved. Thus, it may well be that a door has finally been opened to the production of artificial milkfish seed, a field on which so many years of effort have been expended.

In the field of seed production technology for shrimp culture as well, new methods are being developed to induce spawning by eliminating one of the eyestalks of the mature male shrimp. But the central focus of the current research program is to develop, on an experimental basis, concentrated aquaculture methods by throwing light on optimum mixed feed blend ratios in fish ponds, water exchange ratios, and stocking densities.

The Center is also conducting studies on mullet, oyster, mussel, giant perch, rabbitfish, and Placuna aquaculture.

In the field of freshwater aquaculture, an active Freshwater Fisheries Station has been established at Binangonan on Lagna de Bay, which has focused its energies on the development of aquaculture techniques using the lake waters of this lake, such as:

cage cultivation of milkfish fingerlings, research on the hybridizing of Tilapia species, seed production from Indian carp, and freshwater acclimatization and culture of giant tiger prawns.

However, with the increasingly severe eutrophication and pollution of this lake in recent years, there has been a tendency to shift the bulk of the research effort away from the development of individual aquaculture techniques into water quality environment and eco-system studies of the entire lake, which will be the determining influences on aquaculture activity.

International Center for Living Aquatic Resources Management (ICLARM)

ICLARM is a non-governmental, non-profit independent international scientific research organization. Its character is similar to various existing international organizations devoted to agricultural research. Its headquarters were established in Manila in 1977 and its efforts were at first aimed principally at Southeast Asia and the Southwest Pacific.

Its objective is to provide technical and financial assistance to organizations in less-developed countries to enable them to carry out long-term research in the following five areas: aquaculture, traditional fisheries, research development and management, maritime matters, and education and training.

The basic operating principle of ICLARM is to conduct joint research with existing organizations. This organization is unique in that it does not maintain its own independent research facilities.

Aquaculture represents one of the most important of ICLARM's activities. It is presently involved in the following five research projects:

1) General applied research related to polyculture with domestic animals.
2) Genetic improvement of Tilapia broodstock in the Philippines.
3) Cooperative research and training program for aquaculture and inland fisheries.

4) Economics of milkfish production.

5) Economics of catfish production.

All of the above projects are being carried out on a joint basis; in the case of (1), (2), and (3), the collaborating organization is the Freshwater Aquaculture Center of CLSU; in the case of (4), the cooperators are the Bureau of Agricultural Economics and the Fishing Industry Development Council; and in (5), the Institute of Research and Development at Kasetsart University in Thailand.

SECTION THREE

THE SITE ENVIRONMENT

3-1 Natural Conditions

(1) Climate

1) Temperature and Humidity

Temperatures in the Munoz area reach a peak in April-May and a low in December. Average monthly readings are between 25.2-27.6°C, with very little variation over the year.

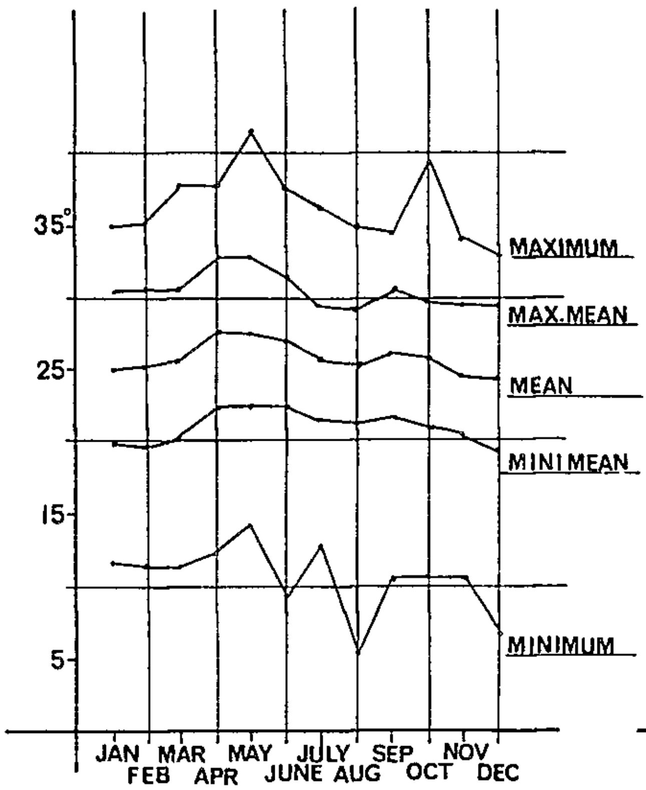
Humidity, as would be expected, is low during the dry season of August-September. Between December and February, both temperature and humidity are relatively low, and this period is the most delightful season of the year.

Based on readings at the CLSU Meteorological Observatory Station, average values for temperature and humidity over the 1967-1977 period were as follows:

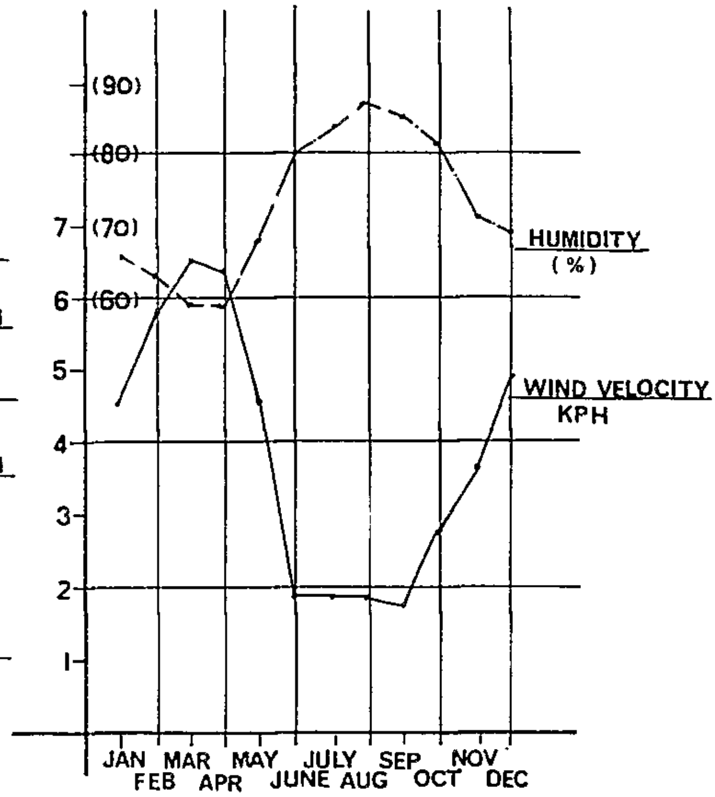
Annual average temperature	25.9°C
Average high temperature	30.8°C
Average low temperature	21.1°C
Average annual humidity	73%
Average peak humidity	87%
Average low humidity	58%

2) Rainfall and number of days with rain

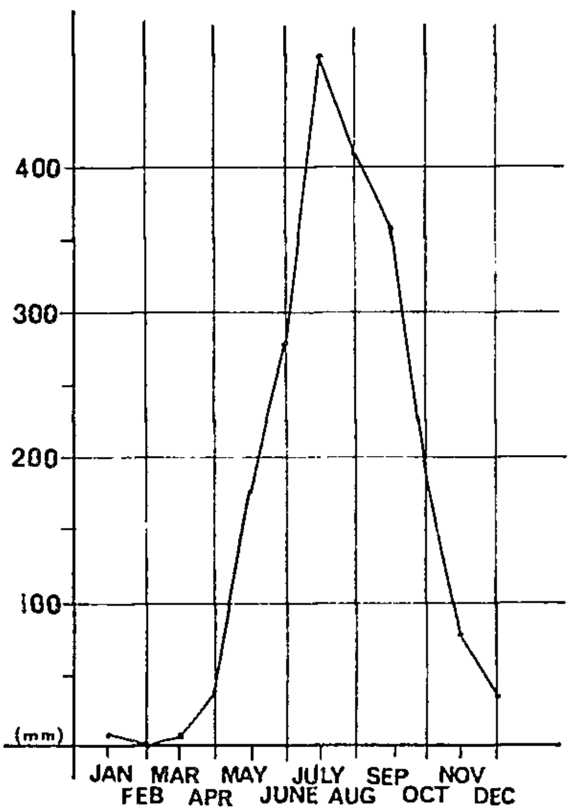
Average annual rainfall measures 2,047.7mm, with 60% of this concentrated in the rainy season of July, August, and September. The amount of rainfall during the dry season of January-April is only 47.5mm, barely 2.3% of the annual total.



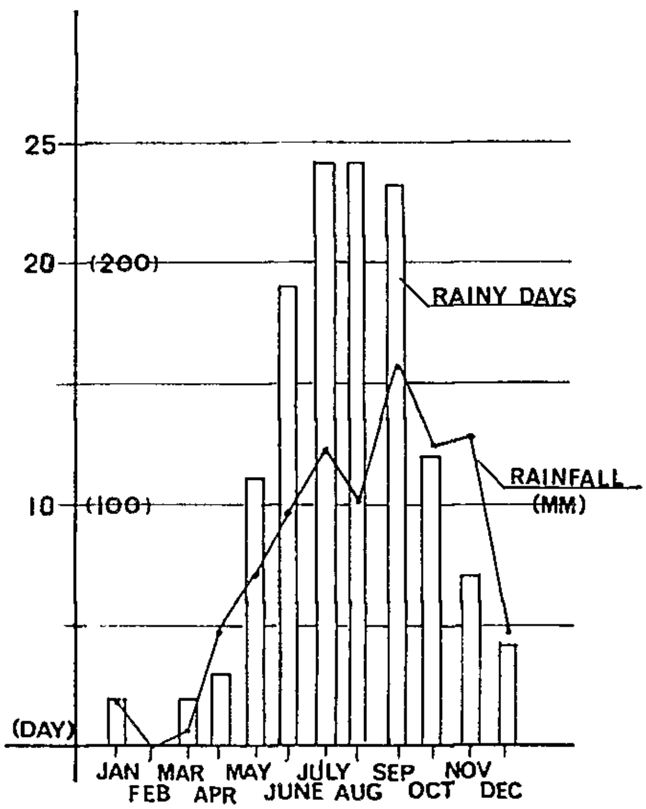
Temperature(°C)



Humidity(%), Average Wind Velocity(Km/hr)



Average Monthly Rainfall(mm)



Average Rainy Day(day)
Maximum in One Day(mm)

The record rainfall for a single day was measured on September 17, 1967 at 157mm.

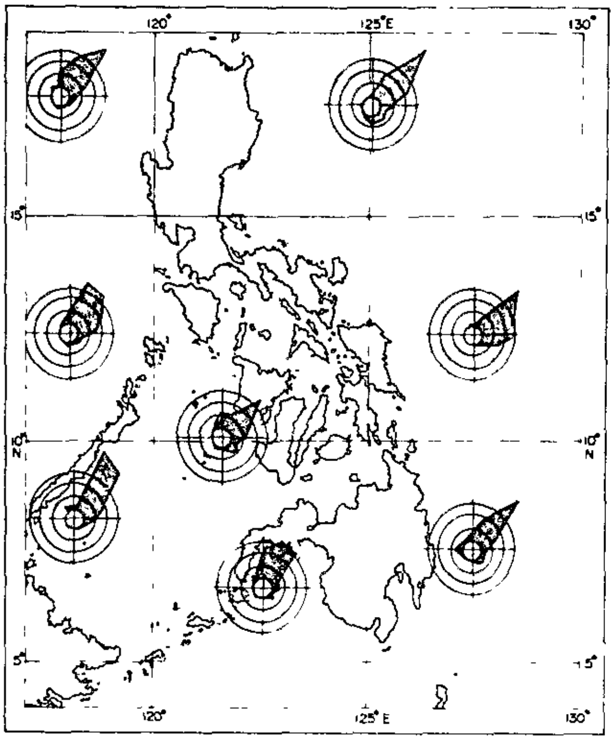
The number of days with rain per year total 131, with 71 days (54%) occurring during the July-September rainy season and 7 days (5.3%) during the dry season of January-April. The annual variation in rainfall and days with rain show a distinctive two-season tropical pattern.

3) Wind velocity and direction

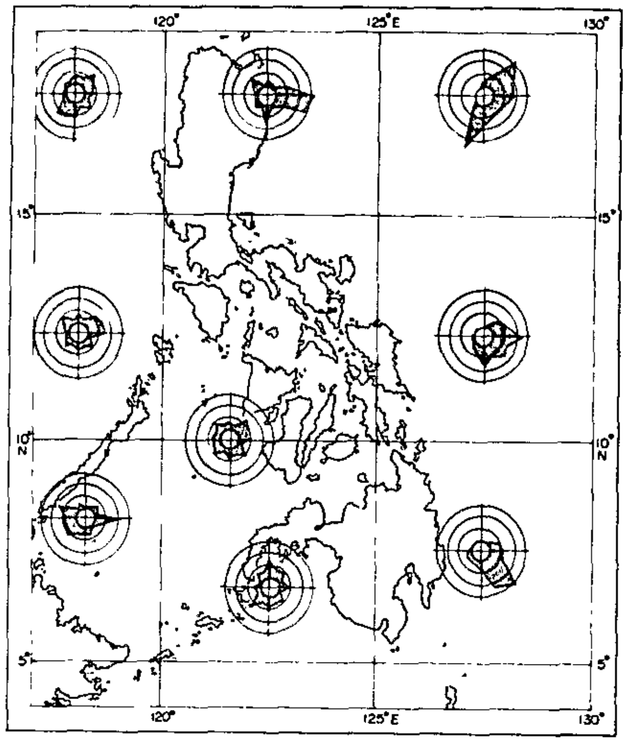
Average wind velocity is very subdued, at about 1.07 meters per second. It becomes slightly stronger during the dry season (the February average is 1.8 m/sec.), and exceptionally calm during the rainy season (the September average is 0.49 m/sec.).

The prevailing wind direction during the winter season (October through January) is a northeasterly seasonal wind, coming under the influence of the Continental high. During February-April, the Continental pressure area recedes, giving way largely to northeasterly trade winds. During these shifts in seasonal winds, a tropical oceanic air mass envelops the Philippine Islands, bringing fair weather and annual temperature highs. The prevailing winds during such periods are north-north-east to south, but the direction of the trade winds is unstable.

During the summer season (June-September), almost continuous Asian low pressure and southern hemisphere northerly trade winds are prevailing. Their influence reaches the middle and northern sections of the Philippine Islands, with southeast-to-southwest seasonal winds predominating. The pattern of prevailing wind directions, by season, in the Philippine region is given below.

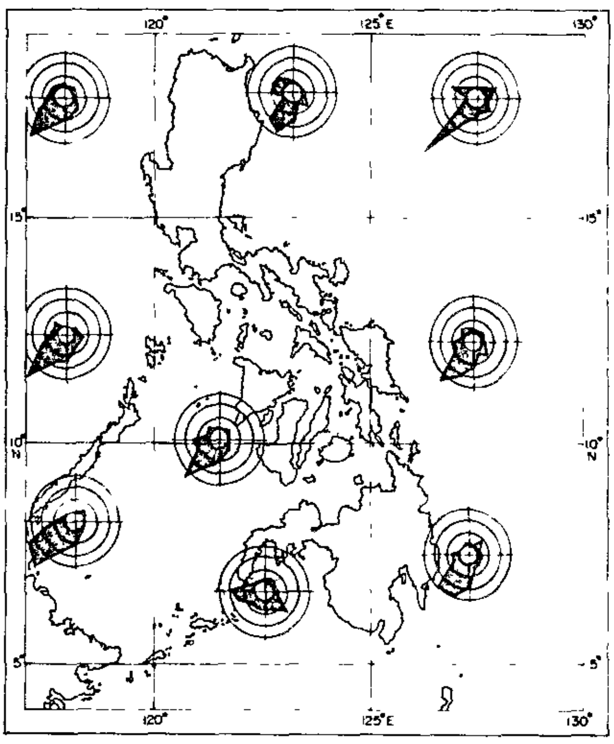


February

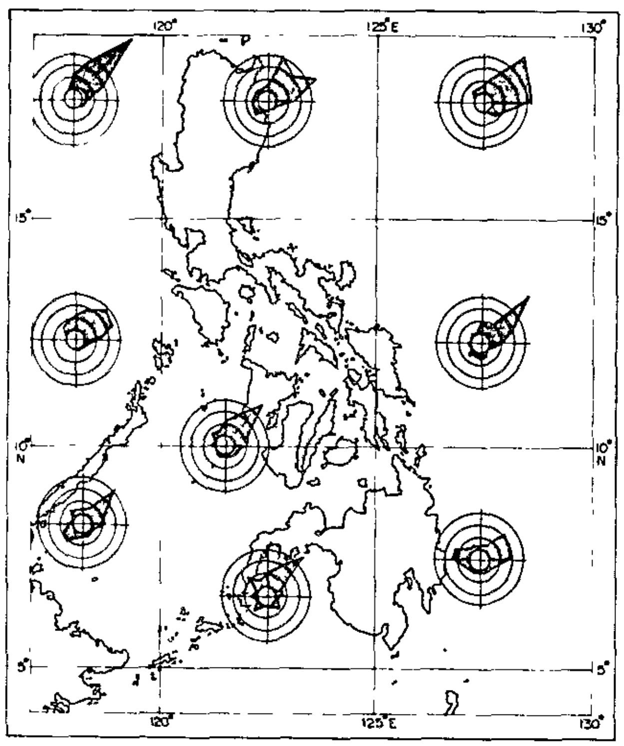


May

Seasonal Distribution of Wind Direction



August



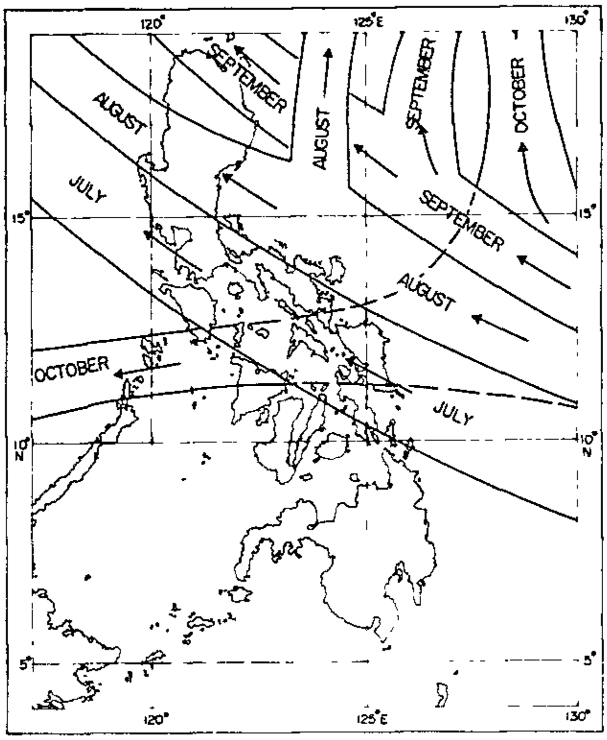
December

In the Philippines, a Typhoon is defined as one of four types of tropical cyclone, in which central wind velocity reaching 117 km/hour. The next category is Severe Tropical Storm, with velocities of 88-117 km/hour, followed by Tropical Storm-- 63-87, and Tropical Depression (61).

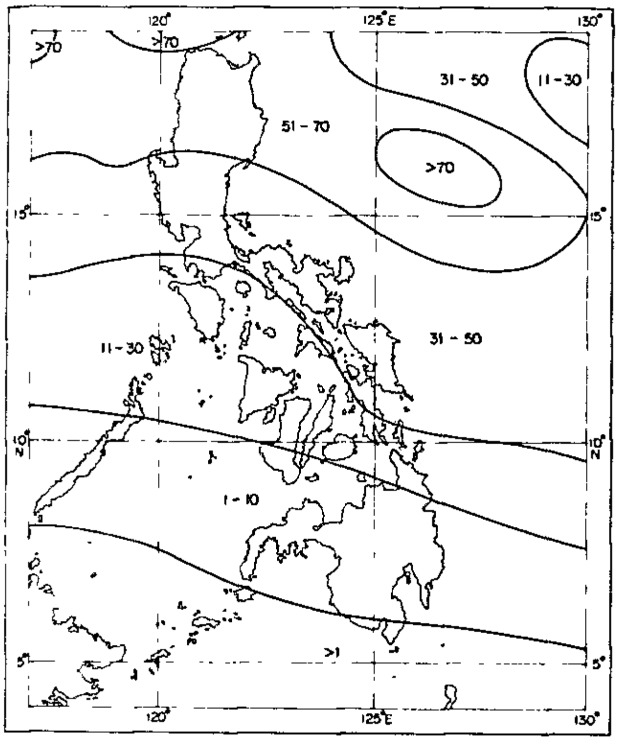
Tropical cyclones occur on the average 20 times a year, with about 10 of these reaching typhoon levels.

The target area for this project comes under the influence of an average of 10 tropical cyclones each year, with 1-2 typhoons being observed. More than 60% of these storms develop during the July-October period. The highest recorded wind velocity at the CLSU Meteorological Station is 34.4 m/sec., with an accompanying wind direction of WNW (for October 27, 1978).

The average path of tropical cyclones, togehter with the most frequent paths taken by typhoons during the period of highest occurrence (July-October), are shown in the following chart.



Usual paths of tropical cyclones – JULY to OCTOBER



Zonal frequency of typhoons (50years)

(2) Earthquakes

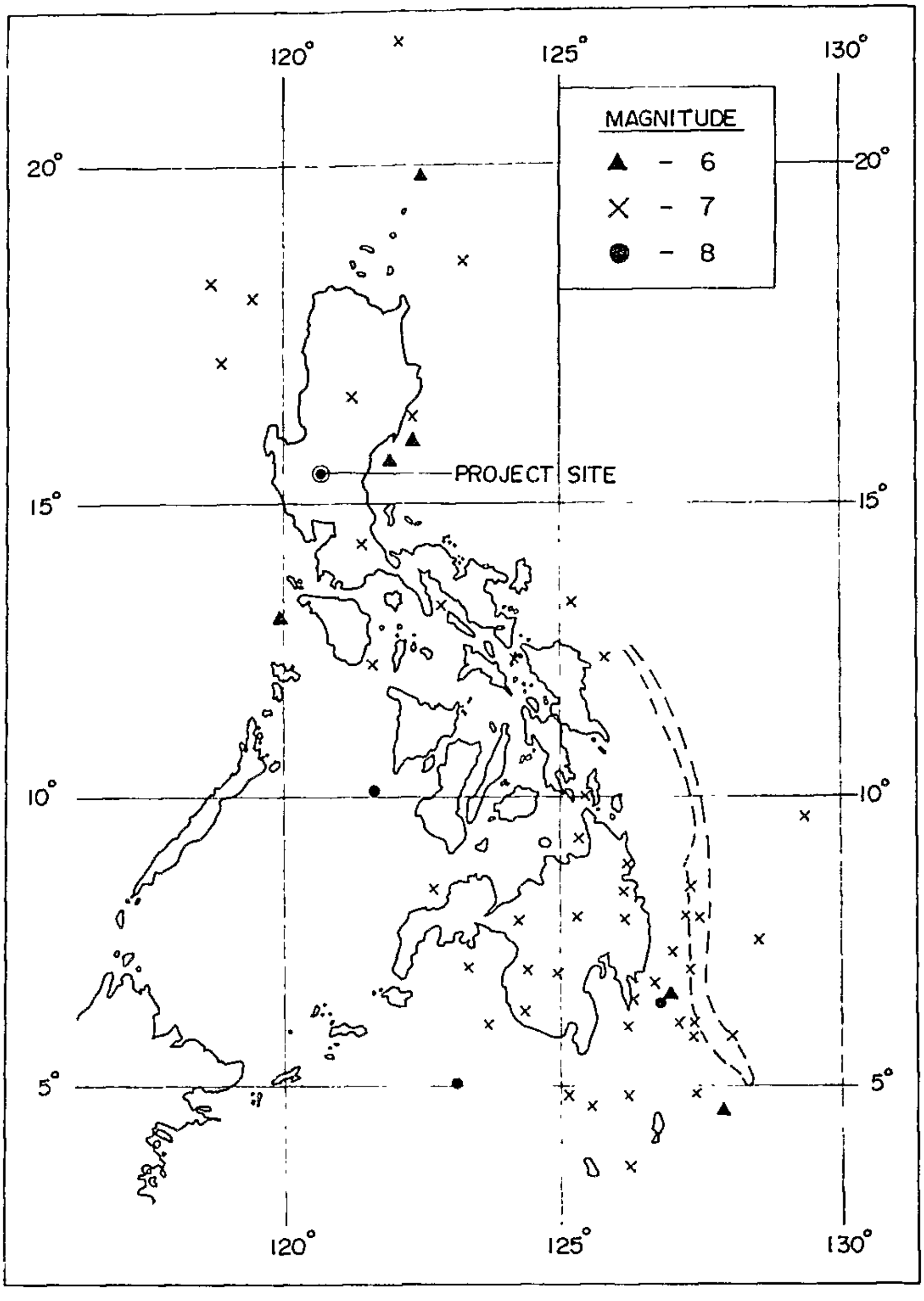
The Philippine Islands, along with Japan, is an earthquake-prone country, one of the world's few volcanic countries belonging to the Pacific Basin earthquake zone and the Pacific volcanic system. As a result, earthquakes occur with considerable frequency throughout the country.

According to recorded observations between 1901 and 1976, 55 earthquakes of Magnitude 6 or higher occurred during this period, with an average of one every 1.4 years. Major earthquakes of Magnitude 8 or higher have been observed three times:

October, 1918 ---------- M 8.5
April, 1924 ---------- M 8.3
June, 1948 ---------- M 8.2

Based on the area divisions for setting earthquake force for construction purposes, as stipulated in the National Structural Code for Buildings, Central Luzon has been classified as the area that is most susceptible to earthquakes in the country.

In the following chart, we show the epicenter of earthquake of Magnitude 6 or higher during the 1901-1976 period and well as their specific magnitudes.



MAP OF MAJOR EARTHQUAKES IN THE PHILIPPINES (1900-1976)

3-2 Site Conditions

(1) Location

The city of Munoz is located in the central part of Luzon Island in the northern section of province of Nueva Ecija (N 15°43', 120°54'). It is 26km north-north-west of the province capital at Cabanatuan and about 140km north of the capital, Manila. CLSU is located some 3km north of Munoz on the national highway Rt 5.

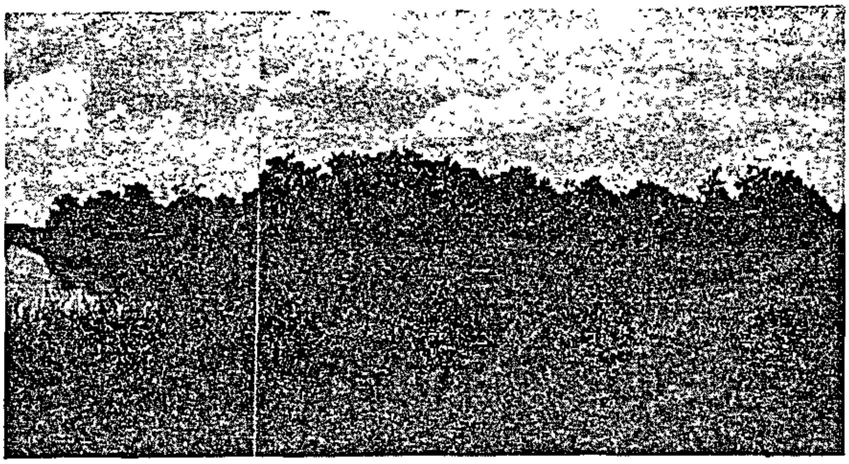
The target project area is part of the large CLSU campus of 658 hectares, running in a north-south direction, astride the national highway running through the campus from southwest to northeast. The site is flat land, surrounded by trees, situated alongside the existing Freshwater Aquaculture Center, some 0.6km from the national highway.

(2) Site Conditions

1) Topography

As measured from a benchmark within the CLSU campus, the height of the site is about 75 meters. It is close to trapezoidal in shape, with the long side running east-west and the short side to the east. The total area of the site is 2.9 hectares. The site is on university-owned land, and we have satisfied ourselves that it poses absolutely no problems as a building site for this project.

Irrigation canals flow along the northern and southern site boundaries, with roads running along the outer perimeter abreast of the waterways. The site countours for the most part slope gently toward the south; on the western side, low sections occur in various places.



Overview of the Project Site

Trees have been planted along most of the outer perimeter. The site is covered all over with shrubs and grass growing to a man's height.

Internal view of the Site

The topsoil is loam, and we observed an outcropping of slightly reddish top soil within the site.

2) Geology

To the south of the site lies a broad alluvial plain extending more than 100km to Manila Bay, while some 10-15km to the east, north, and west lie the borders of hill country. The site area is situated on alluvial ground with developed waterways. Judging from this topography, the site area is somewhat different in character from the swampy alluvial land of the Manila Bay area. The surface areas appear to receive the continual effect of alternate dryness and humidity from the dry and rain seasons. For this reason, its geology is quite distinctive, with the top layer of soil showing a high intensity based on the drying effect, while the shallow alluvial layer directly below is exceedingly soft.

Based on sampling with an earth auger to about 3 meters, the earth is loam type of primarily silt composition. The topsoil appears to have a uniform layer to some depth.

The project facilities are to be reinforced concrete structures of 1-2 stories. The ground load is not particularly heavy so that, while we must await data on detailed boring surveys and load capacity tests, the geology is such that the foundation can probably be of the spread foundation method, without pilings.

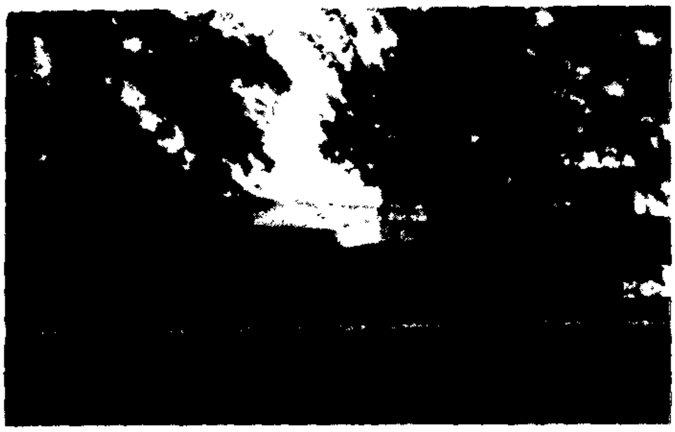
3-3 Description of Existing Facilities

As already noted, the Freshwater Aquaculture Center is situated across the national highway opposite the main CLSU campus. The Center site presently contains 4 buildings, fish ponds, and water supply facilities, as shown below:

(1) Buildings

1)	Administrative/Research ..... Office of the Director, general office, research lab.	372 m^2
2)	Research ..... Research labs., analysis rooms	390 m^2
3)	Wet Laboratory	372 m^2
4)	Repair Workshop	145 m^2

Among the above buildings, the administrative/research building is of particularly simple construction. Although completed in 1972, it already shows considerable wear and tear. The research building and water and air supply facilities are not fully functional, so that the research environment can hardly be described as satisfactory.



Existing lab building in Freshwater Aquaculture Center (FAC)

Existing administration lab building in FAC

.2 Fish Pond

To the north of the buildings lies 103 fish ponds with a total surface area of 109,745 m^2. They are being used as aquaculture experimental ponds. There are also a few concrete and simple water tanks.

Experiment ponds of FAC

3 Water Supply Facilities

The entire water supply for the Center is drawn from its own facilities, with no water being brought in from outside.

..... for drinking water and a portion of the requirements for aquaculture use;

1 deep well (150 feet), pressure pump,

..... for the remaining water for aquaculture use;

1 shallow well (20 feet), pump,

1 overhead tank

3-4 Basic Facilities

The availability of basic facilities in the vicinity of the planned construction site is as follows:

(1) Power

Power supply in the Munoz area is provided by the Pandabangan Dam Public Power Company's power station (with 2 hydro-generators of 50,000 kW capacity). 3 phase/3 wire (69,000V, 60 Hz.) transmit power to the consuming locations.

There is a substation on the CLSU campus, receiving power from the generating station at 5 MVA, 69 KV, which is then stepped down, via a transformer located on campus, to 13,800V for distribution to the various buildings. Each building further steps down the voltage to 460V, 230V or 220V, and 110V for use in the various pieces of equipment and for lighting.

Based on field measurement tests, there is a 10-15% fluctuation in voltages, so that it would be desirable to consider automatic voltage regulators for those items of equipment requiring a constant voltage supply. Lighting fixtures for the most part are to U.S. standards.

Aerial electric lines in service for FAC

The existing transmission lines come to a point adjacent to the site. We do not, therefore, anticipate any problems with power supply after completion of these facilities.

(2) Water Supply and Drainage Facilities

The University campus is totally self-sufficient in water supply, with all water coming from its own wells. In the adjacent Center facility as well, water for drinking and lab. use is pumped up from deep wells (150-200 feet) and distributed to the various consuming locations via concrete water towers (overhead water tanks). The water from the shallow wells (15-20 feet) is distributed to the culture tanks.

Perhaps because the survey was done during the rainy season, we found a generally high underground water table, with water easily found at a depth of only 5-6 meters.

The water from the deep wells is potable and of excellent quality, but the B.O.D. (Biochemical Oxygen Demand) of the water from the shallow wells is high a little.

Waste water from sanitary facilities is processed via septic tanks, with final treatment via the seepage method. A special independent tank is used to dispose of water from the lab. facilities, which is finally treated via seepage after PH adjustment. Other waste water is discharged into waterways for agricultural use.

(3) Fuel

There are no municipal gas facilities, so supply is generally via propane gas cylinders.

(4) Access Roads

National highway Rt 5 is a completely paved 2-lane highway. There is a 0.6km flat area between the highway and the site, which are joined by an unpaved gravel road some 5 meters wide.

Access road to the Site from the national highway

SECTION FOUR

THE BASIC PLAN

4-1 The Basic Concept

The Philippine Government has adopted the following eight objectives for national development:

... Social development and social justice through creation of employment opportunities; reduction of income disparities, and raising living standards of the poor

... Maintenance of economic growth

... Self-sufficiency in foodstuffs

... Increase in energy self-sufficiency

... Price stabilization

... Development of depressed areas, particularly rural districts

... Environmental control and improvement of human settlements

... Maintenance of internal security and harmonious international relations

Between 1973 and 1980, the real rate of growth for the Philippine economy, the base for setting the above goals, reached 6.3% per year, with real national incomes growing at an annual rate of 3.2%, as the nation broke out of the upheavals of the early 1970's. The economy grew 4.% in 1980.

Following are the principle problems faced by the country's economy:

1. The high rate of inflation, which averaged 13% per year during the 1970's.
2. A growing deficit in the balance of payments.
3. A growing international debt.

The rate of inflation in 1980 reached 17.6%, but has abated sharply during 1981. However, the continued rise in the balance of payments deficit and its attendant foreign debt pose major problems. During the first half of 1981, the balance of payments deficit was U.S.$243 million, while the foreign debt, as of the end of June, 1981, totalled U.S.$13.77 billion--no small amount when viewed against the U.S.$4.64 billion of Philippine exports during 1980.

In order to promote economic development, the Philippine government is putting efforts into core industrial development and is implementing 11 major industrial projects with a combined investment value of U.S. 6 billion.

One of the major elements expected to sustain this development is the above-mentioned goal of food self-sufficiency and rural development. The former postulates a replacement of imports along with a growth in the production of commodities for export, so as to reduce the investment needed for the agricultural sector. The latter goal is intended to forestall a further widening in the spread between urban and rural incomes as a result of industrial development.

It is only natural that aquaculture would be given an important position within the key objective of food self-sufficiency in the above development policies. Since aquaculture forms a part of economic activity, it can be considered either as a means of providing large-scale production of low cost, high quality proteins or as a source of high-priced products for luxury consumption. Similarly, aquaculture techniques can be developed either on the basis of small-scale production geared to family labor or with a view to large-scale capital-intensive methods.

The answeres to these problems can only come from a careful consideration of various factors, such as socio-economic conditions, employment, exports, and energy dependence, nor are the above choices mutually exclusive. But, when one considers the role of the Freshwater Aquaculture Center at CLSU, it is possible to obtain a relatively clear assessment of its essential directions: the national objective, as above noted, of food self-sufficiency and rural development; the fact that freshwater aquaculture has the unique characteristic of requiring the same resources as agricultural production and livestock: e.g., land, water, feed and fertilizers: the CLSU policy of contributing to rural development.

Thus, at least for the near to medium term, the Center's research activities, from the standpoint of food self-sufficiency, are likely to be directed toward production of low-cost, high-grade animal proteins. And, judging by the special characteristics of freshwater aquaculture, high priority is likely to be accorded the development of techniques of combining the aquaculture with the agricultural production, as in the case of rice-fish culture. In addition, there is probably a need, within the context of rural development, to present aquaculture techniques as a reasonably complete technological package that can be readily absorbed by small-scale farm households. And it is vital, that future research activities be geared to improve, however slightly, the ratio of investment to yield via the imporvement of varieties, development of rational feeds and fertilizers, and propagation of high-yield hybrid species--all of which are already being developed in the fields of agriculture and animal husbandry.

Given the above positioning and directions of the Freshwater Aquaculture Center, its essential functions may be seen as follows.

4-2 Facilities Plan

(1) Basic Guideline

The facilities have been designed in accordance with the following basic guidelines:

1) The basic design was carried out on the basis of the Minutes of Discussions, dated July 3, 1981, formulated on the basis of the Basic Design Study.
2) The basic design reflects modifications and adjustments, with the agreement of our Philippine counterparts, in the various requests that were made in the course of several discussions with the members of CLSU responsible for the project on the Philippine side.
3) Selection criteria for building sites included: availability of essential facilities, such as water and sewage, power, and access roads; environmental conditions in which research and training activities can fully function without fear of wind or water damage.
4) The legal and regulatory standards for facility design conforms in principle to those currently in force in the Philippines.
5) The plan for facility placement, structure, design, and building materials was developed with full consideration or natural conditions, building conditions, and conditions affecting material supplies.
6) The plan incorporates generally used local building methods and materials, with a view to assuring ease of building maintenance.
7) The facilities have been made as simple as possible, with due consideration having been given to technical and economic factors in their operation and maintenance.
8) Research equipment have been basically selected so as to fully support the research activities to be carried on at this facility.

(2) Functions and Nature of the Facilities

The basic functions and nature of the subject facilities, as shown below, follow essentially the requests of CLSU and have been approved by the representatives of the University.

1) Facility functions
   a) Administrative and service functions--
      ... to provide all services in support of facility administration and research activity.
   b) Research and experimental (lab) function--
      ... for technical development, research, and experiments.
   c) Training function--
      ... Diffusion of technology and training
2) Nature of the facilities
   The facilities have been planned so as to fully satisfy the above functions. They have been classified below into: administrative and training building; research building; wet laboratory building; and an attached building (for pumps and generator).
   a) Administrative and Training Building
      This building provides areas for both administration and training.
      The administration area is to provide overall maintenance of the planned facilities and various services in support of research activities.

      The training area will be used both for extension training and the diffusion of technology as well as for training courses and seminars. Provision has been made for a large conference room, equipped with projector, microphones, and other audio-visual aids, capable of accommodating a maximum of 70 trainees/ attendees at one time.

b) Research Building

This is the central core of the planned facilities. In addition to research and lab activity, it will also be used for student education and guidance. The Research Building will be equipped with rooms for pathology, feed and nutrition, aquatic ecosystem, breeding physiology, and other research and experimental activities. Each room will accommodate at a given time 1-2 researches and 2-3 research assistants.

c) Wet Laboratory Building

This building will be used primarily for water-tank research and experiments. In support of these activities, water and air supply system and drainage will be functionally located. This structure will also contain research lab for feed development and fish processing.

d) Attached Building

This structure will have various rooms to accommodate the main equipment items to be used in the planned facilities, including: water pumps, electricity board and transformers; generator, air blowers, and LPG cylinders.

Power, water, air, and gas in support of facility operation will be centralized for distribution to the various items of terminal equipment. In addition, an underground section will be used as a water reservoia.

3 Facility Size and Space Requirements

The size and space requirements for the planned facilities have been worked out through discussions with University officials and are based on their requests. While size and space standards may be slightly different from the originally requested plan, they have been designed with consideration for local standards and customs and for comparable facilities in Japan. The plan, as agreed, is shown in the following table.

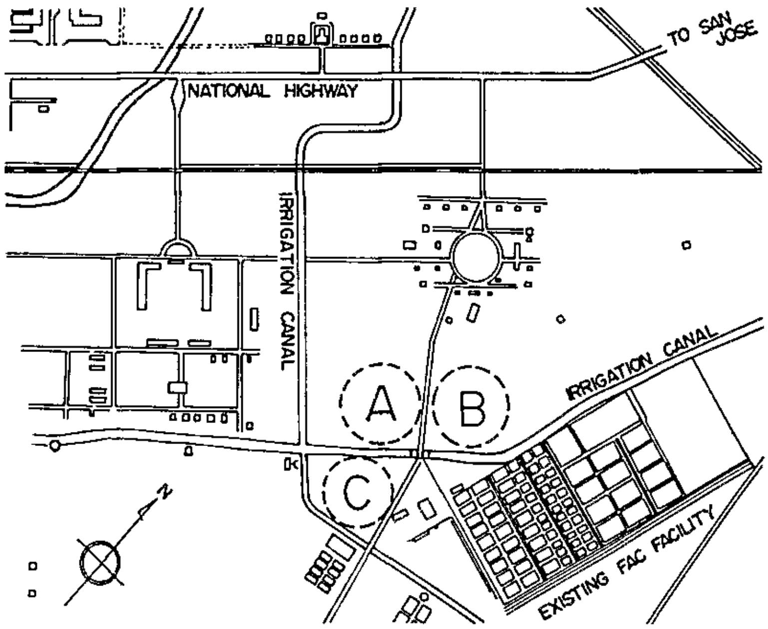
Facilities Name	Floor Area (m^2)	Remarks
(1) Building		
a) Administrative & Training Bldg	(1,105)	
Ground Floor (Training space)	(546)	
Lecture Rm (Large)	130	50 seat
Lecture Rms	145	30x2 seat
Trainee Offices	60	
Cafeteria, Kitchen	145	
Toilet, Corridor, etc.	66	
2nd Floor (Administrative space)	(559)	
Director's Office	42	
Asst Director's Office	29	
Office	83	
Small Conference Rm	38	
Library	61	
Staff Lounge	38	
Large Conference Rm	150	70 seat
Projection Rm	8	
Toilet, Corridor, etc.	110	
b) Research Building	(646)	
Fish Pathology Lab	84	
Fish Nutrition Lab	100	
Aquatic Ecosystem Lab	100	
Fish Reproductive Physiology Lab	79	
Analytical Chemistry Lab	79	
Central Equipment Rm	59	
Thermal Equipment Rm	15	
Dark Rm	10	
Toilet, Corridor, etc.	120	
c) Wet Laboratory	(400)	
Feed Development, Fish Processing Lab	(70)	Refrigerator (8 cu.m)
Culture Tank Rm	288	
Storage	27	
Toilet, Shower Rm	15	
d) Machine Shed		
Pump, Air Blower Rm	20	
Powerboard, Generator Rm	30	
Reservoir	($40m^3$)	Underground
Gas Cylinder Enclosure	-	

Facilities Name	Floor Area (m^2)	Remarks
(2) Facilities		
Electrical Equipment		
Water Supply Equipment		
Drainage Equipment		
Gas Equipment		
Air Supply Equipment		
(3) Research, Training & General Equipment		
Research Equipment		
Training Equipment		
General Equipment		

4-3 Layout Plan

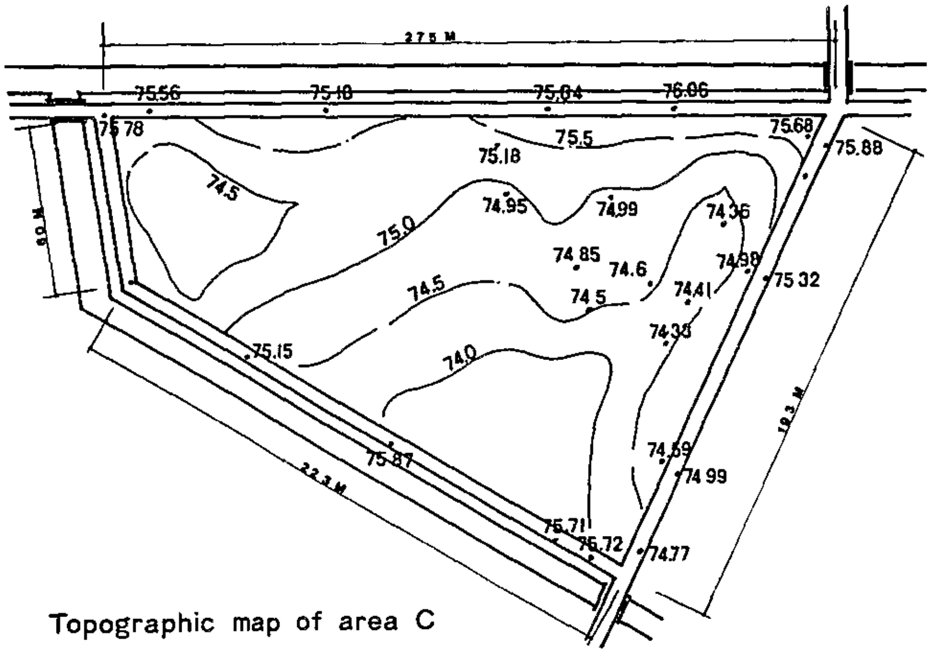
(1) Site Selection

As prospective sites, University officials have proposed three locations, as shown in the following drawing.



Areas A and B are rice paddies, where the ground level is 1 meter lower than the road surface, thus necessitating filling of the site. Area C is at present a vacant field but was formaly a pomology garden. The topographic map indicates that the whole area slopes slightly to the south, which facilitates natural drainage to some extent. The site, occuping approximately 2.9 hectares, is continguous to the compound containing the existing facilities and is easily accessible to the road. No water canal is running within the site -- a promising condition for future facility expansion. Trees are planted along the periphery of the site and the overall site environment seems to be superior to areas A and B.

Accordingly, with the consent of University officials, area C has been finally chosen as the project site.



Topographic map of area C

(2) Site Planning

Site planning has been developed on the basis of the following factors:

1) The buildings will be located in the eastern part of the site for ease of access to and from the existing facilities and connecting road. The western part of the site will be reserved for future expansion.
2) Each building has a different function and character. Careful attention must be paid to the arrangement of each building with regard to dependency and functional connection, considering ease of use, operation and administration.
3) An approach road will be constructed to the administrative and training building from the existing road on the east end of the site.
4) In order to intercept morning and evening sunlight and to permit the rooms to receive southeast winds dominant throughout the year, it seems more favourable to lay the main axis of the building in an east-west direction.

However, as illustrated in the map of the campus, the major existing buildings in the University have the main axis parallel to or at right angles with the northeast-southwest vector. With due consideration to the opinions of University officials, the plan follows existing practice on the Campus and sets the building axis in a northeast-southeast direction.

(3) Building Arrangement

The arrangements of the various buildings are as follows.

1) Administrative and Training Building---
This building is to receive visitors and trainees and to function as an administrative center for the whole facilities.
This building has been located in the northeastern part of the site, so that visitors may have easier access from the existing road.

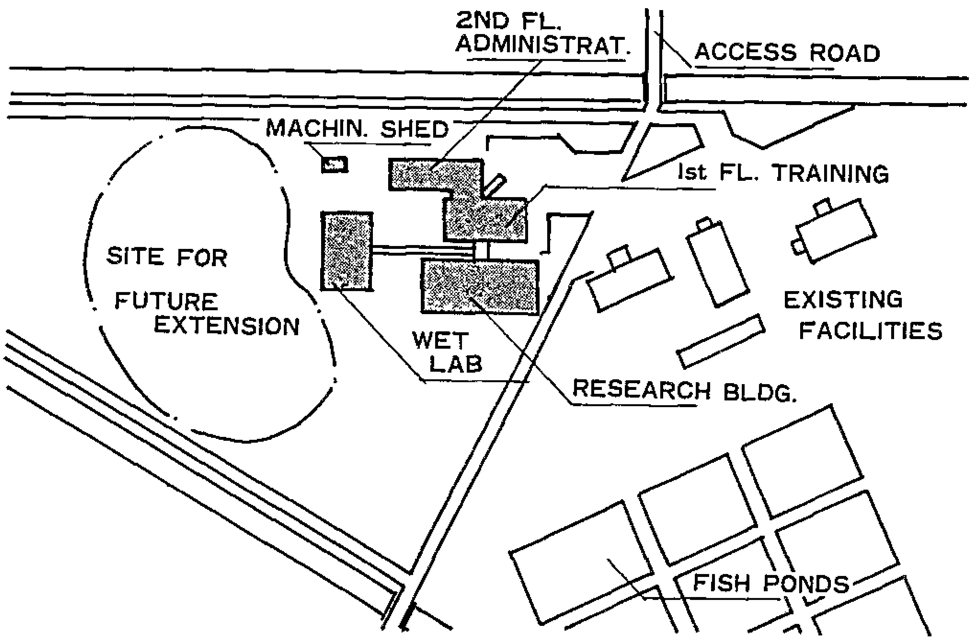
2) Research Building---
A limited number of technical staff members will use the research facilities. It will be necessary, therefore, to avoid overlapping with other functions and, while preserving an independent environment, permit easy access to existing research buildings and experimental ponds.
The Research Building, therefore, has been places southwest of the Administrative and Training Building.

3) Wet Laboratory Building---
This building is related in character to the Research Building and has thus been located close to it.

4) Machine Shed
This shed collectively houses water pumps, air blowers, generator, gas cylinder, etc., and should be located independently of the other buildings in view of noise, exhaust gas and vibration. On the contrary, all the gas, water and air pipes and electricity lines are distributed

to the respective buildings through this facility, so that the shed should be located clsoe to each building.

Due to the somewhat contradictory nature of the facilities, careful attention must be paid to the location of the machine shed. In the plan, we have located this facility in the northwest part of the site, which seldom receives wind and, to the rear of the Wet Laboratory, which will contain a large piping system. The following drawing illustrates the layout of building determined on the basis of access requirements and the natural conditions described above.



Arrangement of buildings

4-4 Building Design

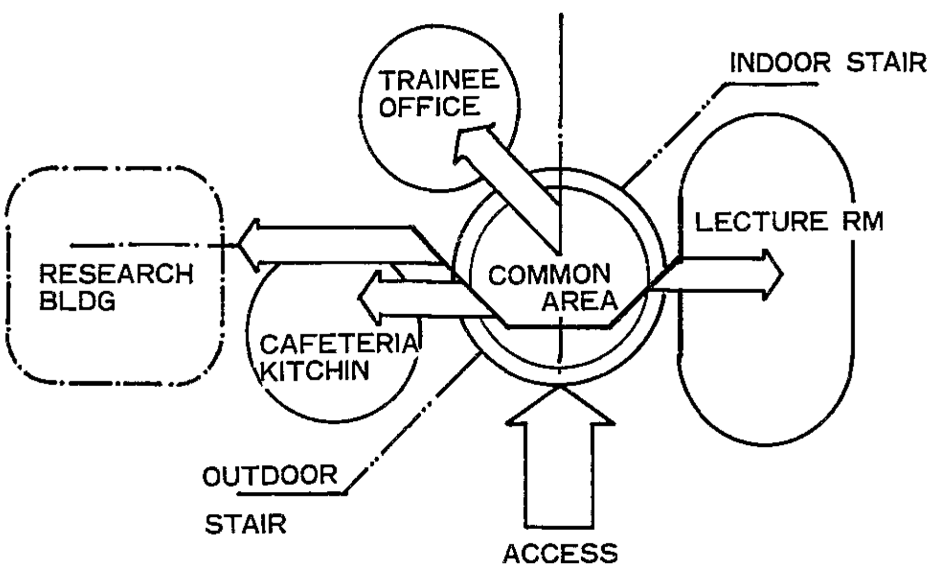
(1) Floor plan

1) Administrative and Training Building

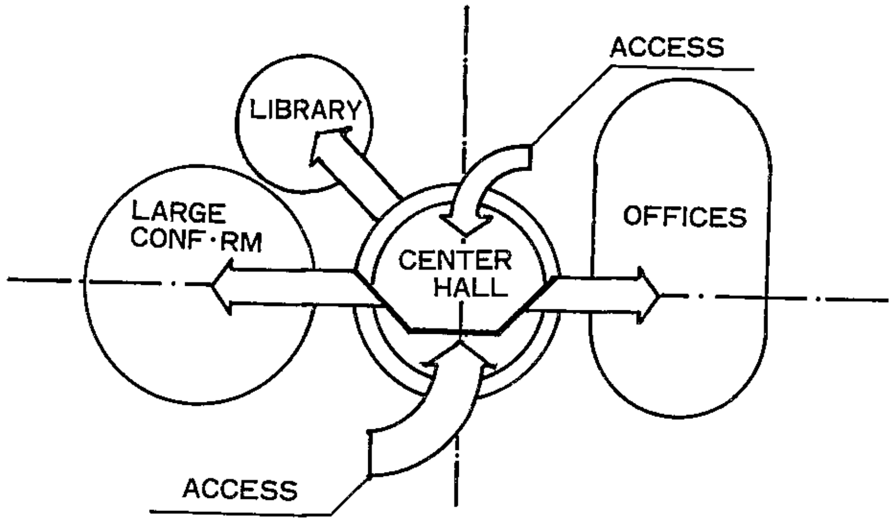
The two-storied Administrative and Training Building consists of a training section and an administration section. The training section will receive a fluctuating number of trainees and will occupy the ground floor, so that visitors can directly reach the location from the approach road. The administration section has a different function and so has been located on the second floor with access from both indoor and outdoor stairs.

Classrooms,trainee offices, and common areas, including cafeteria, kitchen, hall and toilet, comprise the two major areas in the training section. The common areas are placed just inside the entrance, with classrooms on the right side and cafeteria and trainee offices on the left.

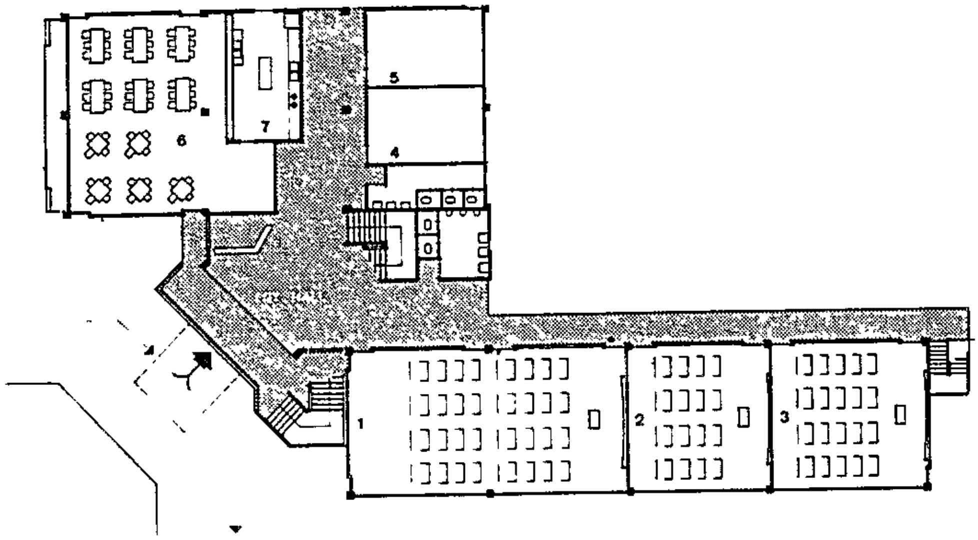
The left side of the building leads to the Research Building. The stairs to the second floor are located in the hall and to the right of the entrance.



The administration section accommodates offices, including those of the Director and Assistant Director, a library (including a printing room), and a large conference room incorporating an audio-visual equipment room. Offices are arranged to the right of the center hall, with library and conference room to the left.

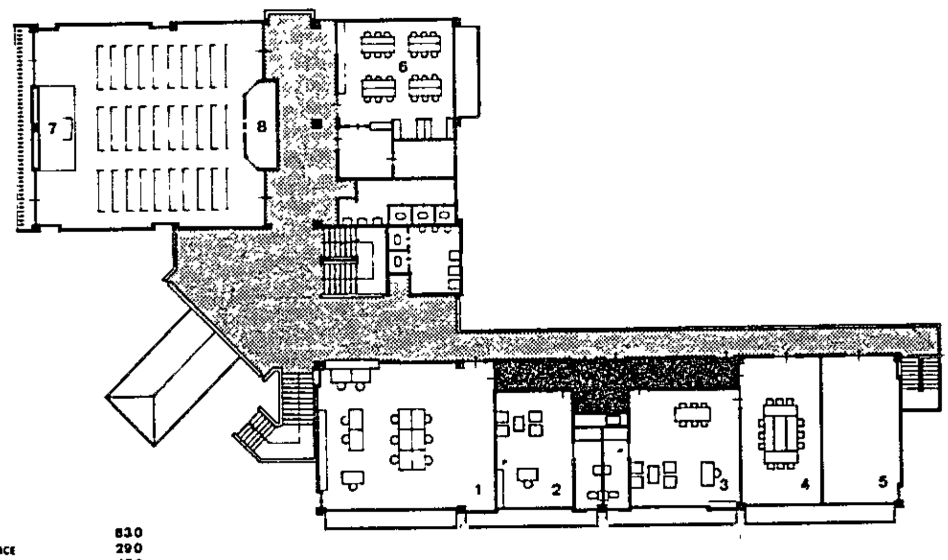


The floor plan for the Administrative and Training Building is shown below.



1	LECTURE R M	130.0
2	LECTURE R M	70.0
3	LECTURE R M	75.0
4	STUDENTS OFFICE	30.0
5	STUDENTS OFFICE	30.0
6	CAFETERIA	120.0
7	KITCHEN	25.0
8	CORRIDOR STAIRS etc	66.0
	TOTAL FLOOR AREA	546.0 m²

TRAINING & ADMINISTRATIVE BLDG　　GROUND FLOOR PLAN

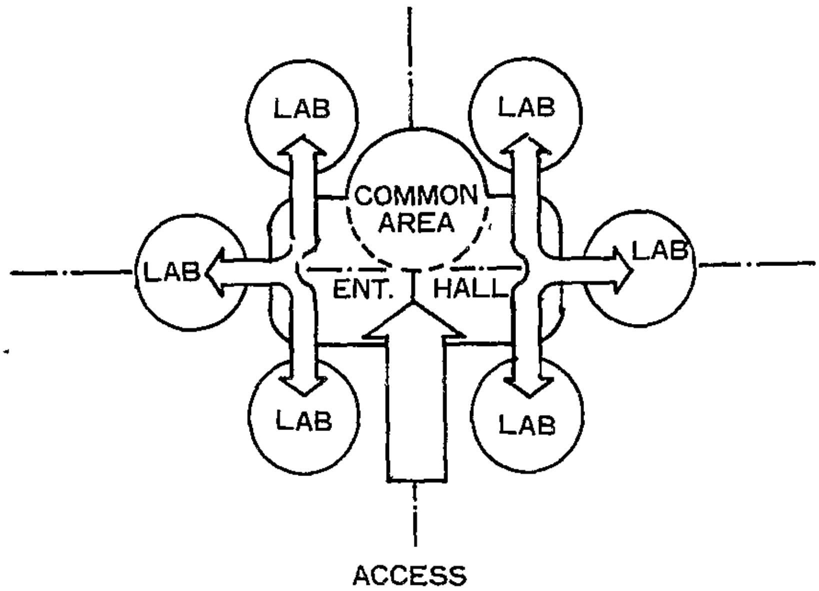


1	OFFICE	83.0
2	ASS'T DIRECTOR'S OFFICE	29.0
3	DIRECTOR'S OFFICE	42.0
4	SMALL CONFERENCE R M	38.0
5	STAFF LOUNGING	38.0
6	LIBRARY	61.0
7	CONFERENCE R M	150.0
8	PROJECTION R M	8.0
9	CORRIDOR STAIRS etc	110.0
	TOTAL FLOOR AREA	559.0 m²

TRAINING & ADMINISTRATIVE BLDG　　2ND FLOOR PLAN

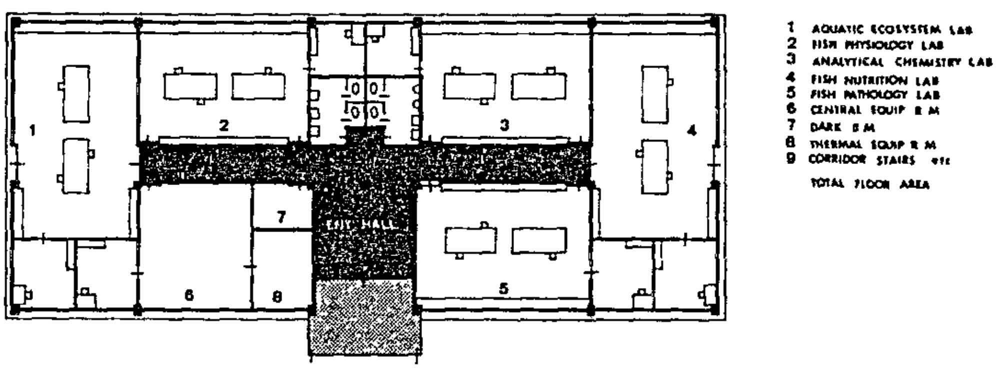
2) Research Building

The research building consists of several rooms having the same character, purpose and facilities. A common area faces the entrance, and the laboratories are arranged on both sides of the entrance hall.



Each laboratory will be equipped with a window-type air conditioner, and ventilation equipment should also be considered. Since the hall and corridors are closed space areas due attention must be paid to architectural and mechanical design to ensure proper ventilation and lighting.

The floor plan for the Research Building is given below.

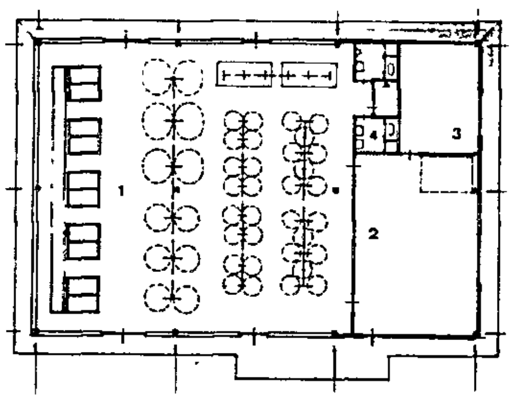


3) Wet Laboratory Building

This building consists mainly of a culture tank room and a feed development - fish processing laboratory.

The culture tank room occupies a floor space of 300 m^2 and will house 2-ton concrete tanks, polycarbonate movable tanks and various other aquariums and tanks. Water supply, drainage, and air supply pipes will be systematically arranged in the room. The feed development and fish processing labroatory may generate odor, smoke or waste water. We have, therefore, separated this laboratory from the Research Building and incorporated it into the Wet Laboratory Building. A shower room, toilet, storage and freezer room are also included in this building.

The following drawing shows the floor plan for the Wet Laboratory Building.

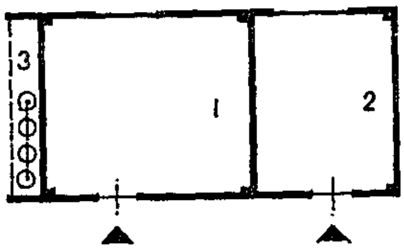


1 CULTURE TANK ROOM
2 FEED DEVELOPMENT-FISH PROCESSING LAB
3 STORAGE

4) Machine Shed

This building houses the major mechanical equipment items supporting the operation of the entire facility.

The floor plan is designed for ease of operation and maintenance. The plan is given below.



1. GENERATOR RM.
2. PUMP RM.
3. GAS CILINDER
4. WATER RESERVOIR (UNDERGROUND)

(2) Number of stories and building heights

The buildings are all one-story, except for the Administrative and Training Building, which has two stories. The ceiling height of the new buildings will conform to the 3 m standard in the existing University building. The total height required for each story is set at 3.5 m. As the cafeteria and large conference room have larger floor space than the ordinary rooms, the ceiling height is set at 3.5 m for the former and 4 m for the latter. The culture tank room will have no ceiling, and the height from floor to eaves is set at 3.5 m. The height of the machine shed is 3 m.

(3) Sectional plan

The most important factor to be considered in the sectional plan will be the natural conditions particular to the tropics, such as concentrated rainfall, strong sunshine and dominant winds. A second factor may involve some constraints on the construction work owing to the limited construction period and availability of materials.

With regard to the above two factors, the sectional plan has been developed as follows:

1) Roofing

Hipped roofs with galvanized steel sheet are commonly seen in the Philippines. This type of roof is effective for conditions of concentrated rainfall, and the sloped roof top may have better radiated heat disippation. Thus, the hipped roof is considered one of the most suitable roof types for wet tropical areas. The existing University buildings generally incorporate this roof type, and we have adopted the same policy in preparing the plan for the new facility. Galvanized steel sheet may pose problems in terms of inadequate corrosion resistance, so we recommend the use of tiled roofs or those of cement shingle. The attic should be designed for maximum ventilation.

2) Outer walls

The general practice encountered in the Philippines for outer wall structure is the laying of concrete blocks between the reinforced concrete column and the beam. Paint finish on mortar plastering is most commonly found. The outerwall of the projected buildings will be reinforced concrete, partly with concrete block, with lithin plastering finish on mortar.

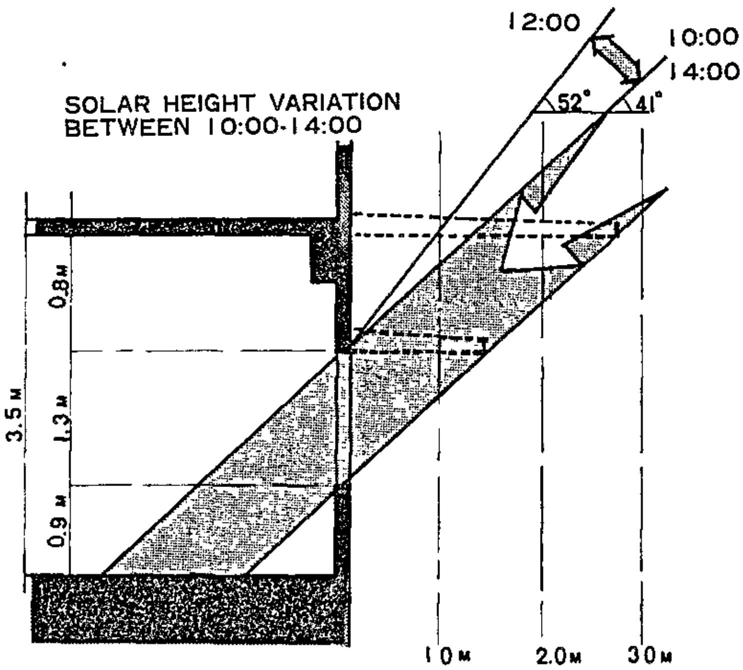
3) Outer opening

Movable louvers (or jalousie windows) are most widely used as in other warm climate areas, followed by outswinging casement windows, both of which are rarely found in Japan. Steel is the most common material for window frames but aluminum is also used.

Most of the buildings have deep, large eaves to intercept the strong sunlight and heavy rainfall characteristic of tropical areas. About half the buildings have sharply protruding eaves, while, in the other half the eaves are placed immediately above the window. In the Philippines, the smallest incident angle of the sun occurs at the winter solstice (around December 22nd). The most unfavourable conditions occur between 10:00 a.m. and 2:00 p.m. on the winter solstice day. The following chart illustrates the time variation of the incident angle between ten and two o'clock on December 22nd.

Solar Height Table (on December 22nd)

Time	07:00/ 17:00	08:00/ 16:00	10:00/ 14:00	11:00/ 13:00	12:00
Height	8°	20°	33°	41°	52°



The required length of eaves calculated from the above drawng is 1.4 m immediately above the window and 2.7 m at 0.8 m above the window opening. It is also recommended that incident side rays be considered in setting eaves size.

4) Flooring

The University buildings use various floor materials, depending on the area -- concrete, mortar, terrazzo, vinyle tile, parquetry, etc. These materials are all available in the Philippines, and the present plan introduces terrazzo floor in the entrance hall, tile or non-slip floor in the laboratories, vinyl tile or parquet floor in the classrooms and offices.

5) Interior Finishing

Commonly used materials are polywood and plaster board for ceilings and mortar, plywood and plaster board for walls, both with and without paint finish. The interior plan will incorprote simple but durable materials suitable for the new training and research complex.

(4) Structure

1) Building structure

1. Each building requires a different structure to conform to difference in size and function. The structure for each building is as follows.

o Administrative and Training Building o Research Building o Machine Shed	Rigid frame structure with reinforced concrete and endurance wall
o Wet Laboratory Building	Steel frame structure

2. A spread foundation is assumed at this stage but the foundation type will be finalized on the basis of results of the borehole and soil load tests.
3. Locally available structural materials will be used to the maximum extent.

2) Structural design

The structural design will conform to the structural codes prevailing in the Philippines: viz, National Structural Code of the Philippines (NSCP), Uniform Building Code (UBC), ACI and AISC. Calculations of stress, allowable unit stress, and cross-section for the structural materials will be made in accordance with ACI. The design load and external force is determined as follows.

1 Live load

Live load (uniform load) is calculated by NSCP. No heavy machinery is expected in the building that might increase live load. However if a greater live load is required, the correction will be made at the design stage.

The following table shows the design loads under the current project and, for reference purposes, those determined by UBC-ICBO, PBA-GSA, and ASBC-ASA*.

Design Live Load

(Unit: lb/ft^2)

Classification / Occupancy	Current Design	UBC	PBA	ASBC
Lecture Rm	40	40	40	40
Corridor	100	100	100	100
Office	80	50	80	80
Lab.	100	-	100	-
Library (Reading Rm)	60	60	60	60
Library (Stack Rm)	150	125	-	150
Large Conf. Rm	100	100	100	100

*

UBC-ICBO	Uniform Building Code by International Conference of Building Officials
PBA-GSA	Public Building Administration, General Service Administration of the Federal Government
ASBC-ASA	American Standard Building Code by American Standard Association

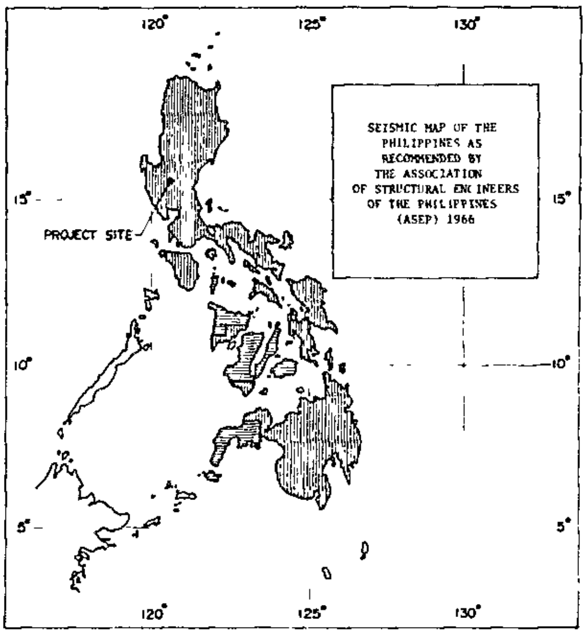
2) Seismic force

As described in section 3-1-(2) the Philippines experience frequent earthquakes. The seismic force has been determined on the basis of the seismic map prepared by ASEP. According to this map, the project site belongs to the zone most frequently affected by earthquakes. The seismic force to be used for the design is calculated in accordance with the following UBC formula.

$$V = ZIKCSW$$

where;

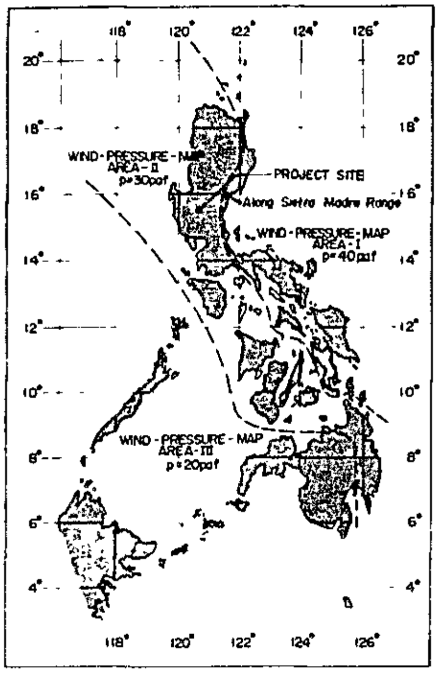
- V: Total lateral force or shear at the base
- Z: Numerical coefficient dependent upon the zone (Refer to figure below)
- I: Numerical coefficient dependent upon occupancy
- K: Numerical coefficient dependent upon structure
- C: Numerical coefficient determined by fundamental elastic period of vibration of the building
- S: Numerical coefficient for site-structure resonance
- W: Total load



3) Wind load

Typhoon is not uncommon in the Philippines. According to the wind pressure map given below, the project site belongs to Area II, which represents a medium wind force. The wind pressure is determined by the UBC chart for base wind pressure above ground.

Wind-Pressure-Map
Areas for the Philippines



Base Wind Pressure above Ground by Area

(unit:lb/sq.ft.)

Height Zone (ft.)	Area I	Area II	Area III
less than 30	30	20	10
30 - 50	40	30	20
50 - 100	50	35	25
100 - 500	60	40	30
500 - 1,200	70	45	35
over 1,200	80	50	40

4) Soil bearing capacity

The soil bearing capacity will be decided on the basis of the results of the soil condition tests, including bore hole and soil load tests. However, the buildings will have spread foundation, and the required soil bearing capacity is provisionally estimated as around 8 ton/m^2.

5) Structural materials

Concrete to be used for the structures will have a standard design strength of F-210 kg/cm^2 or 3,000 psi.

4-5 Building Services Plan

The research activities, which cover a wide range of fields, from experimental aquaculture to pathology, breeding physiology, and aquatic ecosystems, are to be sustained by the facilities in this plan, particularly those relating to water supply and drainage. It is hardly an exaggeration to state that, along with the buildings, the facility package will be a key factor directly affecting the research activities under this program.

The basis of the plan is to devise a simple yet effective equipment package which will assure the maintenance of good quality water, the establishment of an effective piping system for pumping, reservoirs, and drainage, selection of appropriate equipment, and maintenance of quality levels, while minimizing equipment downtime.

To the maximum extent possible, we have specified standard items for equipment material. Even on products of other country, we gave consideration mainly to those items which are relatively widely used in the Philippines, with a view toward the copies with any future expansion or application changes. We have not specified any equipment requiring high-level handling or maintenance.

Since these facilities will be continually cultivating and raising marine organisms for experimental use, the water supply system must be developed with a plan for providing spare or replacement equipment.

(1) Plumbing Plan

1) Water supply

As already outlined in Section 3-3 (3), all of the water requirements for the existing Center facilities are drawn from the Center's own wells--water for human use from the deep wells (about 150 feet) and water for aquaculture and lab use from the shallow wells (about 20 feet).

With respect to the plan for water sources, based on a survey of existing sources, including a water quality analysis, the BOD (Biochemical Oxygen Demand) level in the shallow well is quite high, while this water is also affected by the changes between the dry and rainy seasons. Thus, both the quality and quantity of the water from the shallow well were found to be unstable. Accordingly, in the facilities for this project, we intend to rely on water from the deep well for both human use and the bulk of the aquaculture and lab requirements.

Water Quality Analysis Chart

Item	Deep Well	Shallow Well	Canal	Notes
Dissolved oxygen	1.6 ppm	5.5 ppm	6.8 ppm	CLSU analysis
Ammonia	0.26 ppm	0.26 ppm	0.45 ppm	"
P.H	7.4	6.9	7.0	"
Total alkalinity	548 ppm	315 ppm	67 ppm	"
Hardness	184 ppm	143 ppm	42 ppm	"
Suspended solid	19.7 ppm	22.3 ppm	209.4 ppm	"
B.O.D.	0.25 ppm	1.57 ppm	1.65 ppm	24 hrs.
Chlorine ion	41 mg/l	6 mg/l	5 mg/l	Analyzed in Tokyo
Organic phosphor	0.05 mg/l	0.05 mg/l	0.05 mg/l	"

Note: Value from the local analysis by CLSU are shown in P.P.M.; those from the Tokyo analysis in mg/l (following the JIS measuring standard).
The B.O.D. analysis was performed over a 24-hour period. In Japan, this measurement covers 125 hours (5 days), and the 5 day measurement is about 2-3 times that of the 24-hour value.
We did an organic phosphor analysis to check for agricultural chemicals, and the results were not detected.

The water from the deep well is to be pumped up and stored in a receiving tank (some 50 m^3) below the pump room. The water so stored will be pumped up to an elevated tank, from which it will be redistributed to the various items of terminal equipment by a gravity system.

The daily volume of water consumption, along with the capacity and applications of the various facilities, have been established as shown below:

a) Required water volume

Aquaculture and Lab Use

Culture Tank 60 m^3 x 80% x 3 times = 144 m^3
(Total tank volume) (use ratio) (no. of refillings per day)

Laboratory 5 rooms x 3 m^3 = 15 m^3
(No. of labs) (estimated consumption)

Human Consumption

Staff 20 persons x 0.12 m^3 = 2.4 m^3
(No. of staff) (consumption per person/day)

Trainees	110 trainees	x 0.5 x 0.12 m^3 = 6.6 m^3 (use ratio) (consumption per person/ day)	
	Total		168.6 m^3

Thus, the daily water consumption will be some 170 m^3.

b) Pump Capacity for Deep Well

We estimate the maximum water consumption per hour for the various facilities to be as follows:

Culture tanks	144 m^3 ÷ 24 hrs	= 6.0 m^3	
Research labs	15 m^3 ÷ 8 hrs	= 1.9 m^3	
Staff use	2.4 m^3 ÷ 8 hrs	= 0.3 m^3	
Trainee use	6.6 m^3 ÷ 8 hrs	= 0.8 m^3	
	Sub-total	9.0 m^3	
When refilling tank	60 m^3 x 20%	= 12 m^3	
(Assuming that 20% of the tanks will be filled per unit hour)			
Reserve water (allowing for future expansion of research activities)			15 m^3
	Grand Total	36 m^3	

Thus, the capacity of the water pump, with loss allowance, should be 40 m^3 per hour = 670 l/minute. The head should be 60 m including allowance for loss.

c) Reservoir Tank Capacity

The capacity of the reservoir tank has been determined on the basis of the following formula:

$Vs = Qd - QsT + Vf$

where:

- Vs: Capacity of reservoir tank
- Qd Daily usage ------ 170 m^3/day
- Qs Water supply capacity --- 40 m^3/hr
- T: Hours of pump operation at peak periods. (T has been set at 3 hours)
- Vf: Reserve water for hydrant use Vf has been set at 2.6 m

$Vs = 170 - 40 \times 3 + 2.6 = 52.6\ m^3$

Thus, the reservoir tank should have a capacity of some 50 m^3.

d) Capacity for Elevated Tank and Pressure Pump

The capacities of the elevated tank and water pump have been determined on the basis of the following formula:

$Ve = (Qp - Qpu)\ T1 + QpuT2$

where:

- Ve: Capacity of elevated tank
- Qp: Ordinary maximum usage per hour (water for tanks and labs + water for human use + water for refilling tank) ⟶ 21m^3/hr = 350 l/min
- Opu: Water pump capacity --- Set at 350 l/m, the same as for ordinary maximum usage
- T1: Maximum minutes of water pump operation 60 minutes
- T2: Minimum minutes of water pump operation 15 minutes

$Ve = (350 - 350)\ 60 + 350 \times 15 = 5{,}250\ l \longrightarrow 6\ m^3$

From the above, the capacity of the elevated tank is set at 6 m^3; the water pump, at 350 l/min; the head at 20 m.

e) Determination of Hydrant Pump

The capacity of the hydrant pump is derived as follows:

The maximum number of hydrant plug per floor
x 150 l x 1.3 (piping loss) =
1 x 150 x 1.3 = 200 l/min

The hydrant pump capacity is to be 200 l/min with the head of 50 m.

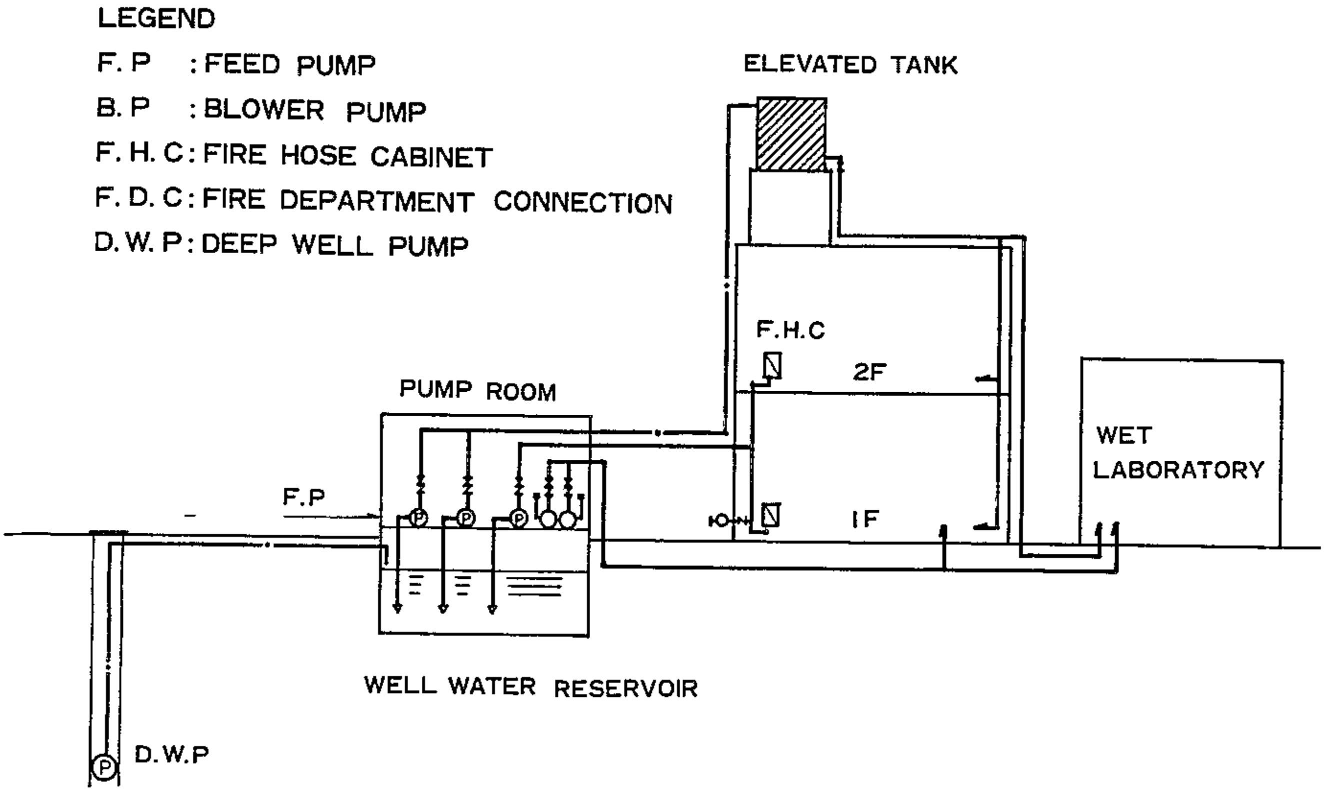
From the above, we may below summarize the capacities and general specifications of the water supply facilities and consuming equipment items:

Water Supply Facilities

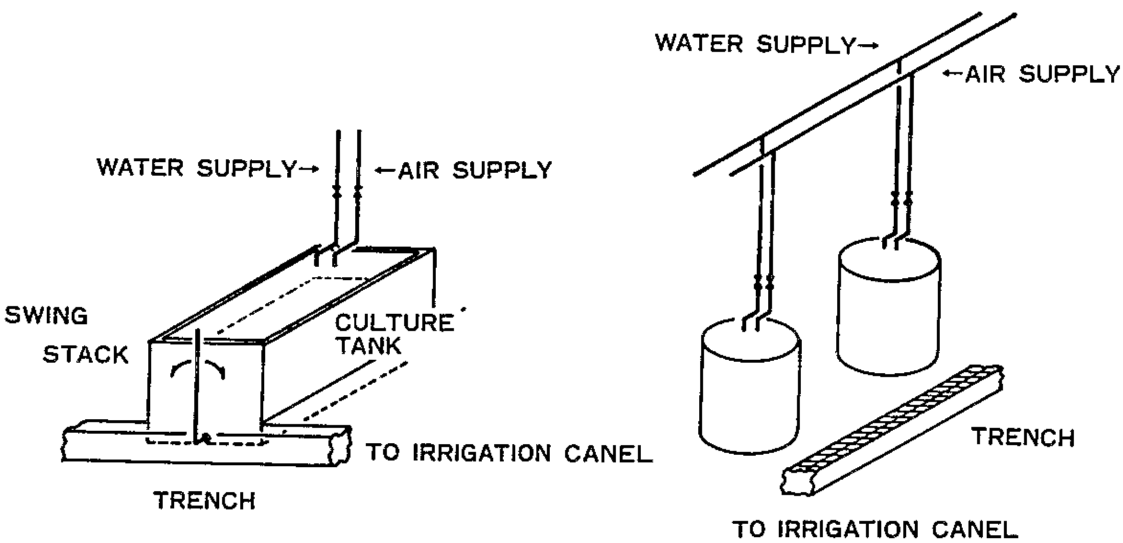
Item	General Specifications	Q'ty
Deep well pump	670 l/min x 60 mH x 15 Kw	2
Reservoir tank	50 m^3	1
Water pump	350 l/min x 20 mH x 3.7 Kw	2
Elevated tank	6 m^3	1
Hydrant pump	200 l/min x 50 mH x 5.5 Kw	1

2) Emergency Shower Equipment

Emergency shower facilities will be installed in every research lab in case of accident during the handling of chemicals. They will permit the body to be washed with clean water and so protect the lab workers from injuries from these chemicals.



WATER SUPPLY SYSTEM DIAGRAM



WET LABORATORY WATER SUPPLY SYSTEM

3) Drainage Facility

This will be a 5-branch system covering: stormwater, waste water, soil water, chemical waste water, and pathology waste water.

Stormwater --- to be released by pipes from gutter into agricultural canal

Waste water -- kitchen waste water to be evaporated and permeated via grease trap

Soil water --- To be evaporated and permeated after being treated via septic tank

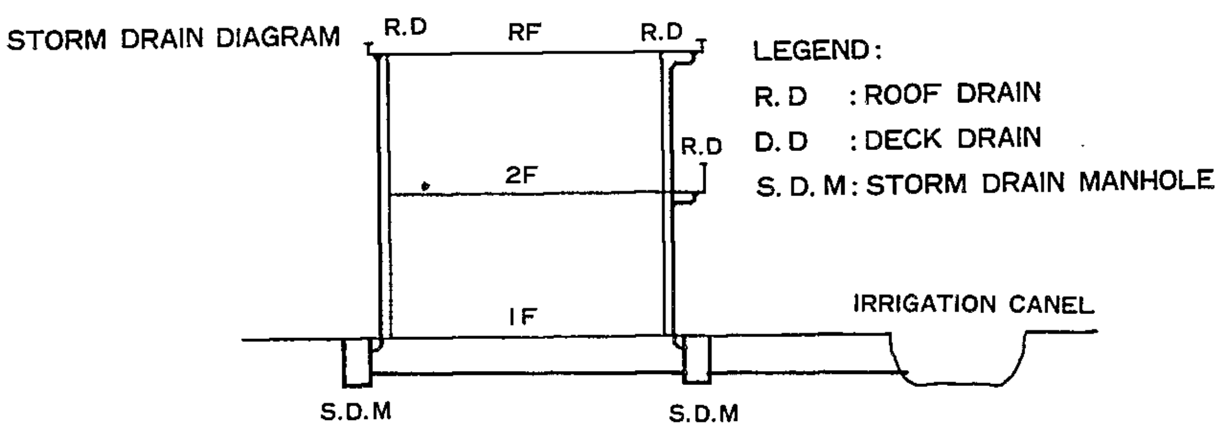
Chemical waste water ---

High-density chemicals and chemicals from heavy metals will be collected in a plastic tank and released at regular intervals to the processing station. Water for washing analytical utensils and water from low density solutions will be soaked away after P.H adjustment, via a neutralizing processing tank.

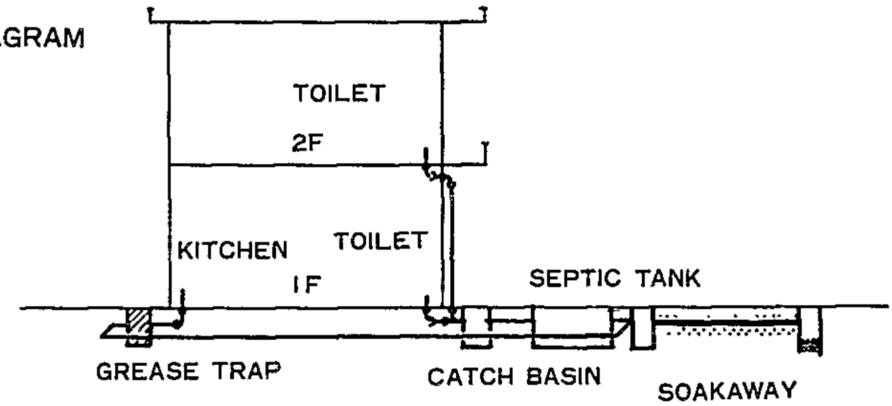
Pathology waste water ---

Waste water from the pathology lab will be evaporated and soaked away after chlorine sterilization in a disinfection tank.

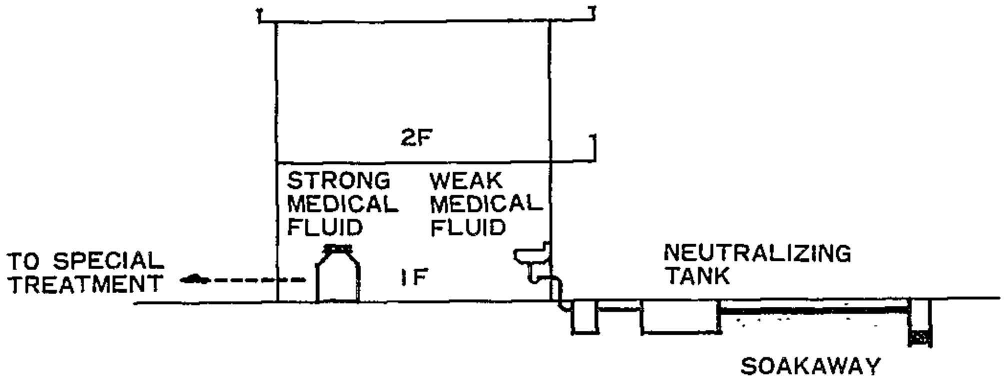
DRAINAGE SYSTEM DIAGRAM



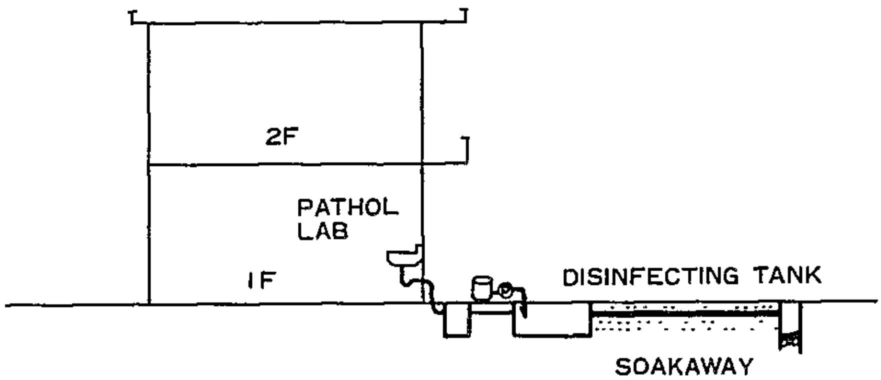
SANITARY DIAGRAM



CHEMICAL TREATMENT DIAGRAM



DISINFECTION DIAGRAM



4) Gas Equipment

Propane gas will be used both for cooking and as a source of heat for the lab equipment. As needed, the gas will be piped and supplied to the areas where needed from the gas cylinder room in the attached building.

5) Air Supply Equipment

Air for aeration use will be supplied from the air blower installed in the pump room in the machine shed to the wet lab and the various research labs. The required blowing capacity has been estimated at 0.5 m^3/hr per 1 m^3.

The blower capacity has been derived as follows:

$0.5\ m^3/hr = 0.008 \longrightarrow 0.01\ m^3/min$

(48 tons + 15 tons) x 0.01 = 0.63 → 0.7 m^3/min

(wet lab) (research lab) (blower power per min)

From the above, the volume of air transmitted comes to 0.7 m^3/min; and the transmitted air pressure, after allowing for piping loss and tank depth, works out to 0.4 kg/cm^2.

(2) Electrical Equipment Plan

1) Power Supply

Power is to be supplied by the Electric Power Corporation to the University substation's power receiving board at 5MVA 69 KV and retransmitted to each building at 13,800 V.

Since there is a high voltage distribution line already in the vicinity of the target site, power will be supplied from this line. Construction of the power supply facilities will be the responsibility of the CLSU authorities.

Power receiving capacities will be as follows:

Voltage	220V 3-phase, 200V 1-phase
Capacity	200 KVA

The power requirements of the various items of equipment are as follows:

1)	Lighting equipment, outlets	80 KVA
2)	Air blower, water pumps, powered equipment	30 KVA
3)	Power for air conditioning and ventilating equipment	70 KVA
4)	Power for research equipment	10 KVA
5)	Other	10 KVA

2) In-House Generator

Given the high frequency and long duration of power blackouts under existing conditions and considering the nature of the planned facilities, an in-house generator is an absolutely essential unit.

The generator will have an engine capable of regular operation. The equipment items that are to receive power from this generator include: water supply facilities, air supply facilities, lab equipment, freezer, certain air-conditioners plus a small number of emergency lighting fixtures.

Generator start-up will be automatic; at the time of a power stoppage power will be automatically furnished to the necessary facilities.

Generator capacity has been determined as shown below.

The power consumption of the various items of equipment to be supplied by the generator is as follows:

1)	Deep well pump	15 KW
2)	Water pump	3.7 KW
3)	Hydrant pump	5.5 KW
4)	Air blower	2.2 KW
5)	Freezer	2.7 KW
6)	Air conditioner	2.64 KW x 8
7)	Research lab equipment	3.0 KW
8)	Emergency lighting	2.0 KW

The generating capacity will be the largest value from among the following formulas for determining capacity requirements:

PG 1: Capacity based on the generator load during normal operating periods

$$PG\ 1 = \frac{1.5}{0.92 \times 0.85} + \frac{3.7}{0.92 \times 0.85} + \frac{5.5}{0.92 \times 0.85} + \frac{2.2}{0.85 \times 0.85} + \frac{2.7}{0.75 \times 0.85} + \frac{2.64}{0.75 \times 0.85} \times 8 + \frac{5}{0.8} = \underline{77.15\ KVA}$$

PG 2: Capacity based on the sudden voltage drop from the generator when starting up the largest motor.

The capacity (KVA) of the largest motor at start-up = $\sqrt{3} \times 220V \times 252A \times 0.67 \times 10^{-3} = 64.3$ KVA

$$PG\ 2 = \frac{Xd(1-\Delta E)}{\Delta E} \times \text{capacity at start-up}$$

$$= \frac{0.21(1-0.3)}{0.3} \times 64.3\ KVA = \underline{31.5\ KVA}$$

PG 3: Capacity based on the transit maximum load on the generator when the maximum load has finally been attained.

$$PG\ 3 = \frac{Xd(1-\Delta E)}{\Delta E} \times$$ Total load during regular operating times (-) load of largest motor during regular operating times (+) load of largest motor at start-up time

$$= \frac{0.21(1-0.3)}{0.3} \times (77.15 - 19.2 + 64.3) = \underline{59.9\ KVA}$$

Comparing the values as derived from the above estimates:

PG 1 : > PG 2 : > PG 3 :

Accordingly, the required generating capacity will be 77.15 KVA

3) Power Control Facilities

Power will be redistirubted from the panelboard substation to the switchboards for the various facilities, power, and lighting. The power control facilities will basically follow the system now being used within the University. Interior power dsitribution will be by duct lines; outside distribution by both under ground and overhead lines.

4) Lighting Fixtures

From the standpoint of ease of operation and maintenance, it would be desirable for the lighting fixtures to be locally procured. Fluorescent lighting, being the most widely used form of lighting in the Philippines, will be the primary type used in this project, but incandescent lighting will also be used as required.

The brightness of the various rooms has been determined with due regard to local conditions:

Offices	300 lx
Classrooms	300
Conference Room	300
Labs	400
Wet Lab	150
Lavatories	100

5) Outlets

Individual outlets will be provided for general use, lab equipment and ceiling and ventilating fans. Outlet voltage will be dual 220/110 V.

6) Control and Alarm Facilities

The control and monitoring system will be designed as follows:

We will use a self-regulating system for the deep-well pump, and water pumps, keyed to water levels of reservoir tank, and elevated tank.

The air blower will be turned on and off automatically via a self-contained pressure switch. The compressor for the air conditioners, ceiling fans, and ventilating fans will be individually operated.

Emergency alarm facilitiės will be attached to the reservoir tank, elevated tank, pump and air blower and programmed to emit an alarm during emergencies, thereby ensuring protection to the equipment.

7) Manual Fire Alarm System
A push-button fire-alarm system will be installed in the administrative building, classrooms, and research labs and corridors for emergency use.

Following is a summary chart describing the proposed power supply system.

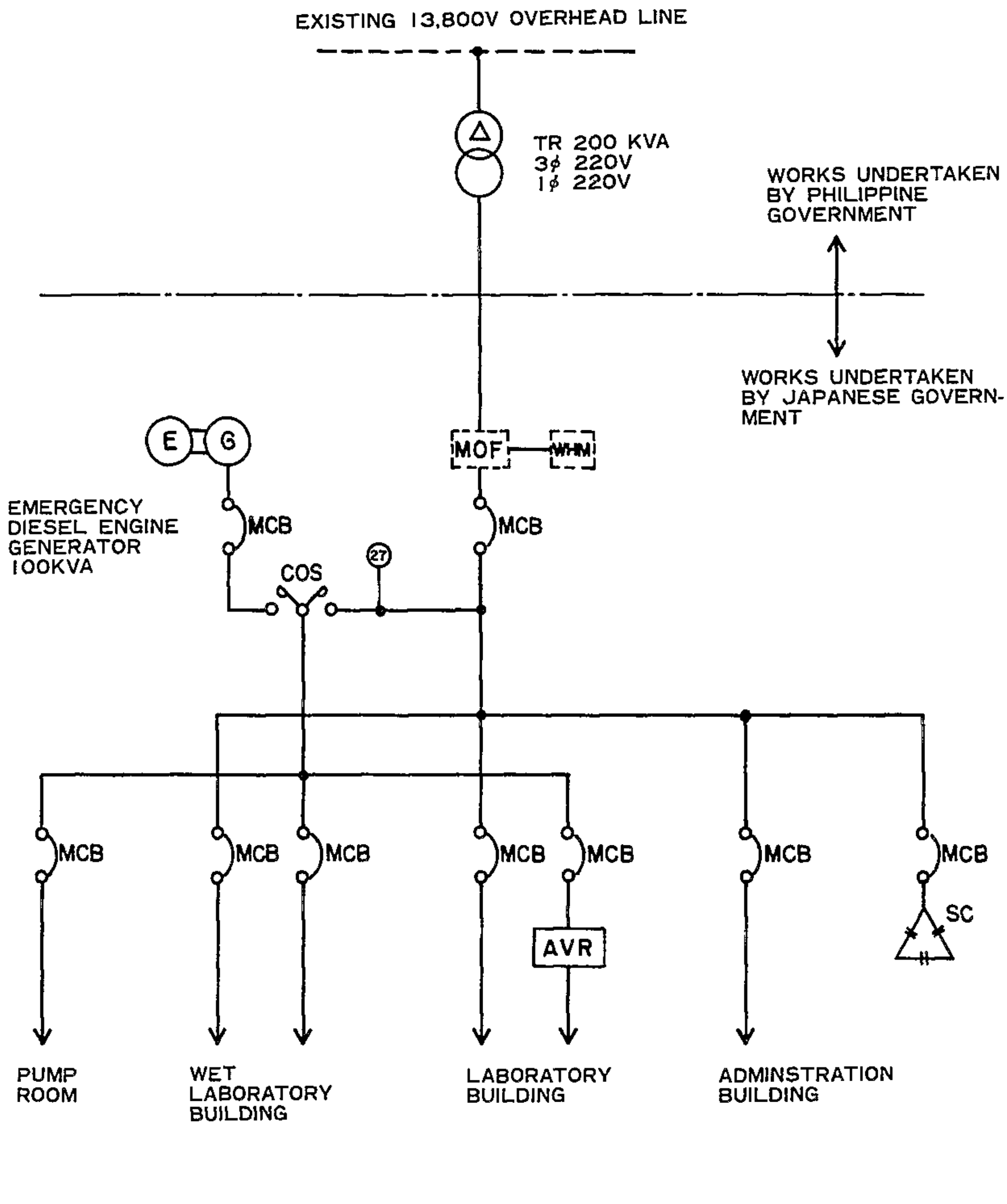
(3) Communication and Broadcast Equipment

1) Interphone System
An interphone system will be installed in selected rooms to permit 2-way communication among these locations.
2) TV/Radio Antenna
A roof antenna will be installed for joint TV/Radio use, with antenna-outlets in selected rooms.

(4) Air Conditioning and Ventilation

1) The use of air conditioning is very limited in the existing University facilities, serving only the Office of the President, Conference Room, and certain dormitories.

ELECTRIC POWER SUPPLY SYSTEM



In the present plan, air conditioning will be provided in the research labs and a portion of the administration building. In these rooms, temperature and humidity will be controlled according to use.

In rooms likely to emit foul odors or gas, such as labs, central equipment room, and thermal equipment room, the air conditioning will have to be supplemented by a forced exhaust system. Since this will increase air conditioning loads, a small thermal exchange units will be installed, as necessary, as a means of reducing air conditioning load and economizing on operating costs. In the general offices, window-type air conditioners (air-cooled) will be installed; in the conference rooms, floor-type (air cooled). In the interest of operating and maintenance efficiency, the units will be limited to 2-3 standard types.

The following rooms are to be air conditioned:

a) Administrative and Training Building:
   - Office of the Director
   - Office of the Assistant Director
   - Large Conference Room
   - Small Conference Room

b) Research Building:
   - Pathology lab
   - Feed and nutirtion lab
   - Aquaculture ecosystem lab
   - Breeding physiology lab
   - Analytical chemistry lab
   - Central equipment room

Other rooms will, in principle, be naturally ventilated, assisted by ceiling and other fans.

2) Ventilation

High-powered ventilating equipment will be provided to selected rooms, all of the labs, kitchen, dark room and lavatories.

(5) Experimental Tank

As already outlined in Section 3-3 (2), the exterior ponds is already quite well set up from both a quantity and quality standpoint. Accordingly, in the present plan, the focus has been on an interior tank.

A 300 m^2 culture tank room will be set up within the Wet Laboratory Building, incorporating a 2-ton stationary concrete tanks and portable small-size tanks (of 30 - 500 l) as well as a piping system for water supply, air supply and drainage, capable of controling 60-ton tank water.

Water and air supply ducts will all be of the pit or overhead type and will allow for maintenance and possible future changes in distribution ducts. The water level control system in the stationary tank will be of a type that will maintain desired water levels through a movable adjoining elbow.

4-6 Equipment Plan

We have selected lab and training equipment and general equipment, as shown in Appendix III at the end of the report.

Selection of research equipment has been geared primarily to the requests submitted by CLSU, these equipment is of such level as to permit the full development and maintenance of the facility's research functions. Consideration has been given to the scope and level of the various types of lab equipment installed in fishery and aquaculture research labs of comparable scale both in Philippines and other countries.

The number of equipment items has been keyed to the central equipment room, with a view to minimizing overlap with the various research labs, and in accordance with a policy of limiting the qualifications of users by concentrated placement of high quality measuring equipment and so improving operation, maintenance, and utilization rates.

The voltage capacity to be supplied from the power facilities for these equipment items are:

Voltage	220V 3-phase; 220V 110V 1-phase
Capacity	200 KVA

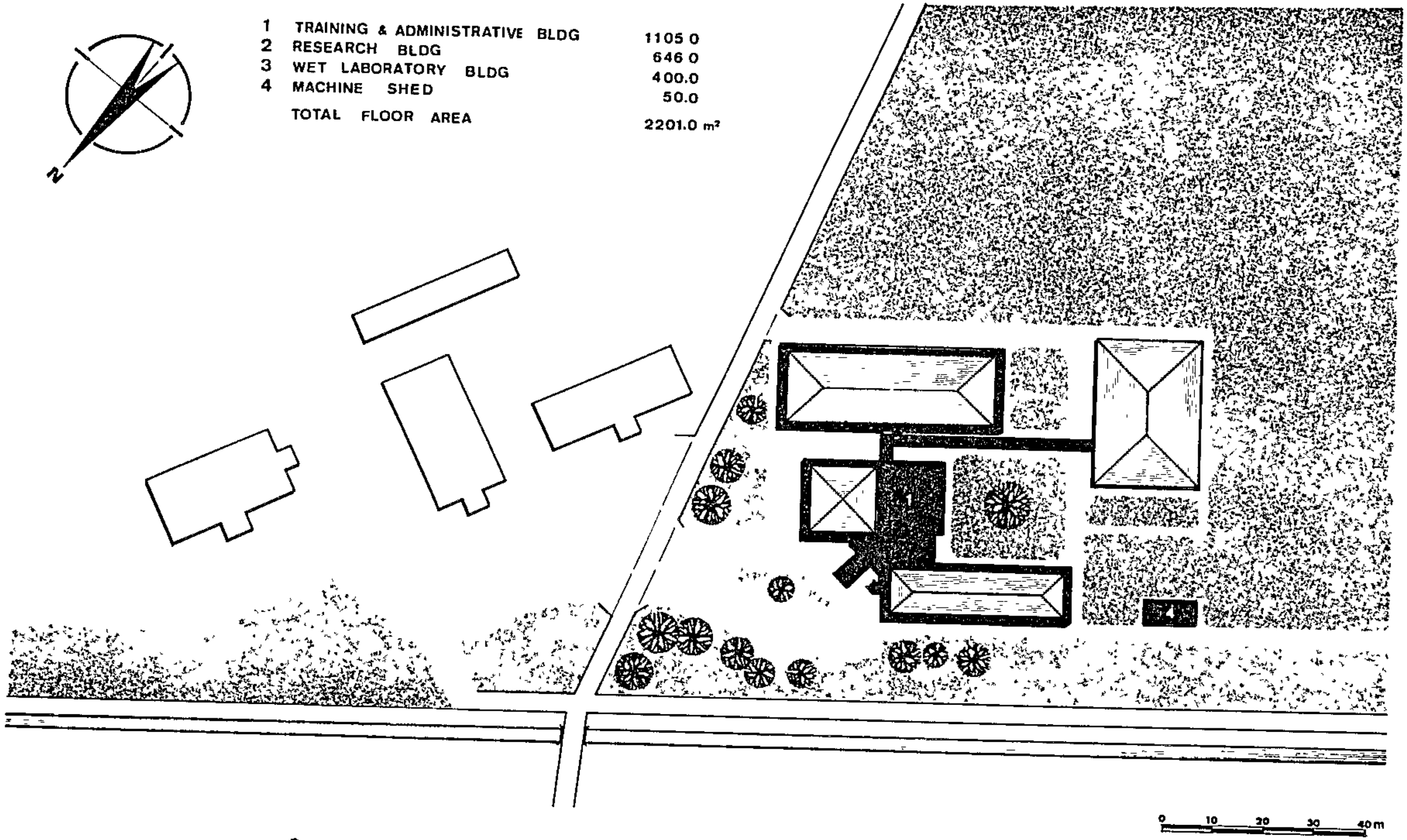
Propane gas will be used, piped in from the gas cylinder in the machine shed. (See Section 4-5-(2))

With regard to procurement of the equipment for this project, local procurement will be relied on to the maximum extent possible. With regard to equipment requiring periodic maintenance and overhaul, it is necessary to select equipment types with a view to availability of local interchange of parts and a system for supplying rotating supply of disposables.

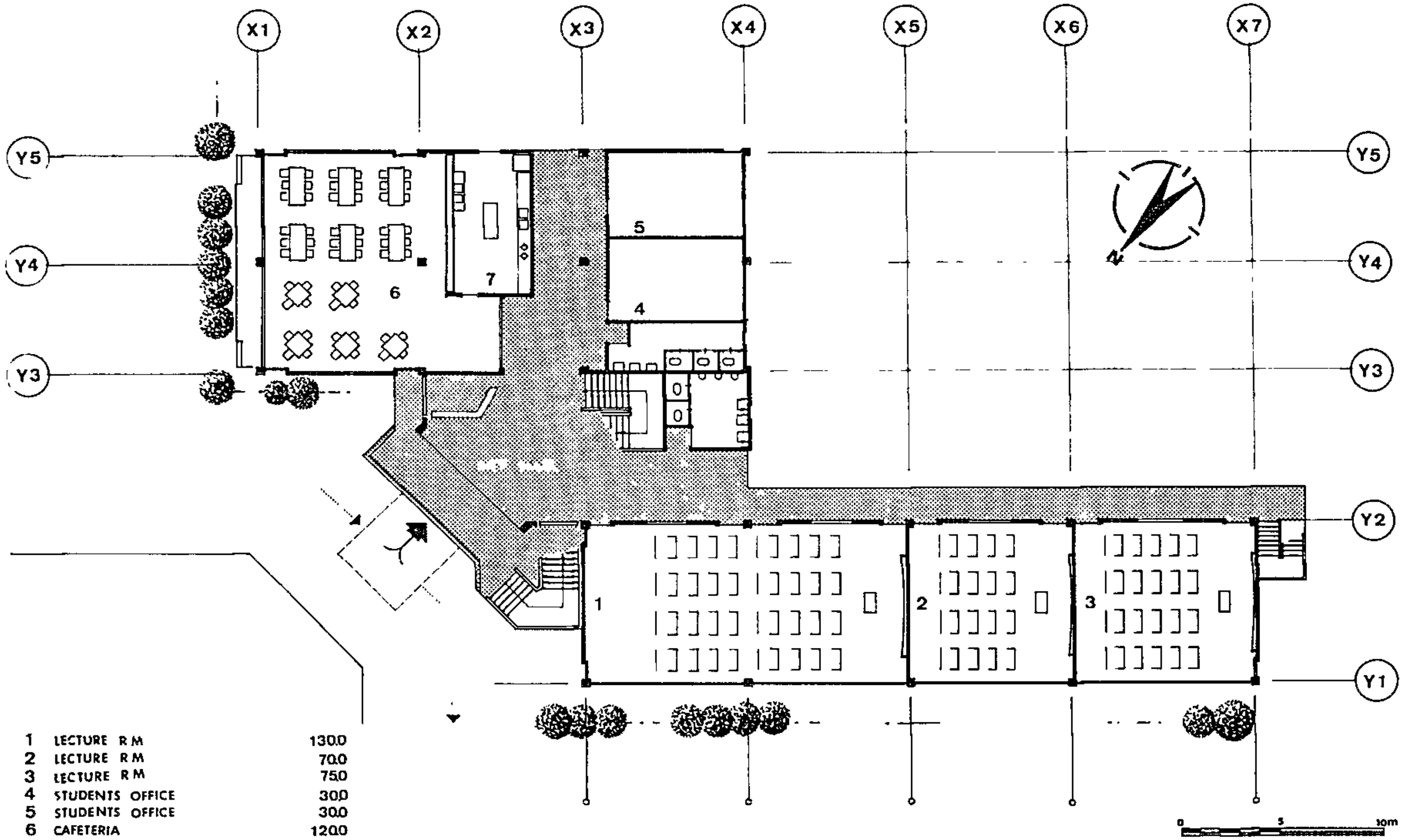
SECTION FIVE

DRAWINGS

1	TRAINING & ADMINISTRATIVE BLDG	1105 0
2	RESEARCH BLDG	646 0
3	WET LABORATORY BLDG	400.0
4	MACHINE SHED	50.0
	TOTAL FLOOR AREA	2201.0 m²

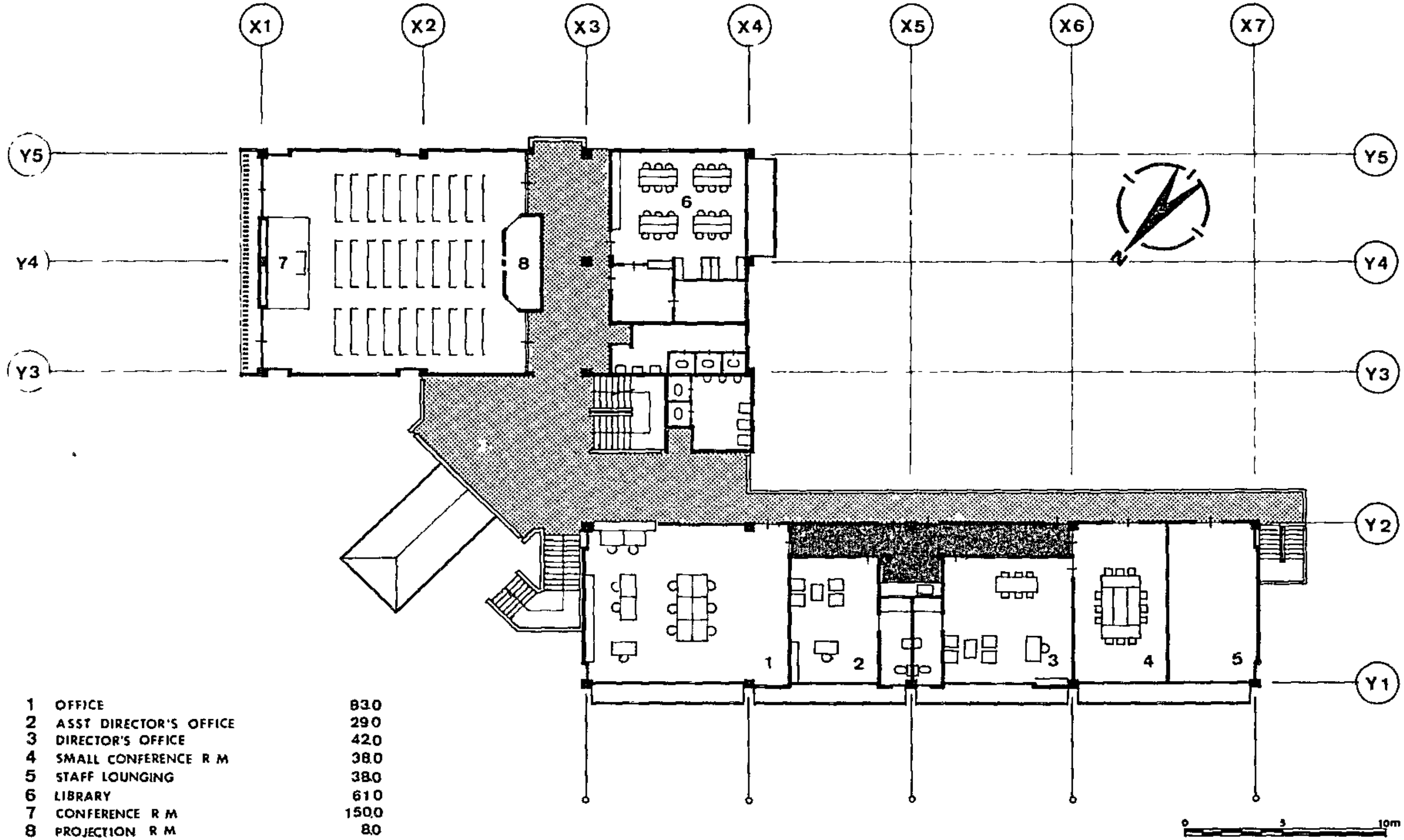


LOCATION PLAN S — 1 800



1	LECTURE R M	130.0
2	LECTURE R M	70.0
3	LECTURE R M	75.0
4	STUDENTS OFFICE	30.0
5	STUDENTS OFFICE	30.0
6	CAFETERIA	120.0
7	KITCHEN	25.0
8	CORRIDOR STAIRS, etc	66.0
	TOTAL FLOOR AREA	546.0m²

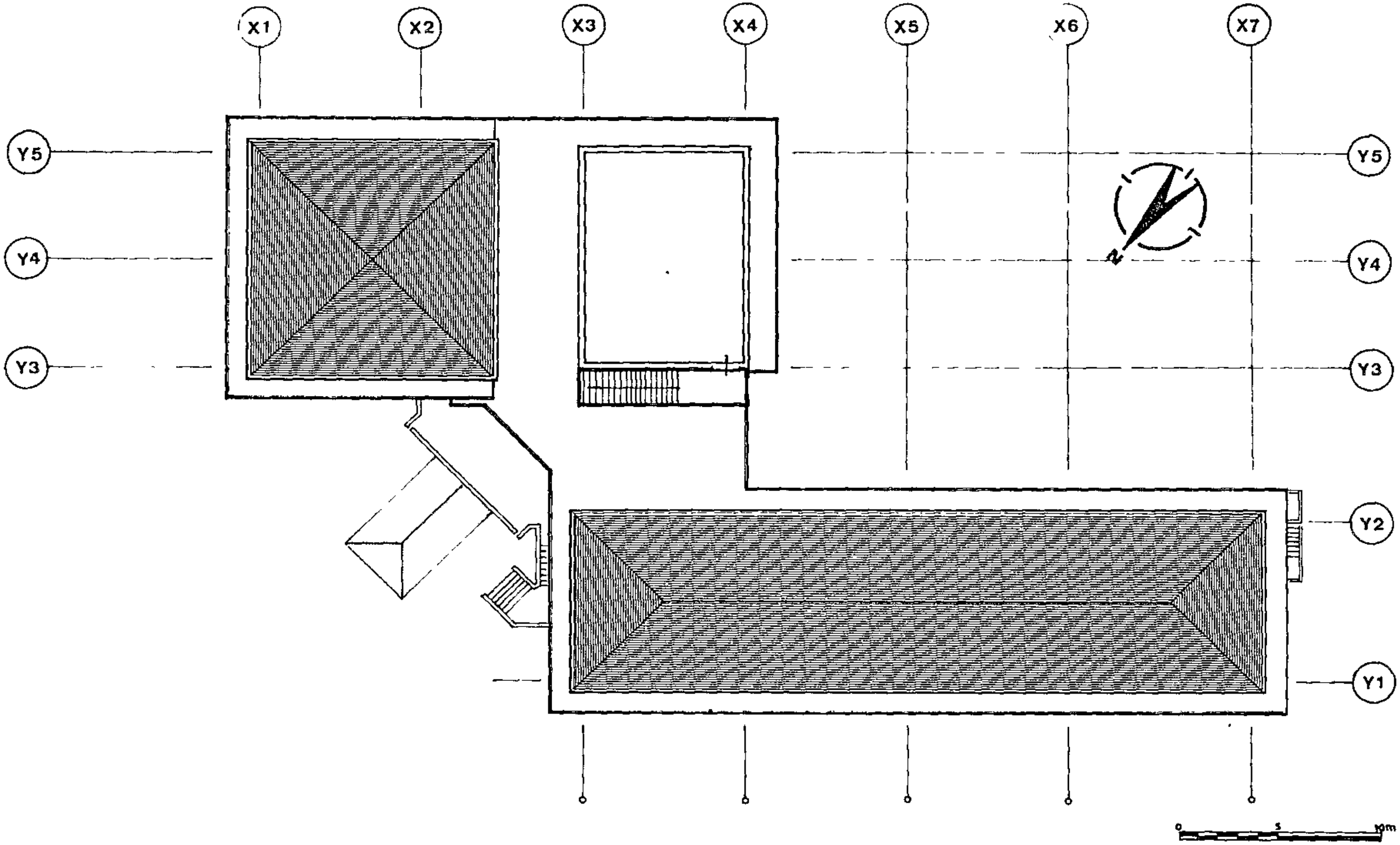
TRAINING & ADMINISTRATIVE BLDG GROUND FLOOR PLAN S = 1 200



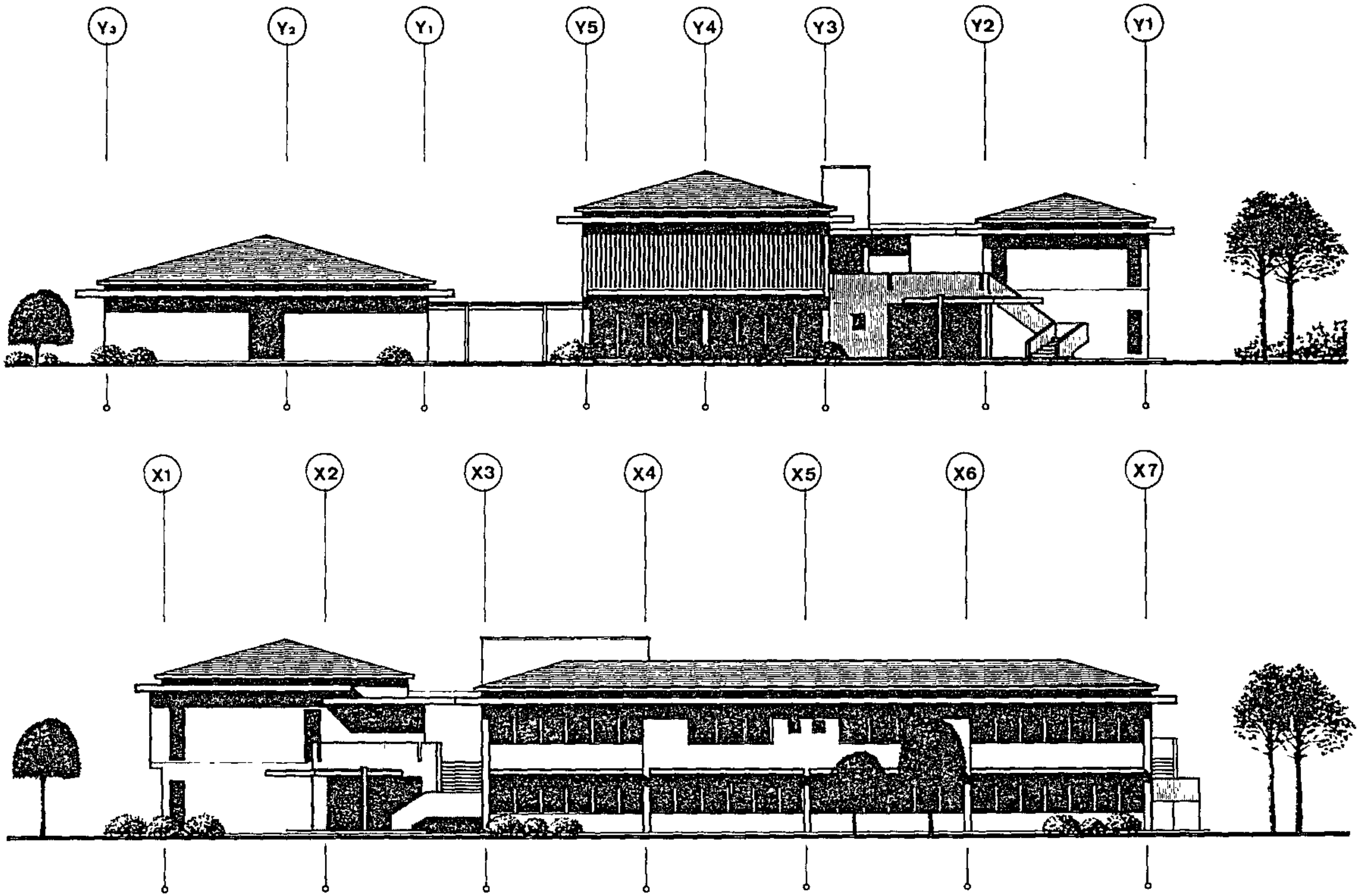
1	OFFICE	83.0
2	ASST DIRECTOR'S OFFICE	29.0
3	DIRECTOR'S OFFICE	42.0
4	SMALL CONFERENCE R M	38.0
5	STAFF LOUNGING	38.0
6	LIBRARY	61.0
7	CONFERENCE R M	150.0
8	PROJECTION R M	8.0
9	CORRIDOR. STAIRS. etc	110.0

TOTAL FLOOR AREA 559.0 m²

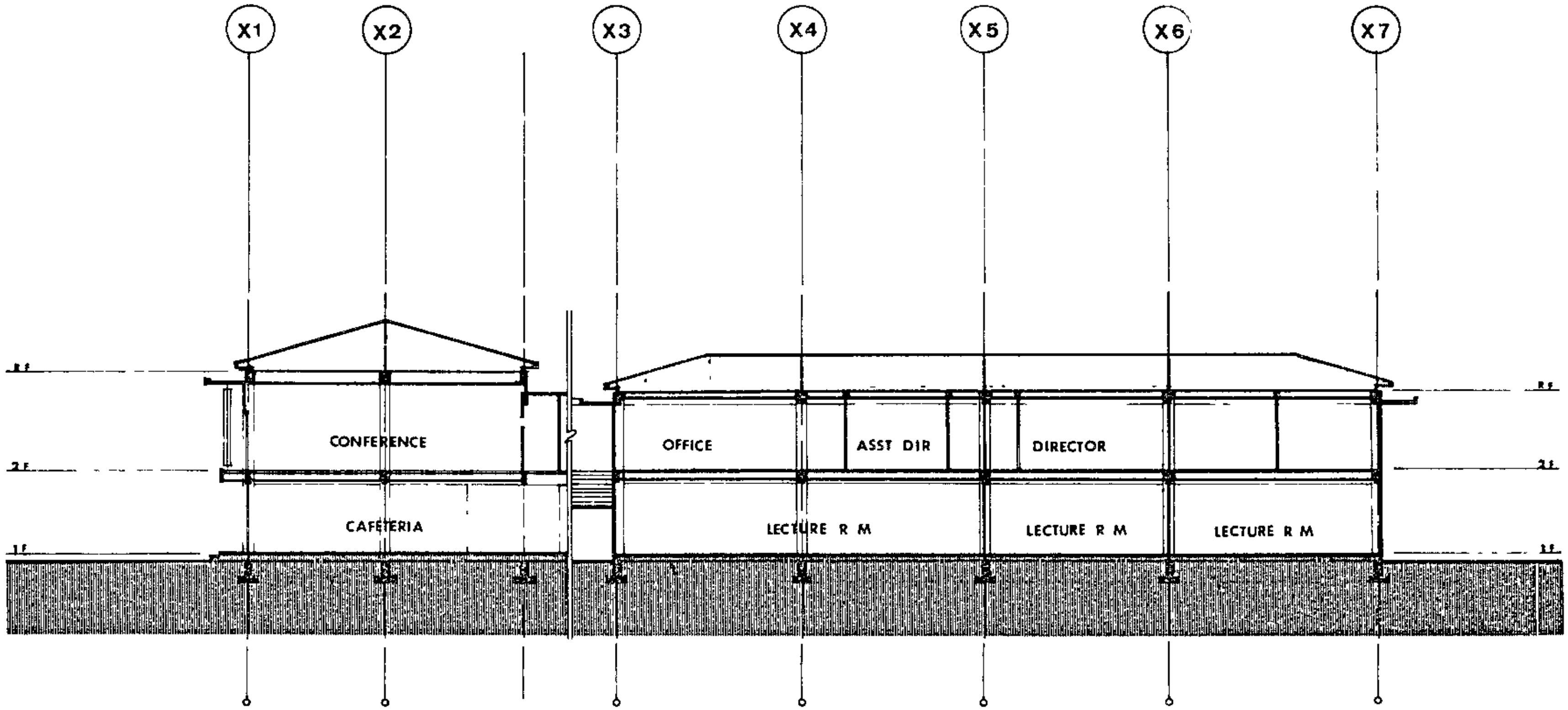
TRAINING & ADMINISTRATIVE BLDG 2ND FLOOR PLAN S = 1:200



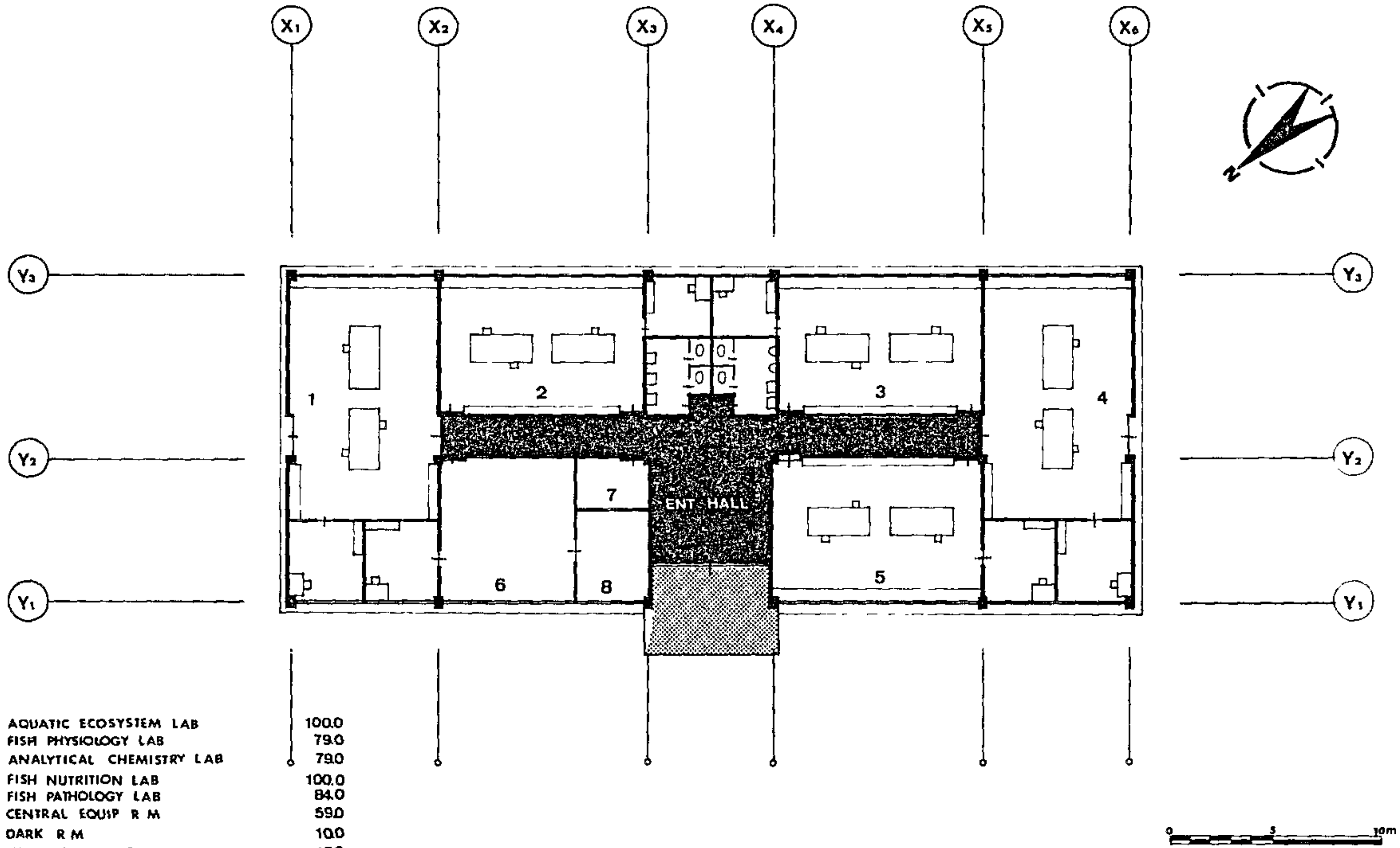
TRAINING & ADMINSTRATIVE BLDG ROOF PLAN S=1 200



TRAINING & ADMINISTRATIVE BLDG ELEVATION S = 1 : 200



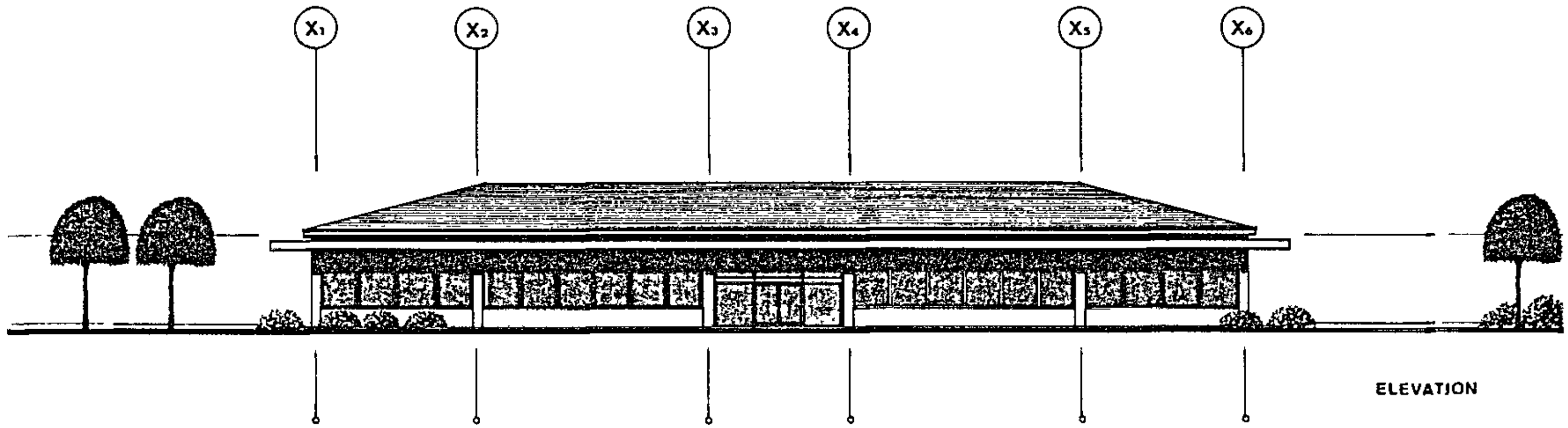
TRAINING & ADMINISTRATIVE BLDG SECTION S=1 200



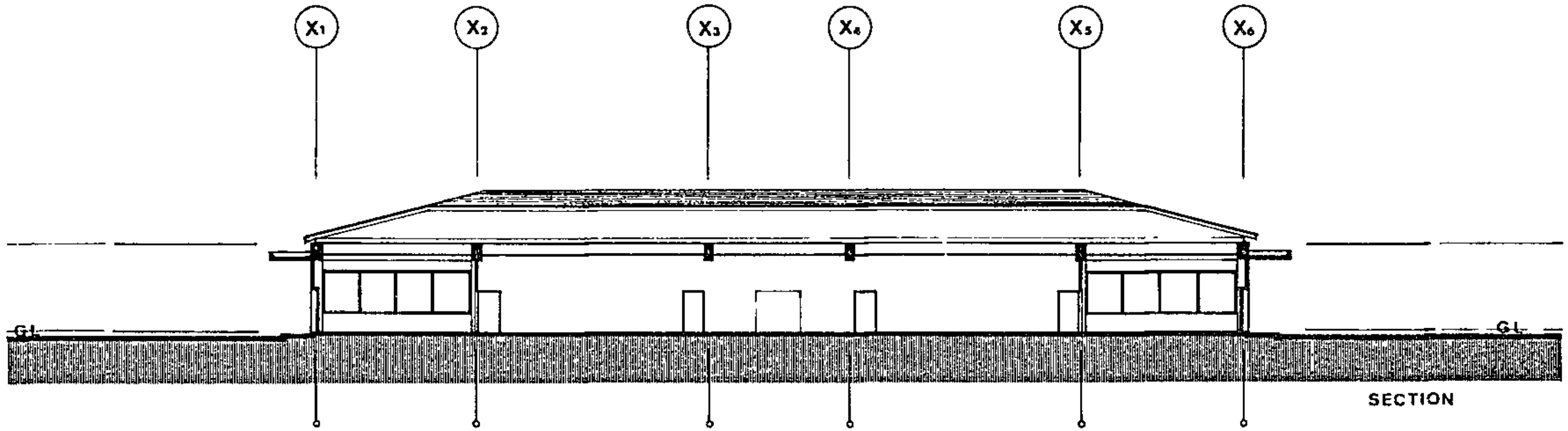
1	AQUATIC ECOSYSTEM LAB	100.0
2	FISH PHYSIOLOGY LAB	79.0
3	ANALYTICAL CHEMISTRY LAB	79.0
4	FISH NUTRITION LAB	100.0
5	FISH PATHOLOGY LAB	84.0
6	CENTRAL EQUIP R M	59.0
7	DARK R M	10.0
8	THERMAL EQUIP R M	15.0
9	CORRIDOR STAIRS etc	120.0
	TOTAL FLOOR AREA	646.0 m²

RESEARCH BLDG GROUND FLOOR PLAN

S = 1 : 200

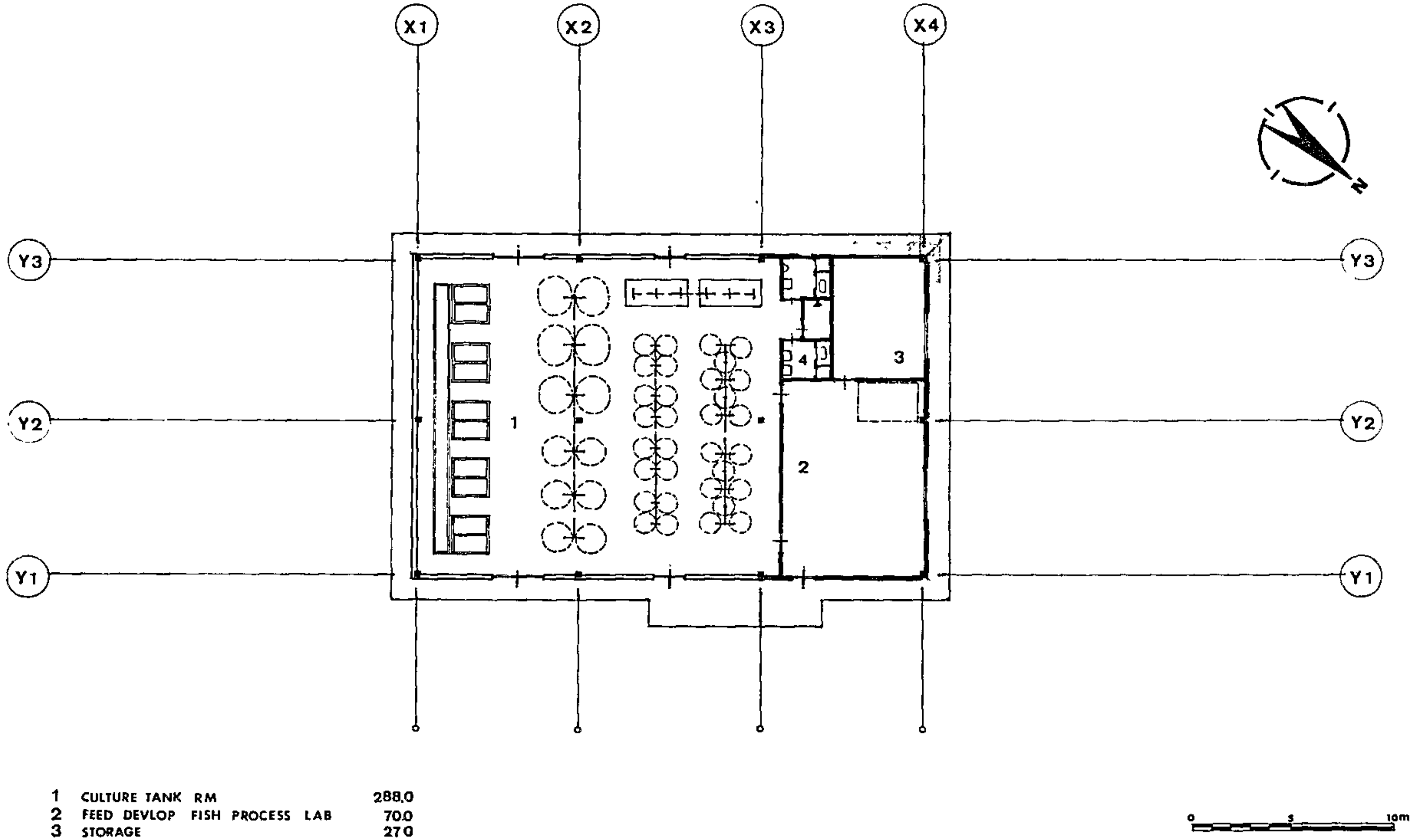


ELEVATION



SECTION

RESEARCH BLDG **ELEVATION & SECTION** S = 1 : 200

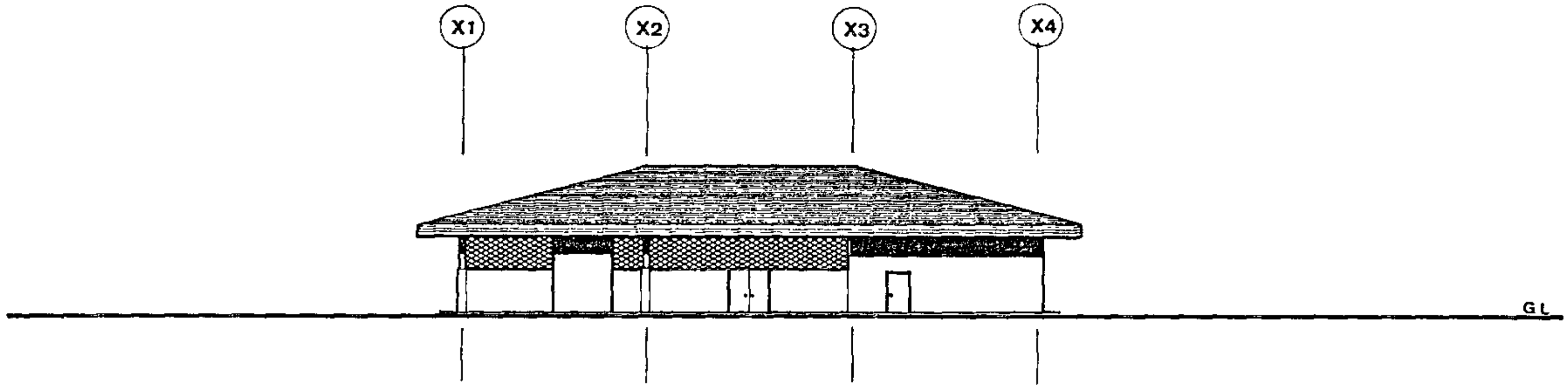


1	CULTURE TANK RM	288.0
2	FEED DEVLOP FISH PROCESS LAB	70.0
3	STORAGE	27.0
4	COMFORT & SHOWER R M	15.0
	TOTAL FLOOR AREA	400.0 m^2

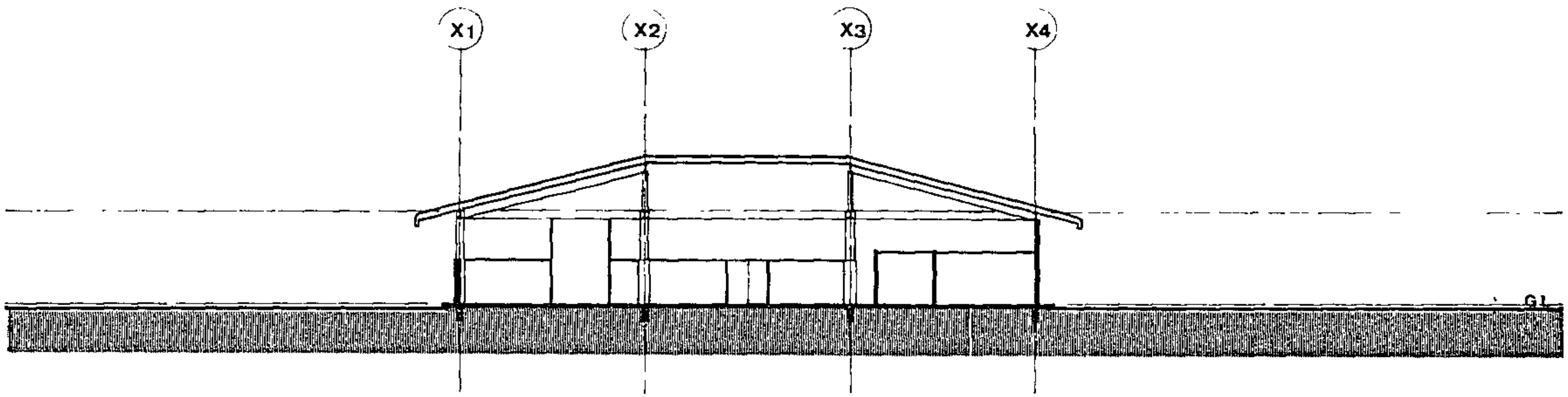
WET LABORATORY BLDG

GROUND FLOOR PLAN

S — 1 200

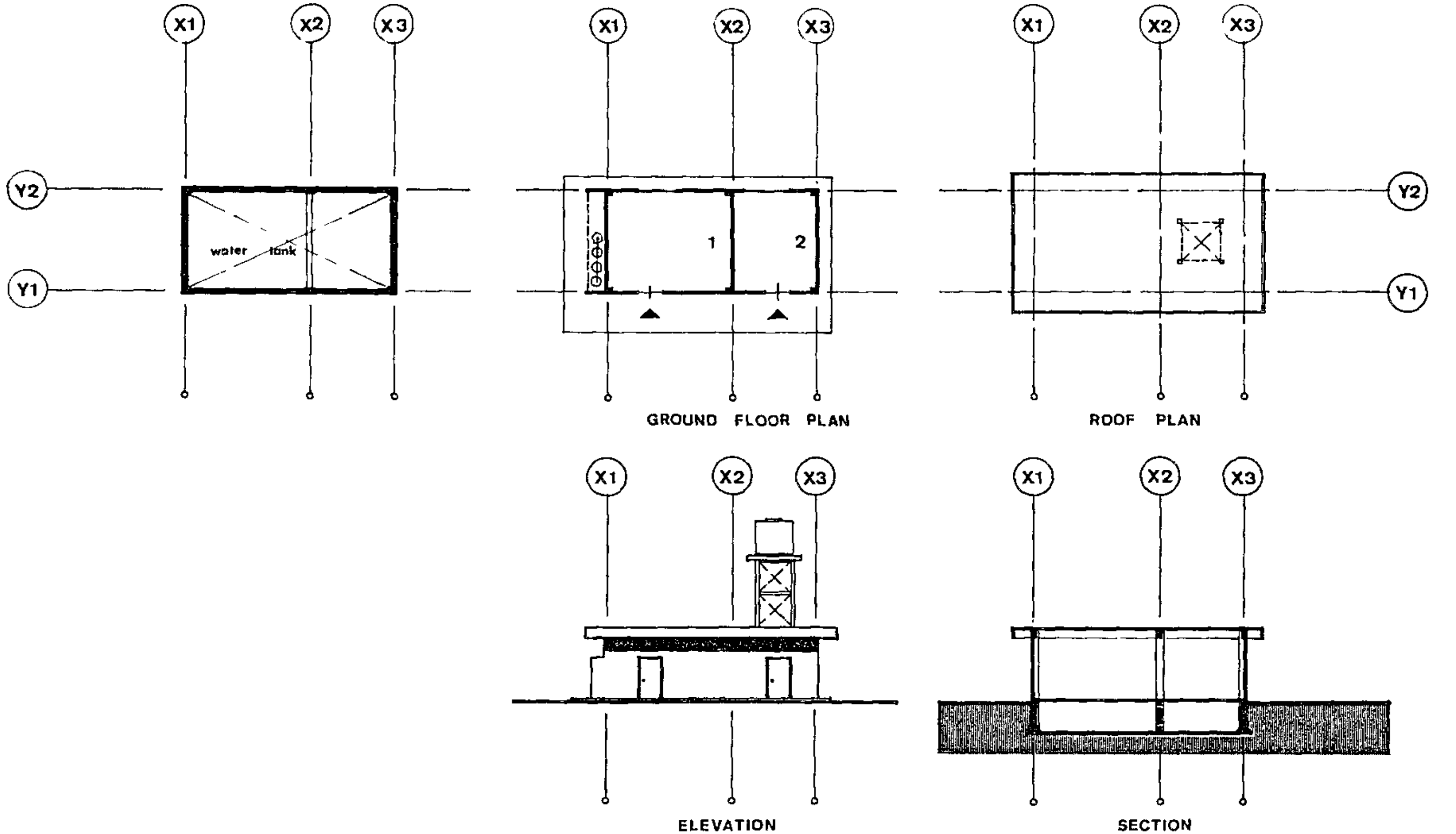


ELEVATION



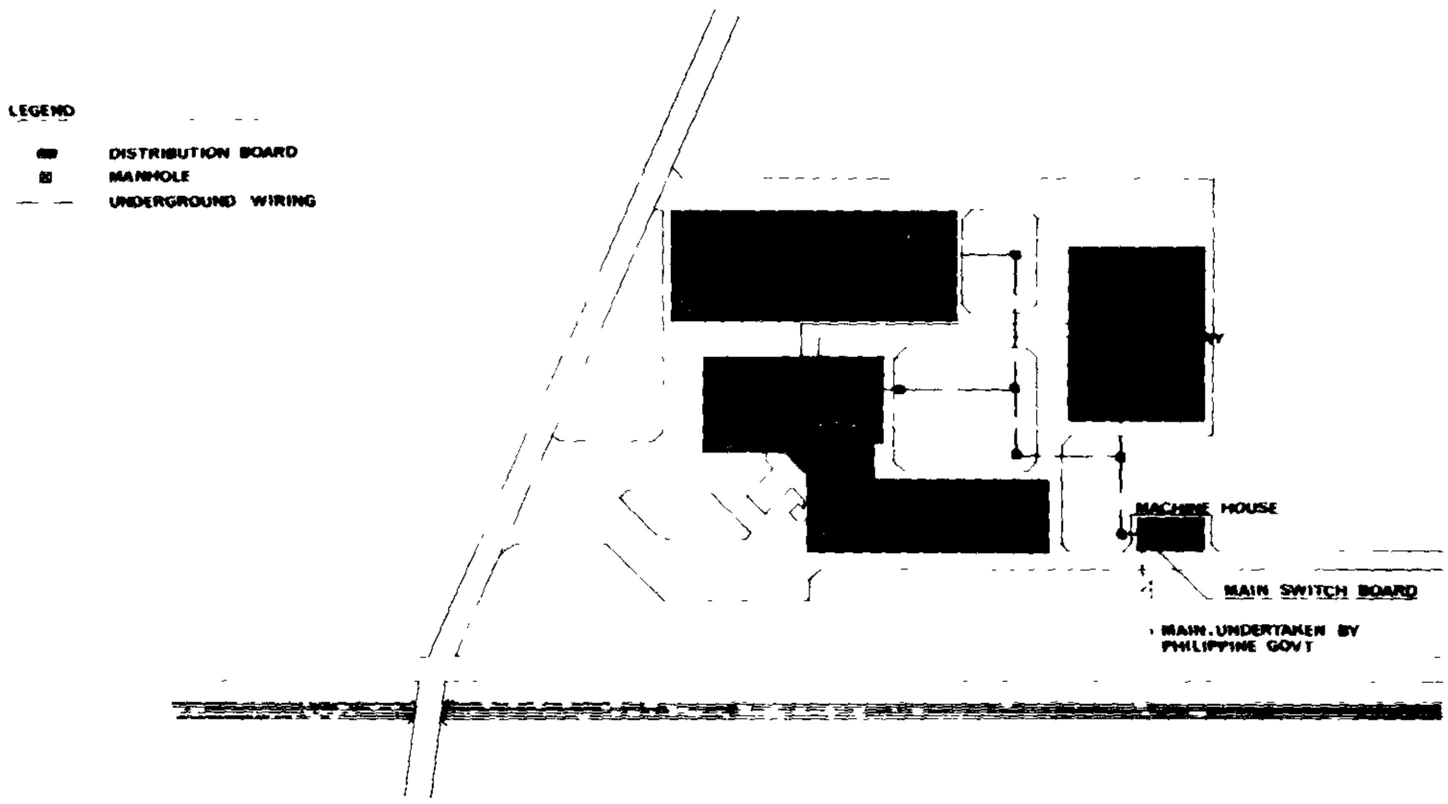
SECTION

WET LABORATORY BLDG ELEVATION & SECTION S = 1 : 200

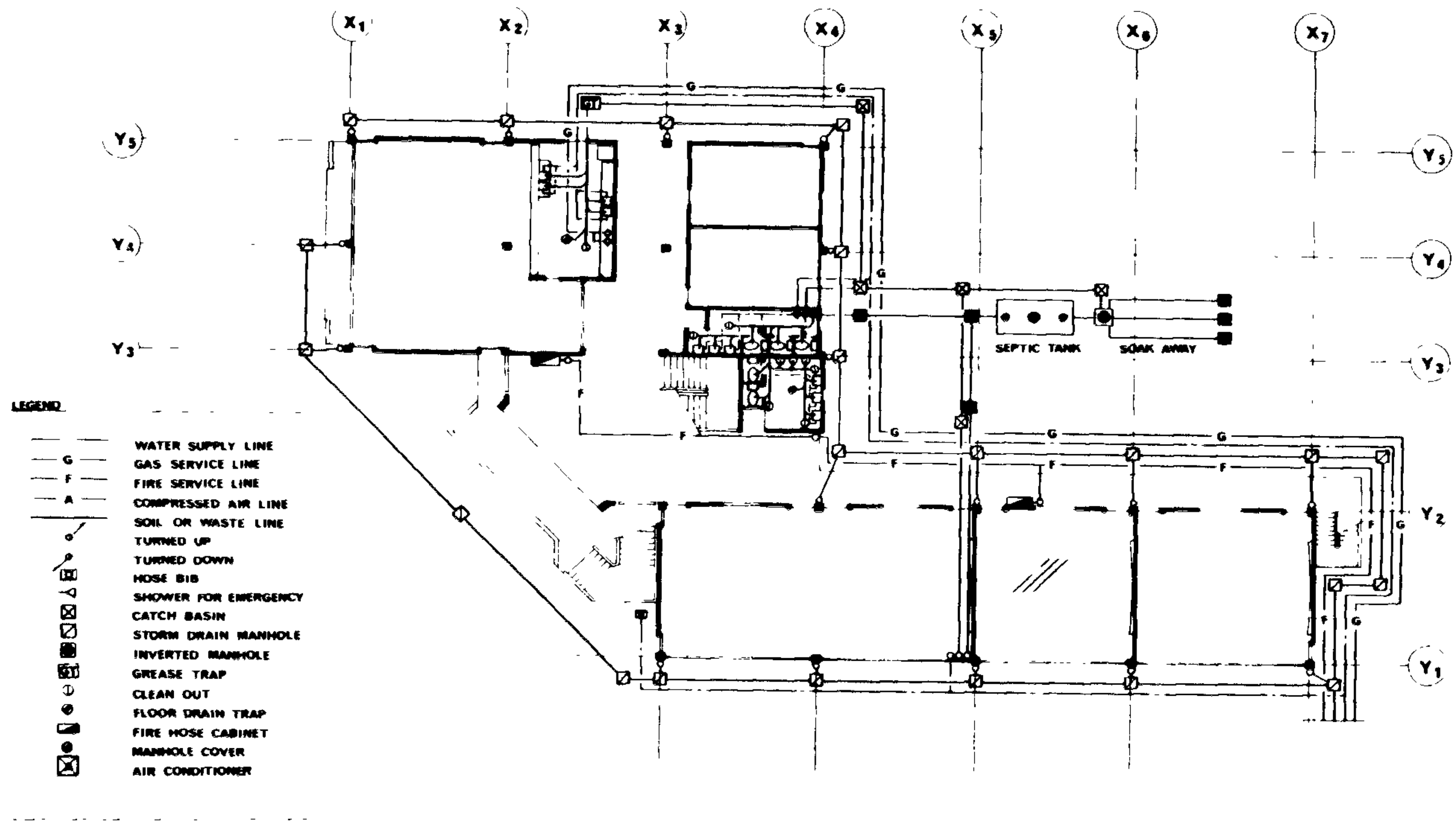


1	GENERATOR RM	30.0
2	PUMP RM	20.0
	TOTAL FLOOR AREA	50.0m²

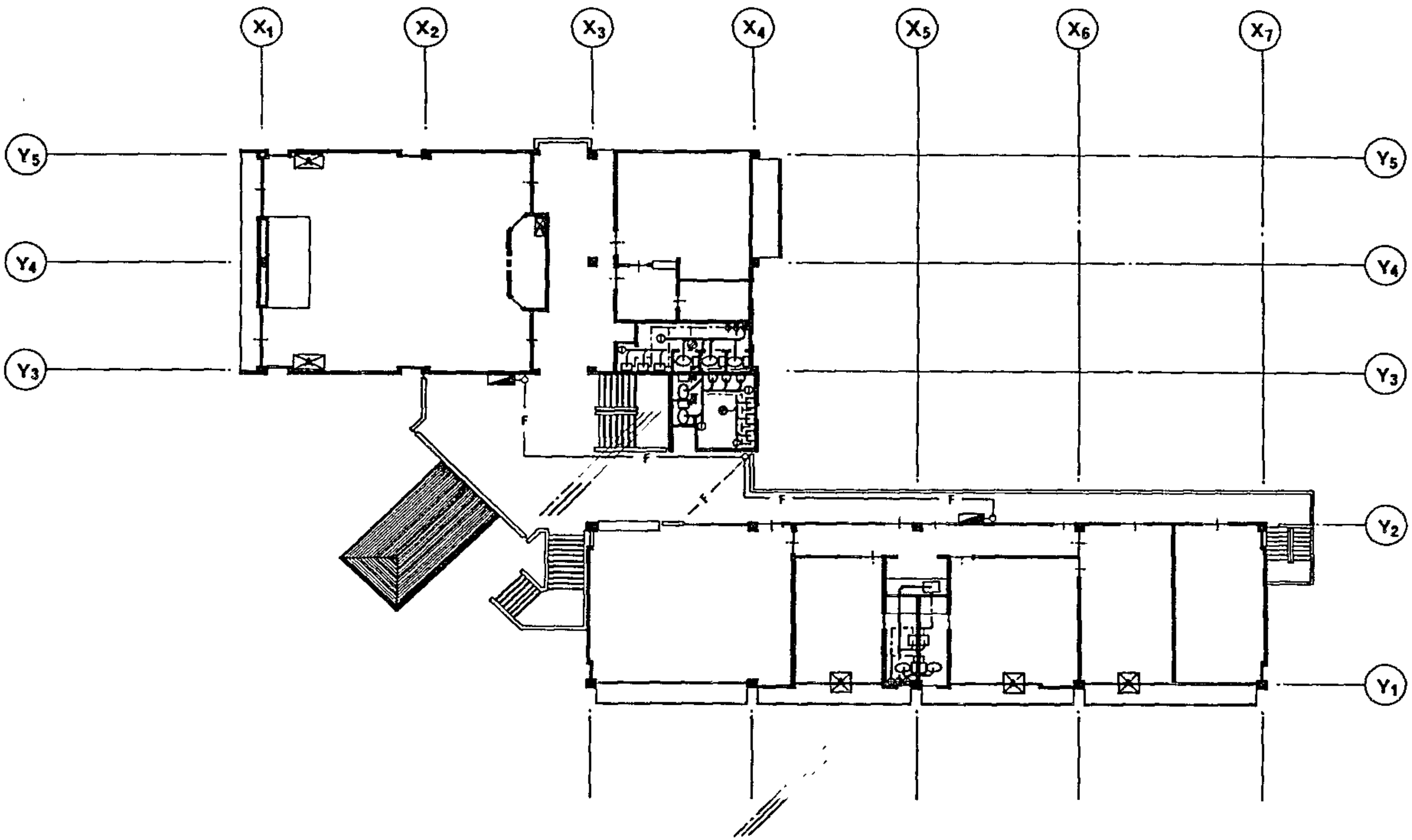
MACHINE SHED



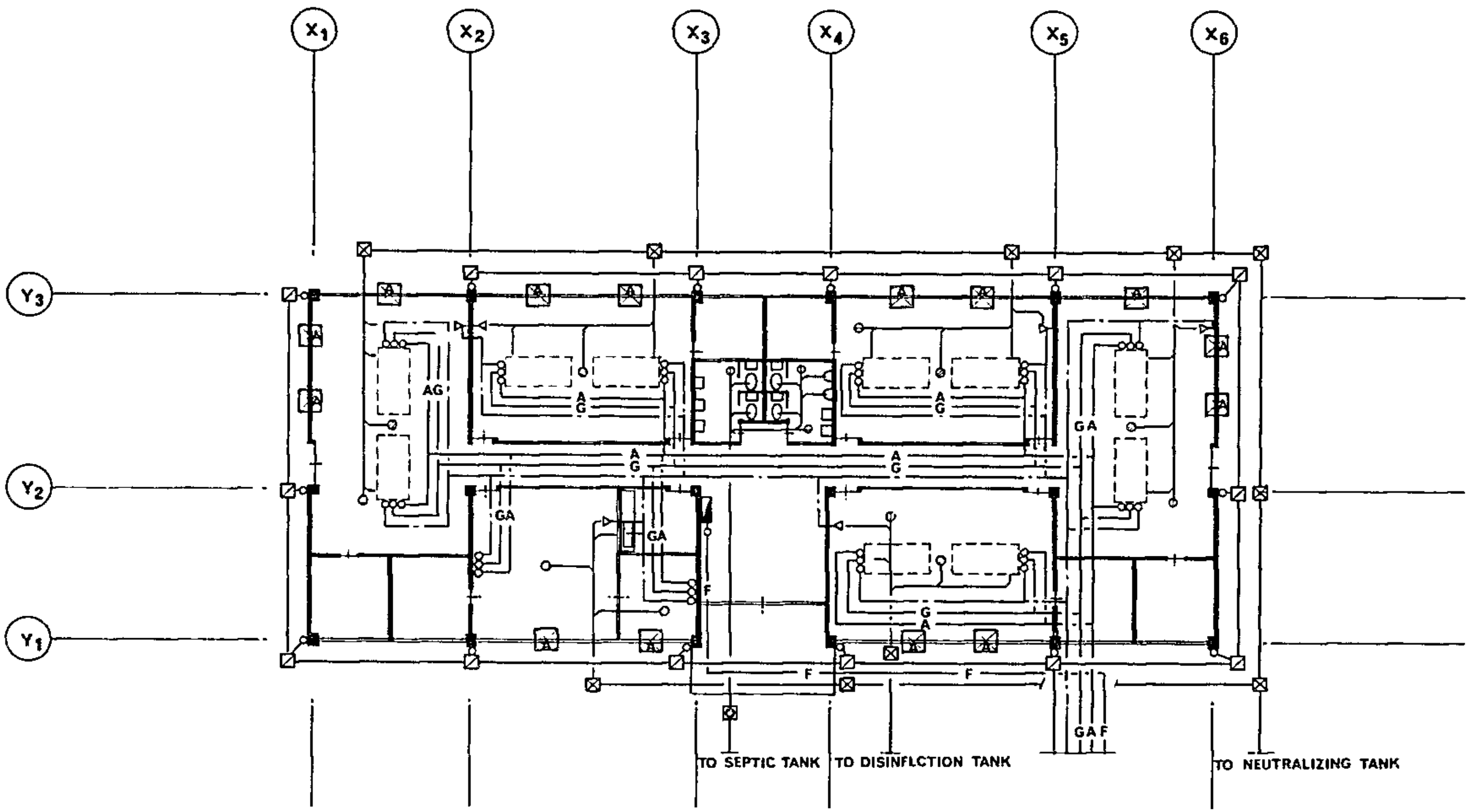
SITE PLAN — ELECTRICAL POWER PLAN



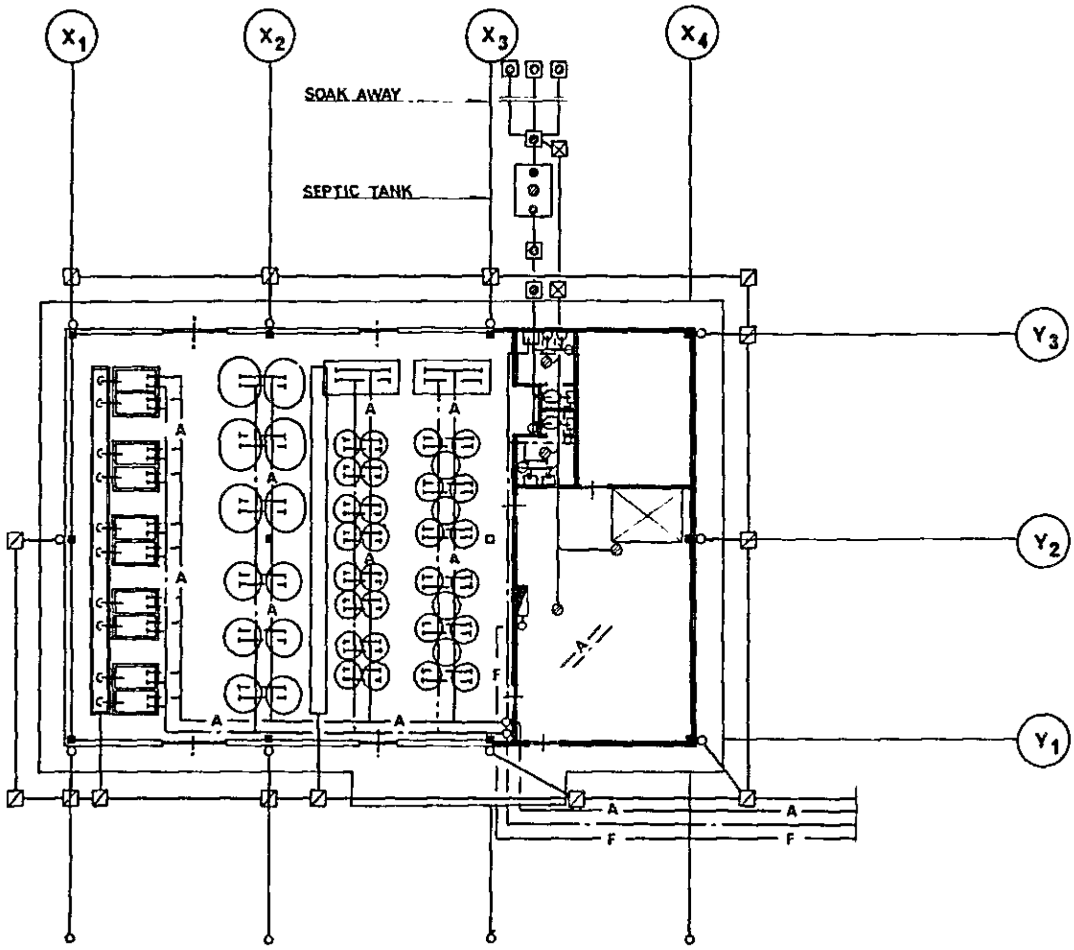
TRAINING & ADMINISTRATIVE BLDG GROUND FLOOR PLAN — MECHANICAL PLAN



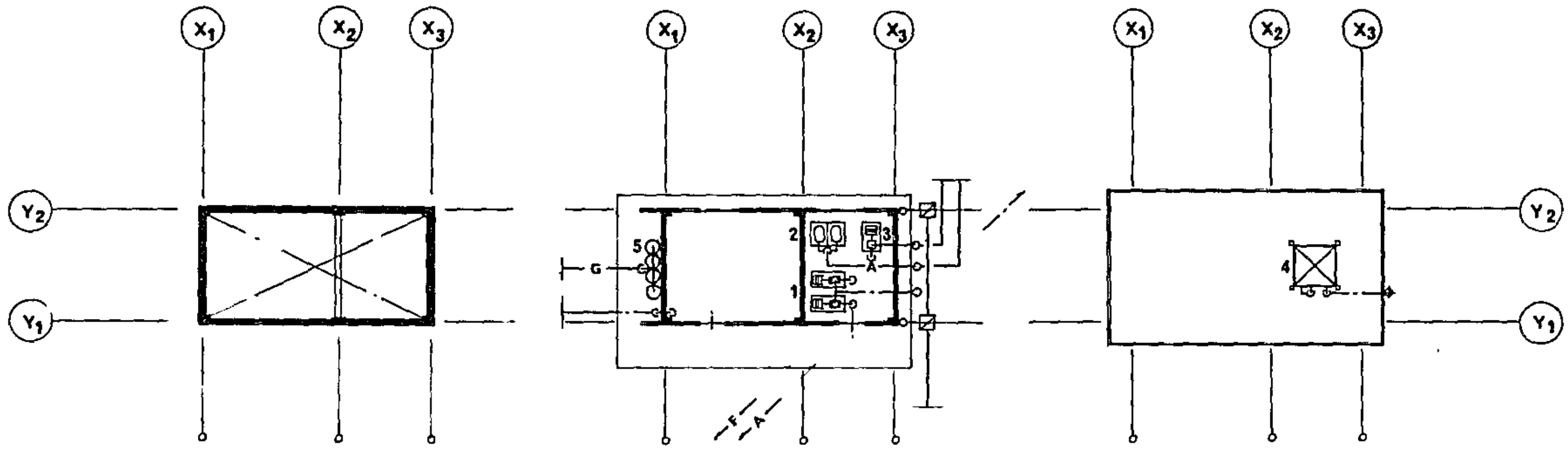
TRAINING & ADMINISTRATIVE BLDG 2ND FLOOR PLAN—MECHANICAL PLAN



RESEARCH BLDG — MECHANICAL PLAN



WET LABORATORY BLDG —MECHANICAL PLAN



LEGEND

1 FEED PUMP
2 BLOWER PUMP
3 FIRE FIGHTING PUMP
4 ELEVATED TANK
5 GAS CYLINDER (LPG)

MACHINE HOUSE — MECHANICAL PLAN

SECTION SIX

CONSTRUCTION PLAN

6-1 Construction Schedule

(1) Overall Review of Building in the Philippines

Presently, almost all building construction in the Philippines, -- from low to high-rise-- is accomplished with local products and technology. Structurally, low-level construction is block or wooden; medium and high-rise construction is mainly reinforced concrete.

Particularly in the Manila area, one sees many structures that are outstanding from both a construction and technological standpoint.

Buildings are erected by domestic contractors, estimated to number variously 3,000 or 4,000. Most of the main contracting firms have their base of activity in the Manila area but operate throughout most of the country.

(2) Building Materials

The primary building materials in the Philippines, stone, cement, steel and wood, as well as secondary materials, (block, roofing material, porcelain, sheet glass, hardware, electric cable, and lighting fixtures) are largely obtainable locally. However, certain electrical supplies, casting pipes, aluminum production, and steel products show variations in quality, and there are problems also with the volume of production. Thus, based on the tolerances and scope of the subject plan, certain items would be better brought in from Japan. Thus, while most of the materials for this program will, on principle, be procured domestically, a few items of equipment and facilities will probably be serviced in Japan.

Since materials are not generally comparable in terms of quality or tolerance, it is not easy to make simple price comparisons with the same items in Japan. But, in general, prices of imported materials are higher than Japan, while domestic products tend to be less expensive.

The unit prices of the principal building materials, as determined during the survey period, were as follows:

Material	Unit	Price(Peso)
H-sections	TON	9,750.00
Concrete Block	m^2	97.50
Brick	m^2	72.00
Mosaic Tile	m^2	200.00
Ceramic Tile	m^2	195.00
Vinyl Tile	m^2	50.00
Asphalt (for water proofing)	m^2	90.00
Mortar	m^3	400.00
Glass (6mm thick)	m^2	140.50
Formed Glass	m^2	180.00
Wire Glass	m^2	200.00
Electric Pipe 1/2" dia.	m	7.00
" 1" dia.	m	12.00
" 2" dia.	m	20.00
Fluorecent Lamp 400 x 2	pc	20.00

(3) Labor Conditions

Wage rates differ according to job classification and degree of skill. However, the minimum wage law provides for a guaranteed minimum of 13.5 Pesos/day.

The supply and demand of technicians is a function of locality. In the target area, the supply of general labor is quite adequate, but there may be shortages of skilled workers above a particular level.

Hourly wages for the main job classifications are as follows:

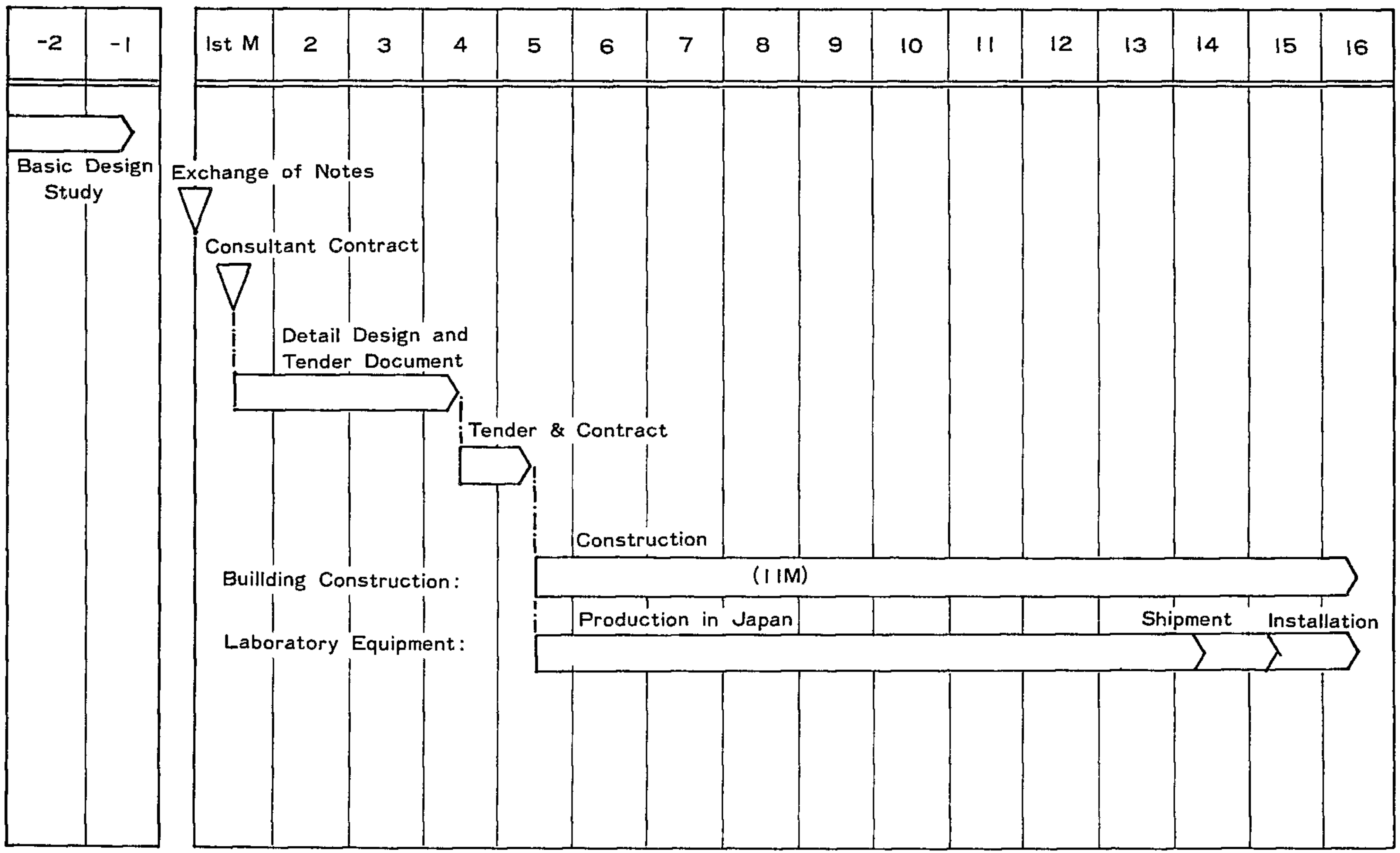
Classification	Unit Rate (Peso/Hr)
Construction Worker	2.5 - 3.5
Carpenter	3.2 - 7.0
Rebar Assembler	3.5 - 5.0
Plasterer	3.2 - 5.0
Mason (for tile, block, brick)	3.2 - 6.0
Painter	3.5 - 5.0
Plumber	3.5 - 7.0
Electrician	3.5 -10.0

(4) Laws and Regulations Affecting the Construction Industry

The following are the various laws and regulations currently pertaining to building in the Philippines:
The National Building Code of the Philippines covers regulations on construction permits, completion inspections, fire prevention codes, height restrictions, area restrictions, lighting and ventilation codes, sanitary codes, electricity, and machinery. Other regulations also cover load conditions, earthquake resistance, wind resistance and other external factors, strength of structural materials, design tolerance stress, etc.

6-2 Construction Program

Following is the construction schedule and progress chart for the entire project.



PROJECT PROGRESS CHART

SECTION SEVEN

OPERATING PLAN

7-1 Personnel

As shown in the Basic Plan, the functions of these facilities are divided into three areas: research, education and training, and administration. The departments which will require personnel in these new facilities are as follows:

Office of the Director	1
Office of the Assistant Director	1
Research Labs	5
Library	1
Cafeteria	1
Classrooms	3
Office	1

The qualifications and specialties of the technical and professional personnel attached to the existing Center are as follows:

Ph. D...3 persons	aquaculture, fish nutrition, aquaculture engineering (1 each)
Ph. D. Candidate..1	Water quality and bio-production
M.A..............3	Parasites, fish pathology, fishery economics (1 each)
M.A. Candidate....1	Aquaculture
B.A. 12	Inland fisheries (7), agricultural engineering (2), chemist (1), animal husbandry (2)
Other........... 3	Instructors (2), Fishery education (1)

Two of the "others" are assigned from BFAR on a full-time basis, and 2 of the B.A.'s are similarly deployed to work exclusively on the ICLARM Project. In addition, two persons with Ph.D's in breeding and aquaculture respectively are deployed from ICLARM. Within the new research facilities will be labs for pathology, feed nutrition, ecology, breeding physiology, feed and fishery product processing. With the exemption of fishery processing, specialists will be assigned to each lab.

Personnel arrangements for the Officers of the Director and Assistant Director as well as the general office will be carried over from the existing facility, so no problems are anticipated.

The library will require at a minimum a chief librarian or assistant librarian. While the operating system for the cafeteria has not yet been determined, outside catering will probably be appropriate.

With regard to education and training, it will probably be difficult to deploy particular personnel meeting the various levels and curricula of the trainees. In any event, it will probably be necessary to add a few technicians in line with the expansion of the Center's training functions.

Apart from technical personnel, the areas in which it would be desirable to increase the existing staff would be as follows: an office administrator who would coordinate the management of the Center; a mechanic who would be responsible for maintenance and management of pumps and generator; an electrician; a specialist in light electrical equipment to be responsible for the audio-visual and measuring equipment.

According to the future plans of the Center, during the first expansion period through 1985, it is planned to add 3 M.A. and 3 B.A. technical professionals. If University officials make an effort to line up this personnel to coordinate with the nature and coming on stream of the new Center facilities, the existing administrative set-up can probably be directly utilized. Accordingly, few problems can be anticipated with regard to personnel planning.

7-2 Administration

The objective of the administration plan will be to develop the necessary funding to permit operation of the new facilities in accordance with the initial goals. Preparations should be made to permit establishment of initial budgetary measures.

Funds required to operate the Center fall into four broad categories:

1. Research Activities
2. Personnel
3. Utilities
4. Maintenance

Following are our estimates of the funds required under each heading:

(1) Research Activities

As has been the case to date, funding for each individual research project will be obtained by applying for supplementary funds to such organizations as the National Science Development Board, Philippine Council for Agriculture and Resources Research and Ministry of Natural Resources. The expansion of the Center's facilities will probably improve its chances for obtaining this kind of research funding, so that no problem will be seen in maintaining the previous annual research budget of 1.5 million pesos.

However, the expansion of the facilities and the additional personnel signify an increase in research activities, indicating the need for additional research funds. A fixed portion of these funding requirements should be obtained on a regular annual basis, rather than on a project-by-project basis each year, so that long-term and basic research can be carried out smoothly.

(2) Personnel

The funding of additional personnel in connection with the implementation of this plan has been estimated as follows:

M.A.(3) x 14,000 P/Year:		42,000 Pesos
B.A.(3) x 12,000 P/Year:		36,000 Pesos
Other(6)x 9,000 P/Year:		54,000 Pesos
	Total:	132,000 Pesos

The above amount is by no means small in relation to the current University personnel budget of some 300-350,000 thousand Pesos, and so careful consideration will have to be given to initial budgetary arrangement.

(3) Utilities

The major weight in the utility budget will be electricity. The estimated electricity rate is calculated below for the annual electricity to be consumed by the new facility.

Annual Electricity Budget:

Machinery	Capacity (KW)	Efficiency	Load factor	Operating hours per day (hr)	Operating days in year (day)	Electric power consumption (KWH)
Deep-well pump	15	0.8	-	3.6	260*1	11,232
"	15	0.8	0.5	3.6	105*2	2,268
Pump	5.5	0.8	-	3.6	260	4,118
"	5.5	0.8	0.5	3.6	105*2	832
Air blower	2.2	0.8	-	5	260	2,288
"	2.2	0.8	0.5	5	105*2	462
Refrigerator	2.7	0.9	0.6	24	365	12,772
Cooling unit	2.6x17units =44.2	0.9	0.4	8	260	33,097
"	6.6x2units =13.2	0.9	0.4	0.5	260	618
Ceiling fan, fan	4.0	0.8	0.5	1	260	416
Analizing equipment	10.0	0.5	-	5	260	6,500
Lighting and others	3	-	-	5	260	3,900
Total						78,503 KWH

78,503 KWH x 0.52 pesos/KWH*3 = 40,822 pesos

*1. Assuming 260 days of Center operation annually.

*2. Assuming a 0.5 load factor for equipment operated on days the Center is closed.

*3. Tax-exempted motor-power rate for CLSU (as of June, 1981)

In the actual course of operation, there will be periods of stoppage in the normal commercial electricity supply.
We estimated that the number of operating hours for the emergency generator during such periods will total 150-200 hours per year. But, since we assume that the fuel required for the emergency generator will be offset by the saving in electricity cost for the normal power source, we have made no special provision for this factor in the estimates.

Annual Gas Cost:

Gas will be delivered in propane gas cylinders. Estimating that about four standard cylinders of 10 kg. will be consumed per month:

4 cylinders x 12 months x 70 Pesos = 3,360 Pseos

We assume that the cost of gas used in the cafeteria will be borne by the catering firm, and so it has not been included in these calculations.

(4) Maintenance

Buildings:

Maintenance and administration costs for buildings divide into those that occur regularly each year and those that are confined only to particular years.

Combining the two cost element, we have established an annual reserve equivalent to 0.5% of total construction cost:

75,000 Pesos/year

Equipment:

As with the buildings, we have established an annual reserve for maintenance and repairs equivalent to 1% of equipment cost:

23,330 Pseos/year

Disposable items:

We have established a replenishment rate for basic disposables at 1.5% of equipment cost. Any expenditures for ordinary disposable items exceeding this limit are to be defrayed by research budgets for particular projects.

35,000 Pesos/year

Some income can be anticipated from the sale of fish and rice production from experimental ponds and paddies at the Center.

However, since this kind of revenue will not increase with the expansion of the experimental research program, we anticipate that the income level will stay at the original levels.

Combining the above elements, the total administrative budget required in connection with the facilities expansion program (excluding research expenditures and personnel expenditures for existing staff) may be expected to total about 309,500 Pesos per year. This sum would represent some 15-18% of the present total administrative and maintenance budget for the existing Center (of 1.8-2.0 million Pesos). It is vital, from the standpoint of smooth operation of the Center that University officials take the responsibility for searching out and securing the necessary funding for this budget.

7-3 Operational Program

Eight years have now passed since the Freshwater Aquaculture Center took on its present form of organization in 1973. During this period, management has proceeded relatively smoothly. Looking to the future, assuming its activities conform to the basic precepts behind its founding, the Center's role in Philippine society can be expected to steadily grow.

It would be most desirable if the Center developed and took responsibility on its own for carrying out a management plan. It certainly has the capabilities for doing this, but some comments are given below for reference purpose on three aspects of management in connection with setting the Center's long-term operating patterns.

(1) Problems associated with freshwater aquaculture in the Philippines

In the Philippines, prices of one fish species do not vary much by size. No size breakdowns are given in the BFAR fishery statistics. Whatever the species, small sizes tend to be eaten salted and deep fried.

In Japan, small and cheap fish not directly consumed by humans -- so called scrap fish-- is used for as feed, for pellet fish meal, and freezer fish, using mass feeding techniques to promote rapid growth of meat.

As a result, in the Philippines, it is difficult to develop concentrated high-intensity feeding methods such as are used in Japan. Even in the case of milkfish, the traditional aquaculture species, growth of most fish is expecting on an extensive basis-- (fertilizer → algae → fish). Cultivation relies on natural production, and it can be said that the natural conditions combine to make this natural production possible.

It is probable, therefore, that, the freshwater aquaculture as well, which the Center is expecting to provide low cost, high quality protein, will also in general take the extensive form.

The Freshwater Aquaculture Center has already been engaged in research on paddies, fertilizer method and stocking density for rice-fish culture as well as appropriate densities for various ponds, species mix, feed and polyculture with poultry and livestock. However, more basic analytical work is required with regard to improving extensive aquaculture.

Whether it be fresh or salt water aquaculture, generally speaking, water exchange rate in the facility and fish growth and production are all directly related. This shows that the metabolic production of D.O. and NH 4+ are directly related to water quality and fish growth.

Conditions are quite different as between systems where feed is almost entirely dispensed in concentrated quantities by human hands and the extensive system seeking productive power within the facility. It is important, in the latter case, to establish through research what factors regulate production.

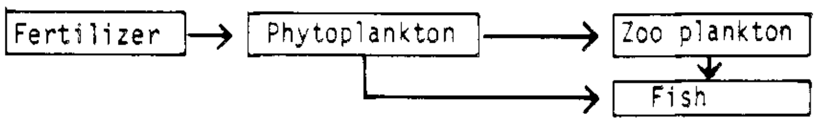
At present, almost all fish culture in ponds use still water. It is vital that research work be done on a high priority basis to analyze the regulating factors -- particularly with regard to water quality-- in production in these paddies and ponds.

If a lack of D.O. or an excess of nitrogen is hampering production, then simple methods like aeration or water exchange may be able to increase production.

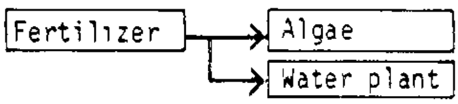
When aquaculture waste water with excess nitrogen content is used in rice cultivation, it is said to produce unproductive growth in the rice shoots. Careful consideration should probably be given to this point in the Philippines.

2. Energy Flow

The typical matter flow in extensive aquaculture is in the following sequence:



However, at times, a deviation develops from this flow in the chain:



Duckweed, water hyacinth, and alismatales occur in this chain but, with the introduction of fish which like to eat the higher hydrophytes (aquatic plants), such as glass carp, common carp, and crucian carp, some degree of use is possible, but this is considered to be a useless flow of nutrient salts.

Among the above species, grass carp and common carp have already been introduced to the Philippines but, since carp and cracian carp contain many varieties and subvarieties which developed varied feeding habits, selection of these species may be effective in controlling the chain.

Preventing the chain from developing is a condition for improving the effectiveness of aquaculture. However, apart from biocontrol based on fish such as glass carp and common carp, it may be effective to consider also the raising of poultry and livestock using the chain which has developed.

(3) Introduction of foreign species

Clarias macrocephalus (white-spotted catfish) was widely distributed over the Philippines, but in recent years, as a result of the transplanting of C. batrachus from Thailand, the former species has been on a declining trend.

Clarias macrocephalus, some 30 cm long, is very tasty, while C. batrachus, though growing to a length of 40 cm, has a poor taste and so a low commercial value.

Within the Clarias genus, C. melanoderma and C. nieuhofi are found in the Philippines. And in Lake Lanao on the island of Mindanao are found many types of the Puntius and Rasboro genus of family cyprinidae.

In general, species in an island setting tend to be smaller and competitively weaker than closely related species raised on a continent. If, then, foreign species are introduced only for their ability to grow to a large size more rapidly, then there is a danger that island species will degenerate. Careful consideration is called for before introducing new aquaculture species.

At present, there are no legislative restrictions in the Philippines on the introduction of foreign species. But it should be the responsibility of the Center to conduct basic research on freshwater organisms-- gaining an understanding of the physiognomy of domestic fish species, and registering the transplanting of organisms produced in water.

As an example of a species that was unintentionally brought into the country, in 1970 Tilapia zilli was blended with T. nilotica. And the Anodonta bivalve species is believed to be attached to the glass carp, transplanted from China, and took root on the island of Luzon.

The introduction of disordered animals and plants can disrupt existing families and create administrative difficulties in new aquaculture facilities.

(4) Management of introduced speices:

At present, in the fish ponds used for brackish water milkfish culture in the Philippines, Tirapia mossambica is an example of a fish species harmful to milkfish -- because of its omnivorous eating habits and prolificness -- that has run rampant.
In other words, an organism that has once gotten outside the aquaculture facility, can conversely become a competitor of other useful organisms. As a result, careful attention must be given to preventing the escape of such species from the aquaculture facility. Very painstaking countermeasures must be taken with respect to the use of species introduced from abroad.

SECTION EIGHT

OVERALL EVALUATION

There are as yet no established methods for measuring the investment value of training facilities. However, as in other development projects, efforts are continuing to develop methods of objective economic evaluation of educational and training facilities. In the case of vocational training facilities, when occupational earnings by age, adjusted by employment probability, are used as a base, it is possible to calculate a rate of return, as per the following formula:

$$It = \frac{Et_2 - Ew_1}{1 + r} + \frac{Et_2 - Ew_2}{(1+r)^2} + \frac{Etn - Ewn}{(1+r)^n}$$

Where: It: the total training investment

Etn: the income over n years of those who have completed the training.

Ewn: the income over n years of those who have not had the training

r: rate of return

To conduct an economic feasibility analysis as per the above, it is assumed that the facilities are primarily geared to vocational training, with the focus on industrial skills, and that those completing the course are employed by industry. It is also predicated that data are sufficiently definitive and accurate to permit the measurement of empoyment probability and wage rates.

The above approach, however, cannot unfortunately be applied to an economic evaluation of the Freshwater Aquaculture Center, since this facility does not aim its technical training at persons generating profit through direct production activity based on the acquired training, but rather at the level of person charged with directing and diffusing aquaculture technology. Also, in addition to training, the Center has the important responsibility of research activity as well.

Many kinds of social benefits can be expected from the activities of the Freshwater Aquaculture Center. But the two primary benefits can be summarized as: 1) a rise in nutritional standards on the basis of providing additional animal proteins to the Philippine people; and 2) improvement of farm incomes through more effective use of land, water, and human resources.

With regard to the first benefit-- the increase in protein supply--, an important factor is the fact that, for the Philippine people, fish is expected to play a major role in future years as a source of cheap, quality animal protein.

The per-capita consumption of proteins in the Philippines in 1979 was: cereals -- 36.57 grams; fish -- 8.88; meats and dairy products -- 6.97. Thus, 69.8% of total protein intake was from vegetable proteins. Within the category of animal proteins, fish accounted for 16.8% of total, meats for 13.3%. And fish represented 56% of all animal protein intake.

Even based on the Government's forecast for 1990, there will be no change in the relative importance of fish in the protein supply picture: cereals -- 39.29 grams; fish -- 11.18; and meat 7.63. Whereas the share of grains will remain virtually unchanged at 67.6% that of fish will be 19.2% and meats 13.1%, with fish expected to account for 59.4% of the total animal protein supply in 1990. In short, fish will occupy an even more important position in the supply of animal protein in that year.

While it is, of course, true that the nation will still be relying on commercial and municipal fisheries for the major portion of its fish supplies, there are high expectations for increasing production in the freshwater aquaculture sector, owing to: the large and underutilized production base in this sector and the fact that aquaculture is relatively less fuel intensive.

As is evident from the Government's food nutritional program, the need for aquaculture, whether for home consumption or as a commercial crop, will doubtless increase, particularly in interia areas.

With regard to the second benefit-- the increase in farm incomes through effective resource use--, as a result of having reached 100% self-sufficiency in rice production, there will be an even greater need in future years for the introduction of specific programs.

Philippine rice output in 1978 totalled 5,760,000 M/T. With no imports recorded in 1979 and exports registering 36,000 M/T, domestic self-sufficiency was clearly achieved.

Nevertheless, rice remains the nation's most important crop, so that efforts are expected to continue to increase rice production. But these efforts will be less oriented to expansion of crop area than to increasing production through irrigation development, diffusion of improved varieties, and rationalization of the planting system.

Also, in order to improve production of land, labor, and fertilizer resources, consideration will naturally have to be given to crop diversification. In this context, freshwater aquaculture can be considered a factor of production with the potential to expedite the use of low and swamp land of marginal cultivability, permit the use and recycling of waste products from agriculture and livestock production, and thereby increase overall agricultural production without the need for large investment.

CLSU has taken on a research project called: "The Farm of the Future". This project demonstrates the capability of diversifying crops and increasing farm income on even a single small hectare of cultivated land by means of improved irrigation, the introduction of a new and rational crop system, and the adoption of ricefish culture.

Freshwater aquaculture, which can be accomplished with a relatively small investment, has a major role to play from the standpoint of effective resource utilization and the improvement of farm incomes through increased productivity.

As an organization for research in freshwater aquaculture, incorporating academic research at the university level, and for education and training geared primarily at persons who will direct the diffusion of these techniques, the Center is increasingly taking on the attributes of a true national facility. Also, thanks to the excellent existing administrative infrastructure, no major problems are foreseen in facility operation. And, finally, the field of freshwater aquaculture is expected to grow in importance within the context of Philippine rural development.

Accordingly, it can be judged that there would be a high degree of aid effectiveness in implementing, through a grant-in-aid from Japan, this program for research and training facilities and buildings at the Freshwater Aquaculture Center, which is defined to play a leading role in spreading and developing freshwater aquaculture, which in turn is looked upon a means of producing the above described social benefits.

APPENDIX

Appendix I Minutes of Discussions

MINUTES OF DISCUSSIONS

In response to the request made by the Government of the Republic of the Philippines for the Construction Project of Freshwater Aquaculture Training and Laboratory Complex at the Freshwater Aquaculture Center, Central Luzon State University (hereinafter referred to as "the Project"), the Government of Japan has sent, through the Japan International Co-operation Agency (hereinafter referred to as "JICA"), a team headed by Dr. Masaru FUJIYA to conduct a basic design survey for 21 days from June 24th 1981. The team had a series of discussions and exchanged views with the authorities concerned.

As the result of the study and discussions, both parties have agreed to recommend to their respective Governments to examine the results of the survey attached herewith towards the realization of the Project.

July 3, 1981

Dr. Masaru FUJIYA
Team Leader
The Japanese Survey Team

Dr. Pedro A. Abella
Executive Vice-President
Central Luzon State University

MINUTES

1. The proposed site of the Project will be Central Luzon State University (hereinafter referred to as "the Project Site").

2. The object of the Project is to provide necessary buildings, incidental facilities and equipment for Freshwater Aquaculture Center at the Project Site (hereinafter referred to as "the Center").

3. The Japanese Survey Team will convey to the Government of Japan the desire of the Government of the Republic of the Philippines that the former takes necessary measures to co-operate in implementing the Project and provides the buildings and other items listed in Annex I within the scope of Japanese economic co-operation in grant form.

4. The Government of the Republic of the Philippines will take necessary measures, in the event that the grant assistance by the Government of Japan is extended to the Project -

   (a) to provide data and information necessary for the design and the construction of the Center.

   (b) to secure lands necessary for the construction of the Center.

   (c) to clear and level the Project Site before the start of the construction.

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(d) to provide the other items listed in Annex II;

(e) to ensure prompt unloading and customs clearance in the Republic of the Philippines of imported materials and equipment for the construction, and to facilitate their internal transport.

(f) to exempt the Japanese nationals concerned from customs duties, internal taxes and other fiscal levies imposed in the Republic of the Philippines for the supply of goods and services for construction.

(g) to provide and accord necessary permissions, licenses and other authorization deemed advisable for carrying out the Project.

ANNEX I

Items requested by the Government of the Republic of the Philippines the cost of which will be borne by the Government of Japan -

1) Buildings for:
   - (a) Research Laboratories and Administration Offices
   - (b) Training Facilities
   - (c) Wet Laboratory
   - (d) Others

2) Equipment to be supplied for:
   - (a) Aquaculture Research
   - (b) Chemical Analysis
   - (c) Training
   - (d) Others

ANNEX II

Items the cost of which will be borne by the Government of the Republic of the Philippines

(1) Water supply mains to the Project Site.

(2) External drainage and sewage line to the Project Site.

(3) Electrical power main line to the Project Site.

(4) Telephone lines and equipment.

(5) Exterior facilities like access roads, fencing, parking and landscaping.

(6) Provision of space necessary for such constructions as temporary offices, working area, stock yards, and others.

(7) Items (1) and (3) shall be completed prior to the start of site works.

Appendix II Minutes of the Second Discussions

MINUTES OF THE SECOND DISCUSSIONS ON ESTABLISHMENT OF FRESHWATER AQUACULTURE TRAINING AND LABORATORY COMPLEX, FRESHWATER AQUACULTURE CENTER, CENTRAL LUZON STATE UNIVERSITY

At the request of the Government of the Republic of the Philippines for the Construction Project of the Freshwater Aquaculture Training and Laboratory Complex, Freshwater Aquaculture Center, Central Luzon State University (hereinafter referred to as the "Center"), the Government of Japan through the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent a basic design study team for 21 days from June 24, 1981 to the Republic of the Philippines.

In order to explain the details of the results of the aforementioned surveys and to exchange views with the Philippine Authorities concerned on the establishment of the Center, the present survey team of JICA headed by Mr. Minoru Tomita, visited the Philippines from September 7, 1981 to September 12, 1981.

During a series of discussions, the Philippines side fully understood the explanation made by the Japanese Team on the Draft Report and confirmed its acceptance of the report in principle. However, certain details of the Grant and design of the buildings were discussed.

MINORU TOMITA
Team Leader
The Japanese Survey Team

AMADO C. CAMPOS, Ph.D.
President
Central Luzon State University

Appendix Ⅲ Equipment List

Items	Descriptions	Outline of specifications	Q'ty
(1) Research Equipment			
1) General laboratory equipment			
1-1	Muffle furnaces	normal temp. -1,200°C	1
1-2	Freezer dryer	14 flasks set-on type	1
1-3	Refrigerator	with freezer room	5
1-4	Freezer	cabinet type	1
1-5	Mechanical convection oven	normal temp. -200°C	1
1-6	Dryer	normal temp. -200°C	5
1-7	Sterilizer		3
1-8	Water bath	temp. controlled	2
1-9	Incubator	temp. controlled	2
1-10	Low-temperature incubator	for algae and BOD measurement, etc.	1
1-11	Magnetic stirrer	bench type and field type	10
1-12	Shaker		2
1-13	Hammer mill	for grain and feed	1
1-14	Centrifuge	18,000 rpm, with cooler	2
1-15	Distiller	electrical type, 10 ltrs/hr	1
1-16	Demineralizer		1
1-17	Filter appratus	millipore type with membrane filters	1
1-18	Rotary evaporator		1
1-19	Extraction appratus	with six Soxhlet units	1
1-20	Crude fiber appratus		1

Items	Descriptions	Outline of specifications	Q'ty
1-21	Fluorescent microscope	two wavelengths changeable	1
1-22	Phase microscope	trinocular type	1
1-23	Stereoscopic microscope	dark-visual field type	2
1-24	Teaching microscope		5
1-25	Dissecting microscope		4
1-26	Microtome	rotary type	1
1-27	Automatic tissue processor		1
1-28	Laboratory glass-ware and utensils		one lot
1-29	Fumehood		3
1-30	Laboratory table		10
1-31	Clean bench		1
2)	Analytical equipment		
2-1	Amino acid analyzer	bench type, sensibility over than 250 pmol	1
2-2	Fatty acid analyzer	bench type	1
2-3	Gas chromat-graphy	with accessories for pestricide analysis	1
2-4	Atomic absorp-tion spectro photometer	wavelength range: 190 - 900nm	1
2-5	Spectrome spectro-photometer	wavelength range: 360 - 850nm	1
2-6	X-ray apparatus		1
2-7	Balance	Various types	8
			one lot

Items	Descriptions	Outline of specifications	Q'ty
3)	Observation equipment		
3-1	D.O. meter	portable type	3
3-2	PH meter	protable type	3
3-3	Turbidimeter	portable type	1
3-4	Water sampler	Kitahara, B type	3
3-5	Bottom sampler	Ekman-Berge type	2
3-6	Nepho calorimeter		1
3-7	Wind-Vane and Anemograph		1
3-8	Rain gauge		1
3-9	Thermister thermometer		1
3-10	Pyranometer		1
3-11	Plankton net	for phyto and zoo plankton	6
4)	Fish cultural and processing equipment		
4-1	Plastic tank	30 ltrs	40
		500 ltrs	20
4-2	Temp. controlled aquarium		1
4-3	Insulated container		10
4-4	Portable fish cage		20
4-5	Fish carrying box		30
4-6	Meat stuffer	for lab use	1
4-7	Sausage tying machine	for lab use	1
4-8	Meat grinder-mixer	for lab use	1

Item	Descriptions	Outline of specifications	Q'ty
4-9	Aluminum foil sealer	handy type	1
4-10	Plastic sealer	handy type	1
4-11	Can seamer	manual type	1
4-12	Chopper		1
4-13	Feed mixer		1

(2) Training and General Equipment

Item	Descriptions	Outline of specifications	Q'ty
5-1	Public address system	amplifier (1), speaker (4) microphone (3), microphone stand (1)	1
5-2	Tape recorder		1
5-3	Slide projector	with rotary magazine	1
5-4	Overhead projector		1
5-5	Camera	Single-lens reflex with accessories	1
5-6	Enlarger		1
5-7	Projection screen		2
5-8	Video tape recorder	with movie camera	1
5-9	Plain paper copier		1
5-10	Electrical rotary press	desk type	1
5-11	Scanner		1
5-12	Typewriter		3
5-13	Mini bus	25-seat	1
5-14	Four-wheel-drived vehicle	4-seat, diesel engine	1
5-15	Tractor	4-wheels drive with trailer and mower	1
5-16	FRP boat	6m length, with outboard engine (10 HP), trailer and life jacket	1

Appendix IV Composition of the Study Team

The Basic Design Study Team comprised seven members under the leadership of Dr. Masaru Fujiya, Counsellor, Research Dept., Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries. The members included:

Team Leader	Dr. Masaru FUJIYA	Counsellor, Research Dept. Fisheries Agnecy, Ministry of Agriculture, Forestry and Fisheries (MAFF)
Planning	Mr. Daisaku NAWA	Senior Officer, Fisheries Promotion Dept., Fisheries Agency, MAFF
Coordinator	Mr. Naoki KAI	Grant Aid Dept., Japan International Cooperation Agency (JICA)
Architect	Mr. Toshiya OGASAWARA	Fisheries Engineering Co., Ltd.
Utilities Engineer	Mr. Katsumi IIZUKA	- ditto -
Laboratory Equipment	Mr. Naohiko NAKAJIMA	- ditto -
Aquaculture	Dr. Hitoshi IDA	- ditto -

Meantime, the draft report explanation team comprising three members was also seat to the Philippines. The member included:

Team Leader	Mr. Minoru TOMITA	Grant Aid Dept., JICA
Member	Mr. Toshiya OGASAWARA	Fisheries Engineering Co., Ltd.
Member	Mr. Naohiko NAKAJIMA	- ditto -

Appendix V Discussants

NAME	ORGANIZATION	POSITION
Amado C. Campos	Central Luzon State University (CLSU)	President
Pedro A. Abella	"	Executive Vice President
Cezak G. Salas Sr.	"	PAID
Catalino R. dela Cruz	College of Inland Fisheries, CLSU	Dean
Emmanuel M. Cruz	Freshwater Aquaculture Center, CLSU	Assistant Director
Rodolfo G. Arce	College of Inland Fisheries, CLSU	Assistant Dean
Ruben C. Sevilleja	"	Instructor
Tereso A. Abella	"	Instructor
Renato D. Recometa	"	Instructor
Milagros F. Miranda	Financial and Management Service, CLSU	Chief
Macario Antolin	"	Chief Accountant
Edmundo Corpuz	National Economic and Development Authority	Assistant Director General
Arnord B. Caoili	Ministry of Natural Resources (MNR)	Assistant Minister
Virginia Pineda	International Relations Division, MNR	Assistant Division Chief
Edgardo C. Quisumbing	Ministry of Agriculture (MOA)	Deputy Excecutive
Johnson P. Mercader	Agricultural Projects Preparation Unit, MOA	Chief
Ednardo B. Pons	"	Assistant Chief
Deborah C. Valencia	"	Pros. Development Assistant

Abraham B. Gaduang	Fisheries Extension Division, Bureau of Fisheries and Aquatic Resources(BFAR)	Chief
Swaru B. Reys	Planning and Management Division, BFAR	Chief
Simeona M. Aypa	Freshwater Fisheries Section, BFAR	Chief
Myrna D. Capati	Office of the Director, BFAR	Assistant Officer-in-charge
Ernesto V. de Vera	Agrarian Reform Program Office, Ministry of Agrarian Reform (MAR)	Chief
Lilia A. Nicolas	Agrarian Reform Program Office, Ministry of Agrarian Reform (MAR)	Senior Officer
Guia R. Mengirg	Central Supports and Coordination Division, National Food and Agriculture Council (NFAC)	Chief
Thefma M. Reyes	Rice Reports Section, NFAC	Chief
Ramon Sanvictores	"	Rice-fish Coordinator
Alfredo C. Santiago Jr.	Binangonan Research Station SEAFDEC	Chief
Jovenal F. Lazaga	"	Executive Assistant
Julia B. Pantastico	"	Researcher
Antonio Bautista	"	Researcher
Richard A. Neal	International Center for Living Aquatic Resources Management (ICLARM)	Deputy Director General
Rosalinda M. Temprosa	International Center for Living Aquatic Resources Management (ICLARM)	Librarian

Appendix VI Survey Itinerary

I. The Basic Design Study Team

1. June 24 Wed.	Lv. Tokyo Ar. Manila	
2. 25 Thu.	Meeting at Manila office of JICA. Curtsey call on National Economic and Development Authority (NEDA). Preliminary discussion with President of CLSU and Dean of College of Inland Fisheries	
3. 26 Fri.	Visits to Ministry of Natural Resources, Ministry of Agriculture and Bureau of Coast and Geodetic Survey for colleting data and information	
4. 27 Sat.	Lv. Manila Ar. Munoz	
5. 28 Sun.	Survey of facilities in campus of CLSU	
6. 29 Mon.	Discussion with members of CLSU on requested items	
7. 30 Tue.	Survey of existing facilities in Freshwater Aquaculture Center Confirmation of its research activities, etc.	
8. Jul. 1 Wed.	Survey of existing infrastructure around the site Visit to construction site of Seed Production Center, BFAR	
9. 2 Thu.	Discussion on the project outline and the Minutes of Discussions	
10. 3 Fri.	Signature of Minutes of Discussions (Project Evaluation Group) Lv. Munoz Ar. Manila Meeting at JICA Manila Office	(Site Survey Group) Meeting and preparation For surveying

11. Jul.	4 Sat.	Lv. Manila Ar. Iloilo Visit to Aquaculture Department, SEAFDEC	Waiting for weather condition. Meeting on facilities and equipment
12.	5 Sun.	Visit to fish ponds in Leganes, SEAFDEC Visit to Iloilo Market Lv. Iloilo Ar. Manila	Reduction of field survey data
13.	6 Mon.	Freshwater Fisheries Station in Binangonan SEAFIDEC	Site survey Sampling of water and soil
14.	7 Tue.	Collection and reduction of data and information	Drawing up survey map Final discussion on facilities and equipment
15.	8 Wed.	Meeting with Embassy of Japan and JICA Manila Office on survey results Report of survey results to NEDA	Lv. Munoz Ar. Manila
16.	9 Thu.	Team Leader, Dr. Fujiya and Coordinator, Mr. Kai; Lv. Manila Ar. Tokyo Curtsey call on Bureau of Fisheries and Aquantic Resources. Data and Information collection about construction codes and regulations	
17.	10 Fri.	Investigation of locally available research equipment Curtsey call on International Center for Living Aquatic Resources Managment (ICLARM) Investigation and data collecting of the projects of freshwater aquaculture and general circumstances around construction	

18. Jul. 11 Sat.		Visit to the fish market in Manila. Investigation for similar facilities (TUP) Collection of publications relative to construction
19.	12 Sun.	Reduction of survey data
20.	13 Mon.	Visit to Ministry of Agriculture for data collection Visit to National Food and Agriculture Countil and Ministry of Agrarian Reform for collecting data and information Investigation for similar facilities (UP) Report of survey results to Embassy of Japan and JICA Manila Office
21.	14 Tue.	Lv. Manila Ar. Tokyo

II The Draft Report Explanation Team

1.	Sept. 7 Mon.	Lv. Tokyo Ar. Manila Meeting with Embassy of Japan and JICA Manila Office
2.	8 Tue.	Lv. Manila Ar. Munoz Overall explanation of the draft report to CLSU ma bers
3.	9 Wed.	Discussion on the draft report
4.	10 Thu.	Confirmation on the results of the discussion and exchange of the Minutes
5.	11 Fri.	Lv. Munoz Ar. Manila Meeting with Embassy of Japan and JICA Manila Office
6.	12 Sat.	Lv. Manila Ar. Tokyo

JICA