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INTERNATIONAL DEVELOPMENT ASSOCIATION

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

July 30, 1969

Agriculture Projects Department

CURRENCY EQUIVALENTS

US$ 1.00	=	Philippine Peso ₱ 3.90
1 ₱	=	US$ 0.256

WEIGHTS AND MEASURES - METRIC SYSTEM

1 hectare (ha)	=	2.47 acres
1 kilometer (km)	=	0.62 miles
1 square kilometer (km^2)	=	0.3886 square miles
1 meter (m)	=	39.37 inches
1 square meter (m^2)	=	10.76 square feet
1 cubic meter (m^3)	=	35.31 cubic feet
1 million cubic meter (Mm^3)	=	810.7 acre feet
1 millimeter (mm)	=	0.039 inches
1 kilogram (kg)	=	2.2 pounds
1 liter (l)	=	0.264 gallons U.S.
1 cavan (paddy)	=	44 kg
22.7 cavans	=	1 metric ton

INITIALS AND ACRONYMS

APC	=	Agricultural Productivity Commission
NIA	=	National Irrigation Administration
NPC	=	National Power Corporation
RCA	=	Rice and Corn Administration
RCPCC	=	Rice and Corn Production Coordinating Council
USAID	=	US Agency for International Development
USBR	=	US Bureau of Reclamation

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UPPER PAMPANGA RIVER IRRIGATION PROJECT

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This report was prepared by Messrs. Golan, Douglass, Marinet and Hoffman (Consultant), and is based on findings of a mission which visited the Philippines in September/October 1968.

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MAP

Upper Pampanga River Irrigation Project

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UPPER PAMPANGA RIVER IRRIGATION PROJECT

Summary

i. The Government of the Philippines has requested a Bank loan to meet the foreign exchange costs of the Upper Pampanga River Irrigation Project in Central Luzon. The project includes the construction of Pantabangan Dam and Reservoir on the Pampanga River, about 10 km north of the town of Rizal, rehabilitation of about 46,000 ha of existing irrigation systems and the construction of a new system to serve 31,000 ha. The project would permit the storage of the flows of the Pampanga River which would provide a dependable water supply for year round cultivation of 72,000 ha and an additional area of 5,000 ha during the wet season only. It would also provide flood protection to lands lying below the dam site.

ii. Total project cost, including interest during construction, is estimated to be ₱ 263 million (US$ 67.5 million), of which US$ 34 million, or approximately 50%, would be in foreign exchange. Design and construction supervision would be the responsibility of consultants to be employed by the National Irrigation Administration (NIA), a Government agency responsible for the national irrigation systems. Construction of the dam and reservoir, the new irrigation systems and project facilities would be done by contract following international competitive bidding procedures. Most of the rehabilitation work on the existing systems which does not lend itself to contract work would be performed on force account by the NIA. However, the necessary equipment, materials and supplies for these works and operation and maintenance equipment would be subject to international competitive bidding. Aside from construction work, the project would also include the engagement of a management consultant firm to review NIA's operations, structure and financial management and a detailed land classification study of the project area.

iii. The borrower would be the Government of the Republic of the Philippines and NIA the executing agency for the project. Coordination of all engineering and agricultural activities on the project would be accomplished through the Upper Pampanga River Project Coordinating Committee. Members of the Committee are the Administrator of NIA, who is also the chairman; the General Manager of the National Power Corporation; the Director, Bureau of Public Works; and a representative of the Rice and Corn Production Coordinating Council. A Joint Technical Staff comprising senior technicians of the participating agencies would render technical assistance to NIA at the request of the Committee as and when needed. The NIA is staffed with competent personnel and with the arrangements for technical assistance and the employment of consultants would be able to implement the project successfully.

iv. At full development, annual paddy production from project lands is projected to increase from the present level of approximately 130,000 m ton to 570,000 m ton. This production would help meet the expected increased

demand for rice in the country and thereby reduce the need to rely on imports. Assuming all incremental production from the project to be import substitution, foreign exchange savings would amount to about US$ 36.5 million annually at full development, compared with an initial foreign exchange investment, excluding interest, of US$ 29 million. The project would thus enable the Philippines to improve its difficult balance of payments position. The project would yield a rate of return to the economy of 13%, excluding benefits from power generation.

v. The project is technically sound and economically justified. It is suitable for a Bank loan of US$ 34 million and an appropriate term would be 25 years, including a grace period of seven years.

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UPPER PAMPANGA RIVER IRRIGATION PROJECT

I. INTRODUCTION

1.01 The Government of the Philippines has requested a Bank loan to meet the foreign exchange costs of the Upper Pampanga River Irrigation Project in Central Luzon. The proposed project would be multi-purpose with primary benefits accruing to irrigation. Upon completion, it would provide a dependable water supply for year round irrigation of 72,000 ha and an additional area of 5,000 ha during the wet season only, as well as flood protection and a possible future source of hydroelectric power.

1.02 Technical feasibility studies for the project were prepared by the US Bureau of Reclamation (USBR) under an agreement with the US Agency for International Development (USAID). Several modifications thereto were subsequently prepared by various ministries of the Philippines Government under the auspices of the Upper Pampanga River Project Coordinating Committee. This report is based on these feasibility studies and findings of the Bank's appraisal mission which visited the Philippines in September/October 1968. Members of the mission were Messrs. A.Golan, J.C. Douglass, J.A. Marinet and C.J. Hoffman (Consultant). This report was prepared by members of the mission.

II. BACKGROUND

2.01 The Philippines archipelago covers an area of about 298,000 km^2 (115,000 sq mi), scattered over some 7,100 islands between the Pacific Ocean and the South China Sea. According to latest estimates, the population is around 34.6 million and growing rapidly at about 3.2% per annum. Gross national product at 1967 market prices was US$ 6.3 billion equivalent, and has been rising at an average of 5.1% per annum between 1962-1967. Per capita income based on 1967 population estimates is US$ 182. The agricultural sector which, together with fishery and forestry, employs nearly two-thirds of the labor force, accounts for only one-third of net domestic product. Income in this sector is substantially lower than the national average.

2.02 Rice, the staple food of the Philippines, is the main agricultural crop, accounting for about one-half of the area planted to food crops in the country. Despite the predominance of rice, the country has yet to reach sustained self-sufficiency in its production. This is directly linked to poor paddy yields, which are among the lowest in Southeast Asia. Several factors have contributed to the low paddy yields, the more important of which is the absence of a dependable water supply which discourages the extensive use of necessary inputs and improved varieties. Adoption of the new high yielding varieties on irrigated lands, however, has made some impact on yields and production. Average annual production of rough rice[1/] in the Philippines for the three years 1965-67, was 4.1 million m ton - about 4% higher than the average of the preceding three years. At the same time, the area devoted to paddy production remained virtually unchanged.

1/ Unhusked rice

2.03 The Government recently launched an all out effort to achieve self-sufficiency in food production, particularly of rice and corn. In the case of rice, it has directed these efforts primarily toward the improvement of yields through the introduction of modern agricultural techniques and high yielding varieties. Farmers are showing keen interest in the new varieties and success to date has surpassed expectations. The recent expansion of production has reduced and, some estimates indicate, temporarily eliminated the rice deficit, but unless a reasonable rate of growth of rice production is maintained, increasing demand arising from the growing population will soon exceed supply.

2.04 Further expansion of areas devoted to high yielding varieties - depends upon the availability of a regulated water supply which is a prerequisite to their profitable cultivation. However, many of the existing irrigation systems in the country which serve about 500,000 ha during the wet season and about 200,000 ha during the dry season are incapable of delivering an assured regulated water supply and, with the exception of the Angat Project covering some 32,000 ha, none of these systems have storage facilities for dry season irrigation.

2.05 Water resources in the country are abundant, but largely unexploited; most of the existing irrigation systems rely upon the direct diversion of unregulated stream flows during the wet season. Cultivation during the dry season is limited by the scant rainfall and the absence of irrigation storage. The urgent need to expand the country's irrigation system has been recognized by Government which assigned high priority to irrigation development under the "Four-Year Program of the Philippines", covering the period ending June 30, 1970.

2.06 Emphasis on irrigation development in the Philippines is concentrated on two fronts. First, improvement and rehabilitation of existing irrigation systems and, second, the construction of storage reservoirs for dry season irrigation. The improvement and rehabilitation program is being carried out with the assistance of a USAID loan of US$ 4.7 million for the purchase of operation and maintenance equipment. In addition, the Government is preparing, with the assistance of consultants, feasibility studies for the rehabilitation and expansion of three systems in Mindanao under a loan from the Asian Development Bank. The first step in developing dry season irrigation has been the construction of Angat Dam in Central Luzon and rehabilitation of the 32,000 ha irrigation system served by the dam. Construction of the dam and a power plant was financed with the assistance of a Bank loan of US$ 34 million (297-PH), and was completed in 1967, while the rehabilitation works were financed in part by a USAID loan. The next dam proposed for dry season irrigation is the Pantabangan Dam, which is the main structure of the Upper Pampanga River Irrigation Project.

2.07 Main responsibility for irrigation development in the country is in the hands of the National Irrigation Administration (NIA), a Government agency created in 1964 to investigate, study, improve, construct and administer all national irrigation systems in the Philippines. About half of the existing systems in the country fall into this category. Further details of NIA's operation and performance to date are given in Chapter VI.

The remaining systems in the country fall into the following categories: communal systems - developed as community or family irrigation schemes with some financial assistance from the Government; private systems - constructed and operated by private individuals; and irrigation service units - pump schemes constructed by the Irrigation Service Unit of the Bureau of Public Works.

III. THE PROJECT AREA

General

3.01 Central Luzon, where the project is located, is the most important rice producing region in the Philippines. It contains about 17% of the annual area planted to paddy and supplies roughly a quarter of the nation's total rice production. The region's contribution to total production is projected to increase to one-third by 1980, largely as a result of the construction of new irrigation systems in the area.

3.02 The proposed project consists of 77,000 ha in the Province of Nueva Ecija, in Central Luzon, about 80 km north of Manila. Project lands lie in the northern part of the Pampanga River Basin, which is bounded by the Sierra Madre mountains on the east, the Caraballo mountains on the north, the Agno River Basin on the west and Manila Bay on the south. The lands extend along the Pampanga and Talavera Rivers (see Map).

3.03 Population of the project area is close to 500,000; population density is about 1.6 persons per hectare, which is well above the national average of 1.2.

3.04 There are a number of urban centers distributed throughout the project area with populations of more than 20,000 people. The largest city is Cabanatuan, whose population is 100,000. Most of these towns provide banking, storage facilities and other agricultural services to the surrounding agricultural areas. The internal network of highways, rail and road connections between the project area and Manila ensure the mobility of the population and access of farmers to service centers to supply their needs.

3.05 The project lands are devoted mainly to one rainy season paddy crop. Only about 46,000 ha are partially irrigated in the wet season. While double cropping of paddy is practiced in various parts of the Philippines, only about 7,000 ha in the project area are double cropped at present due to the absence of a dependable dry season water supply.

Climate

3.06 The climate is tropical and is characterized by a distinct wet and dry season with precipitation occurring mostly during the southwest monsoon, between May and October. August is usually the heaviest month of precipitation. The major climatic constraint on agriculture production is the rainfall pattern. Paddy is now planted to grow during the wet southwest monsoon period. There is insufficient rainfall to support a second paddy crop.

3.07 The mean annual precipitation is lowest in the southern portion of the project and increases towards the mountains. At Cabanatuan City, the mean annual total is about 1,800 mm (71"), of which approximately 85% falls in the wet season. There are occasional months in the dry season when no rain falls.

3.08 Temperature differentials are relatively small throughout the year, and for Cabanatuan City the mean monthly temperature varies from a low of 26°C in January to a high of 30°C in May. Relative humidity averages about 75%. The project lies in the tropical storm typhoon belt and generally experiences one or more intense storms every year.

Soils and Drainage

3.09 A detailed soil survey of the project area carried out in 1967 by the Government's Bureau of Soils, indicates that the project soils are well suited for multicrop irrigated paddy cultivation. About two-thirds of the soils are medium to coarse in texture, and have topography and drainage characteristics suitable for irrigated paddy cultivation the year round. Some of these soils could also be planted to vegetables and other crops during the dry season. The balance of the soils have generally poor drainage and would only be suitable for paddy cultivation. While the internal drainage system throughout the project area is adequate for paddy cultivation, it would be necessary to improve surface drainage in order to remove excess rainfall and irrigation water.

3.10 Large parts of the project area appear suitable for irrigated dry season production of crops other than rice. Their introduction would have the dual advantage of requiring less water than rice while yielding a higher return. However, since the existing soils surveys are inadequate to determine the exact location and suitability of these soils, a detailed land classification would be carried out on the lighter soils of the project (see para 5.03).

Farm Size and Land Tenure

3.11 The average farm unit in the area is 3.2 ha, with about 84% of the farms ranging between one and five hectares and accounting for nearly 70% of the land. Farms larger than 10 ha are few in number, but account for about 10% of the land. The prevailing farm size is suitable for a family type multiple cropping paddy production.

3.12 Of the 15 municipalities in the project area, all but one have been brought under the Agricultural Land Reform Code. The agrarian reform is to be implemented in two stages. The share tenants would first become leasehold tenants, paying a fixed annual land rental to the landowner, and enjoying a security of tenure. Rents are the equivalent of 25% of the average harvest during three years prior to the introduction of land reform in the area less the cost of seed, harvesting, threshing, hauling and processing. In the second stage tenants would become full owners of the land. Landowners would receive 10% of the value of the land in cash and the balance as stocks and/or bonds issued by the Land Bank. Tenants would repay the Land Bank over a period not to exceed 25 years. In the absence of funds, the second stage of the reform has not yet been implemented.

3.13 Prior to the introduction of land reform, about two-thirds of the farmers in the area were tenants, cultivating the land under a crop sharing arrangement with the landlord. About 6,000 share tenants out of the total of 17,000 in the area have already become lessees and the status of the rest is expected to be changed during the next four years. The introduction of fixed rental payments has provided farmers with an added incentive to increase production.

Transportation

3.14 The Upper Pampanga Basin has a well developed network of provincial and municipal roads connecting interior areas with the national highway system. However, the existing network of feeder roads would not be sufficient to allow the transport of expected rice production to storage and marketing centers. The proposed project would provide for the construction of the necessary additional roads. For details of the feeder roads construction program see para 4.08.

3.15 The Pampanga River in the project area is not navigable by any but very small craft.

IV. THE PROJECT

4.01 The project proposed for Bank financing would provide a dependable water supply for year round cultivation of 72,000 ha, and an additional area of 5,000 ha during the wet season only and flood protection to lands lying below the dam site. It includes:

(a) the construction of an earth and rockfill dam and reservoir at the Pantabangan site;
(b) rehabilitation of the existing irrigation systems serving about 46,000 ha;
(c) construction of a new irrigation system to serve about 31,000 ha;
(d) construction of feeder roads and operation and maintenance facilities;
(e) procurement of equipment, materials and supplies;
(f) a study of NIA's operations, structure and financial operations by a management consultant firm;
(g) a land classification of the project area; and
(h) a feasibility study of possible future power development at Pantabangan Dam.

A consulting firm would be engaged to prepare detailed designs for the dam, review and certify designs for all other civil works to be prepared by NIA and supervise all construction works on the project. Construction works on the p project would be completed within six years (see Annex 1). A detailed description of the works is given in Annex 2 and summarized below.

Proposed Works

4.02 The Pantabangan dam site is located in a canyon section of the Pampanga River, about 10 km north of the town of Rizal. The proposed dam would be an earth and rockfill structure, rising 110.5 m above stream-bed, with a crest length of about 920 m. It would provide a reservoir with a

storage capacity of 3,435 Mm^3. Diversion of the river during construction would be through a tunnel in the left abutment. The upstream end of the tunnel would be plugged upon completion of the dam embankment, and a gated crest spillway with an inclined tunnel chute would utilize the downstream portion of the tunnel for spillway discharge. Maximum spillway discharge capacity would be 1,960 m^3/sec which, together with the surcharge storage space, would be adequate to pass the inflow design flood of a peak of 12,000 m^3/sec and a 6.5 day volume of 1,646 Mm^3.

4.03 The irrigation outlet would be through a tunnel whose actual size would be determined during the preparation of detailed designs for the dam. Irrigation releases would be controlled by hollow jet valves issuing into a stilling basin below the dam. Emergency gates would be installed in gate chambers located near the axis of the dam. A 37 km long, 69 KV wood-pole transmission line would be installed to provide construction power to the dam site. An existing unimproved road would be replaced with a modern improved highway and a bridge crossing the Pampanga River to provide access to the dam site.

4.04 A new irrigation system for some 31,000 ha would be built under the project. Work on the distribution system for about 12,000 ha out of this total started in 1967 by the NIA has been completed. These works would not be included in the proposed loan. However, additional works required to upgrade the system would be constructed and financed under the loan. Sufficient checks and structures would be installed in the system to enable close control of water delivery to each field. The system would deliver water down to a 10 ha unit, from which point delivery to individual holdings would be through farm ditches. Work on the 19,000 ha yet to be constructed includes: canals, laterals and sub-laterals, together with structures; farm ditches and gate controlled turnouts; drainage canals; and associated works. All canals in the system, with the exception of certain reaches of the main canals, would be unlined.

4.05 Two main canals would supply the new lands, as well as supplementing the supply to existing irrigated lands. Construction work on one of these canals, Diversion Canal No. 2, has recently been completed by the NIA with the exception of roadway surfacing along the canal banks, installation of gates and concrete lining in certain reaches. Remaining work on this canal would be carried out by contract and is included in the proposed loan. The other canal, Diversion Canal No. 1, would be about 26 km long and serve 25,000 ha of new lands. Its construction would involve earthwork, a siphon at the Talavera River crossing, checks and structures and maintenance roads along both banks.

4.06 The existing Rizal and Pampanga-Bongabon Diversion dam would be modified as part of the new irrigation works. These modifications include heightening of the overflow crest so as to increase diversion capacity and widening of the existing main canals for a length of about 3.4 km.

4.07 The existing irrigation systems in the area, serving about 46,000 ha, would be rehabilitated and improved so as to bring them up to the standards set for the new systems. Work to be carried out on these systems includes the repair of existing canals and structures and construction of sub-laterals, structures, farm ditches and turnouts, drainage canals and associated works. Upon completion of the works, the system would be capable of delivering 1.5 liters per second per ha which would be sufficient to meet peak paddy demands for irrigation water.

4.08 All weather gravelled roads for operation and maintenance would be constructed along the main canals. In addition, feeder roads would be constructed along laterals and sub-laterals, mainly with excavation spoil from the canals, so as to achieve a road density of one kilometer per 75 ha. The roads would be of minimum standard with a roadway section of about 3.5 m and a 15 cm surface of selected borrow. Total length of the roads would be about 1,000 km.

4.09 Three operation and maintenance district offices would be constructed in the project area to serve the irrigation systems. In addition, a permanent project headquarters and a central repair shop would be constructed at Cabanatuan.

Water Supply and Demand

4.10 The project would derive its main water supply from the Pampanga River regulated by storage at Pantabangan Reservoir. Records of stream flow on Pampanga River are available from 1959 through 1965. An estimate of flows for the period 1949 to 1959 were obtained by correlation with recorded flows on the Agno and Talavera Rivers. On the basis of these records and available rainfall data, a fairly reliable estimate was obtained for the river discharge over a 17 year period. The average annual stream flow for the period under review is estimated to be 1,388 Mm^3.

4.11 Unregulated flows from two major tributaries entering the Pampanga River below the dam, but above the existing Pampanga-Bongabon Diversion Dam, and from the Talavera River, would also be available for project use. The quality of water from these rivers and Pampanga is uniformly excellent for irrigation use with all samples analyzed showing less than 300 ppm of dissolved solids.

4.12 Water requirements for the project were based on two crops of paddy in each calendar year. Taking into account conveyance losses and effective rainfall, annual diversion requirements for irrigation water were taken to average 2.0 m in depth for two paddy crops. In determining the operation of Pantabangan Reservoir and judging the adequacy of the water supply, water requirements were computed on a monthly basis using actual rainfall records and consumptive use to estimate residual water requirements to be supplied by irrigation. Monthly irrigation requirements and the flow of the Pampanga River were used in a reservoir study over the 17 years of hydrologic records. Water releases assumed in the study included requirements for firm power generation of 20 MW at 30% plant factor (7.2 hours daily). On the basis of these assumptions, the project could provide a dependable water supply for paddy cultivation of 77,000 ha in the wet season and 72,000 ha in the dry season. Actual water releases for power would depend upon the findings of a power study being conducted by the National Power Corporation and their consultants (for details see para 4.20).

4.13 Should power be excluded from the project, or if it is developed on the basis dictated by irrigation releases only, the available water supply would be adequate to meet the demand of a further 5,000 ha during the dry season. Expansion of the irrigable area during the dry season, however, would have to take place in areas adjacent to the project where sufficient lands are available. Such a move is dictated by the fact that about 5,000 ha of the existing irrigation system to be rehabilitated under the project could not be served by gravity from Pantabangan dam. This area is situated above Diversion Canal No. 1 and would only be served during the wet season out of the Talavera River (see Map).

4.14 Irrigation water demands, both with or without power, could be adequately met with only minor shortages occurring with a frequency of about one in ten years. Shortages of this frequency and magnitude are acceptable. Further details of water supply and demand are provided in Annex 3.

4.15 Rights on all the project's water supply are currently in the hands of the National Power Corporation. Assurances have been obtained that the necessary water rights would be granted to the NIA and that no private water rights which could adversely affect the project's water supply would be granted.

Status of Engineering

4.16 Feasibility studies for Pantabangan Dam and Reservoir, together with preliminary design drawings and quantity estimates, were prepared by the US Bureau of Reclamation (USBR). Sufficient drilling and exploratory work were carried out to determine the suitability of the site from an engineering and geologic standpoint and to ensure the availability of materials for construction of an earth and rockfill dam. Studies of the irrigation and drainage systems, both for the new areas and those to be rehabilitated, were made by the NIA. Surveyed traverse lines were run for the new main canals on which structures were located and from which excavation and embankment quantities have been computed. The lateral and sub-lateral distribution system and the drainage and roads networks were estimated on a unit length or per hectare basis from previous experience by the NIA.

4.17 The NIA has done considerable work in constructing irrigation distribution systems, but lacks experience in major dam design and construction. They would, however, receive assistance from the technical staff of the National Power Corporation and the Bureau of Public Works, who have more experience in this field. Arrangements for technical assistance from these agencies would be made under the auspices of the project's coordinating committee (see para 6.06). In addition, consultants would be engaged to prepare final designs and tender documents, to supervise construction and to certify payment documents for all civil works. While the consultants would have final responsibility for all these aspects, much of the design and field work for the irrigation network would be carried out by NIA's engineers and technicians. The NIA has agreed to engage a consulting engineering firm satisfactory to the Bank as outlined above and on terms and conditions to be approved by the Bank.

4.18 Several modifications of the dam design presented in the feasibility study have been proposed by the Government in an effort to reduce project costs. These proposals, however, have not been worked out in sufficient detail to evaluate their merit at this time. Further review of the proposed changes would be undertaken by the consultants during the preparation of detailed design. Should any special problems related to design criteria arise at that stage, the NIA has agreed that either they or the Bank may call for the appointment of a Review Board consisting of three experts acceptable to the Bank to review the basic design and criteria adopted by the consultants for Pantabangan Dam and to advise as needed on special problems which might develop during construction.

Future Power Development

4.19 Benefits from power installations at Pantabangan Dam would depend upon its joint operation with other existing hydroelectric plants in the country. For this purpose, the Bank recommended to the Government in September 1968 that a study be carried out to determine the benefits from the joint operation of Pantabangan with the Ambuklao/Binga and Angat Reservoirs. The study has been carried out by the National Power Corporation with the assistance of their consultants, Gilbert Associates of the USA. The findings of this study were somewhat inconclusive and the National Power Corporation has therefore suggested that a feasibility study should now be prepared by the consultants who would prepare the detailed design of the Pantabangan Dam. This feasibility study would be completed before the final designs are ready so that the necessary provisions for power could be incorporated in the designs before the tender documents would be issued. The foreign exchange costs of the study are estimated to be about $100,000 and this amount has been included in the loan.

Flood Control

4.20 There are two sources of floods in the project area. One is the heavy rainfall over the relatively flat lands and the second is the run-off from the mountain areas above Pantabangan Dam. In order to control the latter floods in the project area, as well as to help ease the extent of floods further on downstream, the project includes provisions for flood control. For this purpose, the design of Pantabangan Dam includes an allocation of 486 Mm^3 of reservoir space to flood control. Annual flood control benefits are estimated to be US$ 500,000 and justify the cost of US$ 2.5 million associated with this aspect of the project.

Cost Estimates

4.21 Quantity estimates for Pantabangan Dam and Reservoir are based on the USBR feasibility design. Unit prices incurred during construction of the Angat Dam three years ago adjusted to reflect present day cost levels were applied to these quantities. Quantity estimates for modification of the existing diversion dams, irrigation and drainage systems and feeder roads are based on surveys and preliminary drawings which are adequate for cost estimate purposes. Unit prices were based on NIA's recent experience with similar works elsewhere in the Philippines. Unit costs for equipment, material and supplies are based upon current quotations received by NIA. The estimates include the cost of engineering and management consulting services, supervision and overhead. A 20% contingency factor was applied to all cost estimates. Interest during construction on the proposed Bank loan is also included in the estimates. Foreign exchange requirements were based on bids for construction of the Angat Dam and a detailed breakdown of the equipment, materials and supplies required for the project. The cost estimates and foreign exchange requirements are reasonable. Details of the estimates are presented in Annex 4 and are summarized below:

	₱ (millions)			US$ (millions)		
	Local	Foreign	Total	Local	Foreign	Total
Pantabangan Dam and Reservoir	64.4	53.8	118.2	16.5	13.8	30.3
Irrigation System and Roads	42.1	28.5	70.6	10.8	7.3	18.1
Operation and Maintenance Equipment	0.8	5.8	6.6	0.2	1.5	1.7
Consulting Services	1.2	5.8	7.0	0.3	1.5	1.8
Sub-total	108.5	93.9	202.4	27.8	24.1	51.9
Contingencies about 20%	22.2	19.1	41.3	5.7	4.9	10.6
Total Investment Cost	130.7	113.0	243.7	33.5	29.0	62.5
Interest During Construction @ 7.0%	-	19.5	19.5	-	5.0	5.0
TOTAL Project Cost	130.7	132.5	263.2	33.5	34.0	67.5

Procurement and Disbursement

4.22 Construction of Pantabangan Dam, the new irrigation systems, project facilities, feeder and operation and maintenance roads as well as modifications of the existing diversion dams would be done by contracts to be awarded on the basis of international competitive bidding. A single contract is expected to be awarded for construction of the dam and about three for the irrigation works. Rehabilitation work on the existing irrigation system, and the construction of farm ditches throughout the area and an access road to the dam which do not lend themselves to international competitive bidding, would be carried out as force account work by the NIA. The estimated cost of these works is US$ 6.0 million. However, the necessary equipment, materials and supplies for these works, as well as operation and maintenance equipment, would be purchased following international competitive bidding procedures. A detailed list of these items is presented in Annex 5.

4.23 Disbursements out of the loan for civil works contracts to be awarded to non-Filipino contractors and for consulting services would be made against foreign exchange payments. All disbursements for civil works contracts which would be awarded to local contractors and for force account work would be made on a percentage basis. For equipment, materials and supplies, disbursements would be made upon presentation of suppliers invoices and evidence of shipment to the Philippines against their CIF cost or if the successful bidder should be a local supplier disbursements would be made following the presentation of import documents for the CIF cost of the imported components utilized in manufacturing the goods.

4.24 Several laws in the Philippines prohibit international competitive bidding on civil works and equipment. Furthermore, one of the laws specifies

that for the purpose of bid analysis on equipment, all custom duties should be added to the foreign bid in addition to a 15% preference margin for local suppliers. Waiver of the restrictive provisions of these laws which required legislation by Congress was obtained prior to negotiations. Special legislation was passed by Congress in June 1969. According to the provisions of the Act and as agreed during negotiations, equipment and materials for the project would be procured on the basis of international competitive bidding, in which Filipino suppliers could participate with a preference allowance of 15%. The evaluation of bids for such procurement would be made after deducting from bids submitted by non-Filipino bidders customs duties and any other taxes due on the imported goods. No preference would be granted to Filipino contractors on civil works contracts. Agreement was also reached that any contract for the procurement of imported equipment, materials and supplies not exceeding US$ 10,000 would be exempted from international competitive bidding, provided that the aggregate of all such contracts shall not exceed US$ 100,000.

Financing

4.25 The proposed Bank loan of US$ 34 million (₱ 132.5 million) would cover the estimated foreign exchange cost of the project consisting of payments for civil works, imported equipment materials and supplies, consulting services and interest on the loan during the construction period. The loan would represent approximately 50% of the total project cost. It has been agreed that expenditures incurred on the project prior to signing of the loan agreement but after April 30, 1969, would be reimbursable under the loan. Total withdrawals from the loan account for these expenditures would not exceed US$ 200,000.

4.26 Expenditures for the construction of the project, including disbursement of the proposed Bank loan, would be approximately as follows:

Fiscal Years ending June 30 of	Prior to Loan	1970	1971	1972	1973	1974	1975	Total
	US$ Millions							
Government Contribution	1.2	1.4	4.1	5.0	8.2	8.8	4.8	33.5
IBRD Loan	-	1.0	4.4	5.8	7.1	8.7	7.0	34.0
TOTAL	1.2	2.4	8.5	10.8	15.3	17.5	11.8	67.5

4.27 Local currency requirements for the project estimated at ₱ 131 million (US$ 33.5 million) would be provided by the Government through one or all of the following sources: sale of NIA bonds; sale of Government Bonds; and releases out of general revenues.

4.28 The Act creating the NIA specifies that the agency's working capital should be ₱ 300 million (US$ 77 million), to be subscribed and paid by the Government through bonds to be floated by the Central Bank, which shall deliver annually to the NIA the sum of ₱ 30 million (US$ 7.7 million) until its whole capital stock is fully paid up. Meeting the entire local currency

requirement for the project out of this source as proposed by the Government would present several problems. First, under NIA's present ceiling of ₱ 300 million, only some ₱ 180 million (US$ 46.2 million) remain unsubscribed and, therefore, relying exclusively on this source to finance the project, would seriously hamper NIA's operations in other parts of the country. Second, annual capital releases to the NIA are limited to ₱ 30 million (US$ 7.7 million), compared with up to ₱ 34 million (US$ 8.8 million) annual local currency requirements for the project. Third, although the NIA has previously used the funds it received from Government for capital investment, the Act does not specifically authorize it to do so.

4.29 Sale of Government Bonds is another source of funds for the project. Subject to Congressional authorization, the Government can float bonds to finance various development projects. These bonds, as well as the NIA bonds and those of various other Government agencies and public corporations in the Philippines, are usually bought by the Central Bank, the Government Service Insurance System, the Social Security System, the Development Bank of the Philippines and commercial banks. However, the amount of bonds purchased annually by these institutions falls short of the amount offered for sale. With several agencies attempting to sell bonds in a limited market, there is no guarantee that a sufficient amount of bonds could be sold annually to meet the project requirements.

4.30 Congressional legislation appropriating funds for the project out of general Government revenues is the third source for financing the local currency requirements of the project. However, in the past, Government revenues fell far short of annual appropriations and consequently development projects suffered from inadequate funding. To ensure adequate funding for the project, the Government was requested to obtain the necessary authorization to finance the local currency portion of the project through the sale of Government Bonds and releases out of general revenues. Passage of legislation to accomplish this was obtained prior to negotiations.

4.31 In order to ensure the continuous and timely flow of funds for the project, assurances were obtained during negotiations that a special fund would be set up prior to the signing of the loan, for the project into which the Government would deposit every month the local currency requirements for the next three months' period. The present estimates for local currency requirements in each fiscal year are presented in para 4.26.

Auditing of Accounts

4.32 The NIA is a Government agency and, as such, its accounts are audited annually by the Government's Corporate Auditor's Office. Assurances were obtained that NIA would engage consultants to assist them in setting up a cost accounting system for the project, that it would maintain separate accounts for the project which would be audited by the Government's Corporate Auditor's Office and submit the auditor's annual report to the Bank along with a certified copy of NIA's financial statement within four months after the end of the fiscal year.

V. AGRICULTURAL DEVELOPMENT

Present Conditions

5.01 Most of the project area now produces only one crop of rice per year; about 7,000 ha are planted to a second crop. Some machinery is used in preparation of the rice fields, but most operations are performed with draft animals. The crop is harvested at the end of the rainy season when substantial losses are incurred due to a lack of dryers.

5.02 Present production in the project area is mainly from traditional unimproved rice varieties. However, in the last two years, since seed of the high yielding varieties, principally IR8, has become readily available, parts of the area are planted with the new varieties. Overall yields, however, are still low ranging from about 28 cavans (1.2 m ton) per ha on rainfed lands to 40 cavans (1.8 m ton) per ha on the partially irrigated. Total annual paddy production from the project area is presently around 130,000 m ton.

Expected Yields and Production

5.03 About 20,000 ha of project lands appear suitable for growing crops other than rice and may ultimately be more beneficially used for cultivation of other crops. However, until there is a demonstrated market for such crops, all of the project area would be devoted to multiple cropping of rice. In order to identify the exact location and suitability of these soils for the production of crops other than rice, the Government has agreed that the NIA would prepare, with the assistance of consultants, a land classification of the project area in order to delineate those lands suitable only for paddy and those which can be used also for cultivation of other crops and to determine their characteristics and best ultimate use.

5.04 Completion of the project's distribution system would coincide with the end of construction of Pantabangan Dam. Since the area is already partially irrigated it is expected that within three years after water becomes available for irrigation in the dry season, the entire dry season project area of 72,000 ha would be planted to a second crop. With the better irrigation system, control of water and the application of complementary inputs required by the improved varieties, yields are projected to increase gradually to the level of 87 cavans (3.8 m ton) per ha per crop. Total production from two crops of paddy in each calendar year from the project area at full development would be about 570,000 m ton, or roughly four times the present level.

5.05 Transformation of the present production levels into those projected in this report is expected to occur gradually following the introduction of the high yielding varieties in any given area. The entire project area is expected to be planted to the high yielding varieties by the tenth year of the project. Given the emphasis on continuation of rice as the main crop, and the availability of new high yielding varieties, it would be possible to develop even a higher level of production than is projected, provided an accelerated program for the expansion of extension, storage, marketing, credit

and other agricultural services could be developed. The assured water supply provided by the project and a general upgrading of cultivation practices, would also lead to a concurrent increase in production costs. This would be due largely to more intensive use of fertilizers, insecticides and improved seed all of which are readily available to farmers through commercial channels in the project area. Details of yields, cost and returns are presented in Annex 6.

5.06 Farmers in the project area employ large numbers of hired labor for land preparation, transplanting, weeding, harvesting and threshing. There is an abundant supply of farm labor in the area to meet the requirements of double cropping cultivation. Upon completion of the project, production costs in the area are expected to increase gradually from the present level of ₱ 350 to ₱ 745 per ha per crop. This increase would be associated with the more than doubling of rice yields and more than a five fold increase in the farmer's net income (see Annex 6).

Storage and Marketing

5.07 The Central Luzon Plain is considered to be the rice bowl of the Philippines and has long been a net exporter of rice. Much of the surplus production from the region is shipped to Manila which is a major consumption center. Surplus production from the project area is also expected to be shipped to Manila with which it has good rail and highway connections.

5.08 Farmers in the project area can sell their crops to private buyers, millers or the Rice and Corn Administration (RCA) which is a government agency created with the main purpose of stabilizing the price of rice and corn to the farmer. The RCA has milling and storage facilities throughout the country which are sufficient to handle between 10% and 15% of the rice marketed in the Philippines. This should suffice to maintain the average paddy price to the farmer at a level of about ₱ 15 per cavan (US$ 87.4 per m ton) which compares favorably with the projected world market price for rice.

5.09 About 200 warehouses are located in the project area with an aggregate capacity of more than five million cavans (220,000 m ton). With more than half of the paddy production reaching market channels, present facilities can adequately handle production from the project until the construction works are completed. However, some of the rice produced in the Cagayan Valley is stored in Nueva Ecija and eventual regional increases in production would strain existing facilities by 1974. A storage study prepared for the Government by consultants, Weitz-Hettelsater Engineers of the U.S.A., in June, 1968, recommends the construction of additional bulk silos in the project area between 1972 and 1975. The Government has submitted a request to the Bank for financial assistance in implementing the consultant's recommendations for additional storage facilities to be constructed by 1970 in neighboring provinces and elsewhere in the country. It has also obtained a US$ 4.0 million loan from the US Export-Import Bank of which at least US$ 1.0 million would be used to finance the expansion of storage and milling facilities.

5.10 There are some 160 private rice mills in the project area with a total milling capacity per 12-hour day of approximately 23,000 cavans (equivalent to 300,000 m ton per annum). However, about half of the mills are primitive and have a low milling recovery rate. As production from the project area increases, the existing rice mills would be insufficient to meet the milling demands. The introduction of additional milling facilities would be undertaken by the private sector which has been responsive to the needs of the area in the past. Aside from the need to improve and expand the milling capacity in the area, there is also an urgent need to introduce mechanical driers.

5.11 The number of mechanical driers in use throughout the Philippines is limited and the bulk of production is being sun-dried. However, with the introduction of early maturing and high yielding varieties, sun-drying of paddy during the wet season on a large scale will not be feasible. This fact has been recognized by the Government which is promoting the installation of mechanical driers. Credit is currently being made available through banking institutions for the purchase of driers and the needs of the project area would be met through the expansion of drying facilities by the private sector.

VI. ORGANIZATION AND MANAGEMENT

The National Irrigation Administration

6.01 Responsibility for the 300,000 ha of national irrigation systems in the Philippines was in the hands of the irrigation division of the Bureau of Public Works up to 1964. At that time, in an effort to accelerate irrigation development in the country, the Government separated the irrigation branch from the Bureau and set it up as the National Irrigation Administration (NIA). The functions of the NIA are to investigate, study, improve, construct and administer all national irrigation systems in the country. Its financial requirements are met by the Government through the sale of bonds. Overall responsibility for the agency is vested in a Board of Directors composed of seven members with the Secretary of Public Works and Communication acting as chairman. Management of the agency's affairs and business is in the hands of the Irrigation Administrator. Appointment of the Administrator is in the hands of the Board subject to the approval of the President of the Philippines (for further details see Annex 7). It has been agreed that during the disbursement period of the loan and five years thereafter, the Board of NIA would consult with the Bank sufficiently in advance, of any appointment so that the Bank could comment on the suitability of the nominee.

6.02 Although the NIA is staffed with competent personnel and has recently completed successfully the rehabilitation of 32,000 ha on the Angat Project and the construction of a new system on 12,000 ha in the Pampanga project area, the agency is hampered by several problems. First and foremost among these is the shortage of operating funds. This problem has been somewhat alleviated by the recent US$ 4.7 million equipment loan from the USAID which would enable NIA to better maintain the existing systems, and by the

increase in irrigation fees (see para 7.03). The other problems relate to management of equipment, billing and collection of irrigation fees, project reporting systems, the internal organization structure of the agency and its financial management. These shortcomings were highlighted in a 1967 report to the Government prepared by a local management consultant firm, Sycip, Gorres, Velayo and Company.

6.03 Several of the recommendations made by the management consultants are now being implemented by the NIA. However, many of the recommendations were only preliminary and did not present detailed programs for implementation. The preparation and implementation of such programs would now be undertaken in two phases. The first phase would take about six months to accomplish and would outline in detail the action and programs required to correct the problems identified earlier by the consultants. After consultation between the Bank and NIA, the recommended programs would be implemented under phase two of the study. This phase is expected to be accomplished over a two-year period. The NIA has agreed to employ a suitably qualified management consultant firm acceptable to the Bank to carry out the study as outlined and, after consultation with the Bank, to take all necessary actions to implement the recommended and agreed programs.

Construction

6.04 The NIA would be the executing agency for the planning, design, construction and operation and maintenance of all project works. It would also be responsible for collecting water charges. An engineering consulting firm would be engaged by NIA to assist them in all the civil works phases of the project. The consultants would make maximum use of NIA personnel, especially in the designs of the distribution system, but would have final responsibility for technical adequacy of designs and supervision of construction and would certify applications for withdrawal from the loan account. With the assistance of these consultants, NIA should be able to implement successfully all the works on the project.

6.05 The organizational arrangement for discharging the construction responsibility is shown in chart form in Annex 7. A Project Manager has been appointed by the Irrigation Administrator to have direct responsibility for all actions concerned with construction of the project. He would be assisted by two Assistant Project Managers concerned with field and office activities.

6.06 General coordination of project activities between government agencies would be achieved through the Upper Pampanga River Project Coordinating Committee, established under a Presidential Administrative Order. The Administrator of the NIA serves as chairman of the Committee whose members are: the General Manager of the National Power Corporation, the Director, Bureau of Public Works, and a representative of the Rice and Corn Production Coordinating Council (RCPCC). Agricultural activities related to the project such as extension, credit and marketing are coordinated through the RCPCC

representative. The Committee's Joint Technical Staff, comprising senior technicians of the participating agencies would render technical assistance to the NIA at the request of the Committee as and when necessary. Decisions of the Committee would be relayed to the Project Manager through the direct authority exercised by the Administrator of the NIA.

Operation and Maintenance

6.07 The NIA would be responsible for operating and maintaining the project. The organization chart is shown in Annex 7. The Project Manager would have his headquarters at Cabanatuan City and from that location direct all operation and maintenance activities for Pantabangan Dam and the irrigated area. The irrigated lands would be divided into three districts with district headquarters located at Santa Rosa, San Jose and Talavera. Each district would have administrative, equipment and road maintenance sections. Operation of the irrigation system would be further subdivided into zones, divisions and sections, with ditch riders responsible for distribution of water to each section of about 400 ha. A central equipment maintenance shop for major overhauls would be established at Cabanatuan City.

Technical Assistance, Services and Credit to Farmers

6.08 Research. The Maligaya Rice Research and Training Center located in the project area would provide the necessary research facilities to the project. It would also serve as a training center for extension service workers. The Center is carrying out research activites on rice in the following fields: plant breeding; cultivation requirements; fertilizer and soil management practices; irrigation and drainage requirements; pest control; and storage and processing. It also conducts experiments with cotton, soybean and wheat. Several experiments on rice and fertilizers are undertaken in cooperation with the International Rice Research Institute, the Philippine Atomic Energy Commission and the United Nations Special Fund. The Center would be able to provide all necessary research facilities to the project.

6.09 Extension. Several Government agencies provide extension services in the area under the supervision and coordination of the Agricultural Productivity Commission (APC). The principal extension workers in the area are the farm management technicians, the home management technicians and the cooperative officers. Presently there are about 50 extension workers in the area. In conjunction with the land reform program and the introduction of double cropping, this number would be gradually increased so that by 1975, when construction work on the project is completed, there would be about 390 extension workers in the area. Out of this total about 200 would be farm management technicians, each covering about 380 ha. In addition, there would be one supervisor for every 10 farm management technicians. This number, which could be easily recruited from among the graduates of the numerous agricultural colleges in the country, would be adequate to meet the needs of the area. Budget requirements for personnel and operations of the extension services which is currently about ₱ 220,000 annually, is projected to increase to around ₱ 1.8 million by 1975 and would be provided by the APC

out of its budgetary appropriations. The Government has agreed that the necessary personnel and budget requirements for the extension services would be made available to the project.

6.10 Credit. Introduction of high yielding varieties and new cultivation techniques would require a large increase in short term (production), medium and long-term credit. There are sufficient credit institutions in the area to meet the expected increase demand for credit. The major sources of agricultural credit in the area are the Rural Banks followed by the Philippines National Bank, the Development Bank of the Philippines, the Agricultural Credit Administration and about 33 private local banks. Eight out of the 13 Rural Banks in the area participate in the IBRD Rural Credit Project (432-PH), for which a second loan (607-PH) has recently been signed. These loans provide funds to select rural banks through the Central Bank for medium and long-term loans to agricultural producers. By augmenting the rural banks' lending capacity for medium and long-term loans, the Rural Credit Project also enables these banks to devote more of their own funds for short-term production credit as well as utilizing substantial discount facilities with the Central Bank.

6.11 The total of all types of agricultural loans granted by the various banks in the area amounted to about ₱ 50 million (US$ 12.8 million) in 1967. In addition, a considerable amount of credit was extended by other sources such as landlords, farm input dealers, marketing and processing firms and private money lenders. Upon completion of the project, production credit requirements in the area for two crops of paddy are expected to amount to about ₱ 60 million (US$ 15.4 million) annually. The existing credit institutions in the area would be able to meet this need.

VII. FINANCIAL RESULTS

Operation and Maintenance Costs

7.01 Operation and maintenance cost estimates have been based on actual expenditures experienced on the Angat Project, a similar type of project in Central Luzon, adjusted upwards to reflect the level of operations and maintenance efficiency assumed for the project. Annual operation and maintenance costs on the project would amount to about ₱ 48.0 (US$ 12.3) per ha. Operation and maintenance work on the existing irrigation systems in the area are generally inadequate due to lack of equipment and shortage of funds. Since the rehabilitation works on these systems would incorporate deferred maintenance, no attempt would be made to intensify maintenance work on these systems until the rehabilitation works are completed. Operation and maintenance activities on the new irrigation areas would commence upon completion of each system. The entire project system is expected to become operational in 1975. Annual expenditures, including the cost of operating Pantabangan Dam and Reservoir allocated to irrigation, are estimated to be as follows:

Calendar Year	1970-1972	1973	1974	1975
Cost in ₱ millions	0.9	1.8	2.7	3.7
US$ '000 equivalent	230	460	690	950

Water Charges

7.02 The NIA has the necessary powers to collect from the users of each irrigation system constructed by it such fees as may be necessary to finance the continuous operation of the system and to recover the construction cost thereof. Presently, all such collections are paid into the Government general revenues fund. Under the project, however, NIA would retain for use on the project that portion of the irrigation fees collected by it which is necessary to cover actual operation and maintenance costs. This arrangement is required by the Congressional Act under which the Government would borrow funds for the project from the Bank.

7.03 Irrigation fees presently charged by NIA on paddy lands amount to ₱ 25 per ha for the wet season crop and ₱ 35 per ha for the dry season crop. Collections, however, fall far short of assessments. Since annual Government allocations to NIA for operation and maintenance activities are directly related to water charges collections, failure to collect water charges has brought about a serious deterioration in NIA's irrigation systems. The poor collection record of the NIA is partly due to an inadequate collection system. In order to improve collections, the management consultant firm which would be employed to review NIA's operations (see para 6.03), would also help install an updated billing and collection system.

7.04 The NIA has recently increased its irrigation fees on double cropped paddy lands from ₱ 12 to ₱ 60 per ha per annum. This rate would be adequate to cover all operation and maintenance costs on the project but would contribute little toward capital recovery. In order to recover the total investment cost of the project including interest during construction over a 50-year period, irrigation fees would have to be gradually increased from the present annual level of ₱ 60 per ha to ₱ 150 (US$ 38.5) per ha within ten years after completion of the project. In view of the substantial increase in farmers' income which would result from the project, such a charge would not be unduly high and could be met by farmers. To ensure sound operation and maintenance practices on the project as well as equitable contribution by benefiting farmers toward recovery of the capital cost of the project, the Government has agreed that:

(a) should the irrigation fees collected by NIA in the project area fall short of the amount required for the operation and maintenance thereof, it would provide NIA with the necessary supplementary funds. It is currently estimated that total annual expenditures for operation and maintenance on the project would be ₱ 3.7 million (US$ 950,000) starting in 1975.

(b) NIA would gradually increase the level of irrigation fees to recover as much as practicable of the capital cost of the project, taking into account farmers' incentives and capacity to pay. In order to recover all capital costs including interest during construction over a 50-year period, it is presently estimated that irrigation fees would have to be gradually increased to about ₱ 100 (US$ 25.6) per ha within five years after completion of the project and to ₱ 150 (US$ 38.5) within ten years after completion of the project; and

(c) NIA would take all the necessary actions to ensure full and prompt collections of the irrigation fees.

Farmers' Income

7.05 All farm labor requirements - family and hired - have been costed at market values. With an average farm size of 3.2 ha of irrigated land, current annual net returns to a farming family from a single crop of paddy after deducting all production costs, water charges and land rent, amount to about ₱ 330 (US$ 86). Net returns in the rainfed areas are substantially lower. By comparison with present returns, earnings from two crops of rice on a similar farming unit at full agricultural development, assuming water rates of ₱ 150 per ha, would amount to about ₱ 2,160 (US$ 555). For details see Annex 6. This would represent a substantial increase in farmers' income and should provide them with adequate incentives.

VIII. BENEFITS AND JUSTIFICATION

8.01 Upon completion the project would enable farmers to produce two crops of irrigated paddy in an area where production is currently limited to one crop a year under partial irrigation or rainfed conditions. The availability of a secured regulated water supply and better flood protection would permit farmers to use more inputs and to adopt the new high yielding rice varieties on an economical basis.

8.02 Based on recent projections by the Philippines Government, the country's population in 1980 is expected to be around 54 million. Per capita cereal consumption in the Philippines, as well as the share of rice in this total, has undergone little change during the past 30 years. Thus, using the national average per capita consumption of rice of 83 kg per year for the period 1949-1964 as a base, demand for rice in 1980 would be approximately 4.5 million m ton. Assuming a 65% milling efficiency rate, this would represent a paddy demand of 6.9 million m ton, compared with the present annual output of 4.2 million m ton. Thus, unless the drive to expand production is continued, the country would have to import large quantities of rice in the years ahead.

8.03 The major benefits to be derived from the project would be increased paddy production which would help the Government to meet the expected increased demand without resorting to imports. For the purpose of economic analysis it was, therefore, assumed that the 440,000 m ton of incremental paddy production from the project area would serve as import substitution. The value of production from the project area was calculated on the basis of a future price equivalent for rice of US$ 126 m ton in the project area 1/. Using the projected rice price, gross foreign exchange savings through the project at full development would amount to about US$ 36.5 million annually compared with an initial foreign exchange investment excluding interest, of US$ 29 million. This total is exclusive of necessary foreign exchange outlays for farm inputs.

8.04 All farm labor requirements - whether family or hired - have been treated as production cost. Yield projections of 3.8 m ton per crop per ha used in the analysis are substantially below the potential of the high yielding varieties and could be exceeded should farmers use more inputs than were projected in this report.

8.05 At full development, 13 years after completion of all project works, the annual gross value of incremental production is estimated at ₱ 140 million (US$ 36 million). The increase in the net value of production after deducting all incremental production and operation and maintenance costs, would be about ₱ 55.8 million (US$ 14.3 million). No benefits were credited to the project in this analysis from power generation or crops with higher return than rice. Also, cautious assumptions were adopted for future rice prices, yields and the rate of agricultural development. When discounting the benefits over the 50-year life of the project, the rate of return to the economy would exceed 13% (for further details see Annex 8).

IX. CONCLUSIONS AND RECOMMENDATIONS

9.01 The project would be multipurpose with primary benefits accruing to irrigation. Upon completion, the project would provide a dependable water supply for year round paddy cultivation of 72,000 ha and an additional area of 5,000 ha during the wet season only.

9.02 Overall project costs compare favorably with other projects of this type. The cost of the distribution system is very low at around US$ 290 per ha. This, however, is partially due to the fact that all the necessary diversion dams for the project are already in existence as is the distribution system on about 60% of the area which would only require rehabilitation and improvement. Including the cost of the proposed Pantabangan Dam and

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1/ This price was derived from the 1961-1967 average rice import prices (US$ 124 per m ton CIF Manila) and world market price forecasts for 1975 (US$ 140 per m ton 5% broken FOB Bangkok) prepared by the Trade Policies and Export Projections Division of the Bank's Economic Department. It would be equivalent to about US$ 128 per m ton CIF Manila.

Reservoir, total investment in the project would amount to about US$ 840 per ha. The National Irrigation Administration would be the executing agency. Although the agency is relatively new and without prior experience in the construction of major dams, it has competent personnel and with the assistance of consultants should be able to implement the project successfully. The project is technically sound and economically justified. It is suitable for a Bank loan of US$ 34 million. The borrower would be the Government of the Republic of the Philippines and an appropriate term would be 25 years including a seven-year grace period.

9.03 Prior to negotiations the Government:

(a) Passed the necessary legislation to remove the restrictive provisions of existing laws with regard to international competitive bidding and the procedure for comparing foreign and local bids on equipment.

(b) Obtained the necessary authorization from Congress to finance the local currency portion of the project through the sale of Government Bonds and releases out of general revenues (para 4.30).

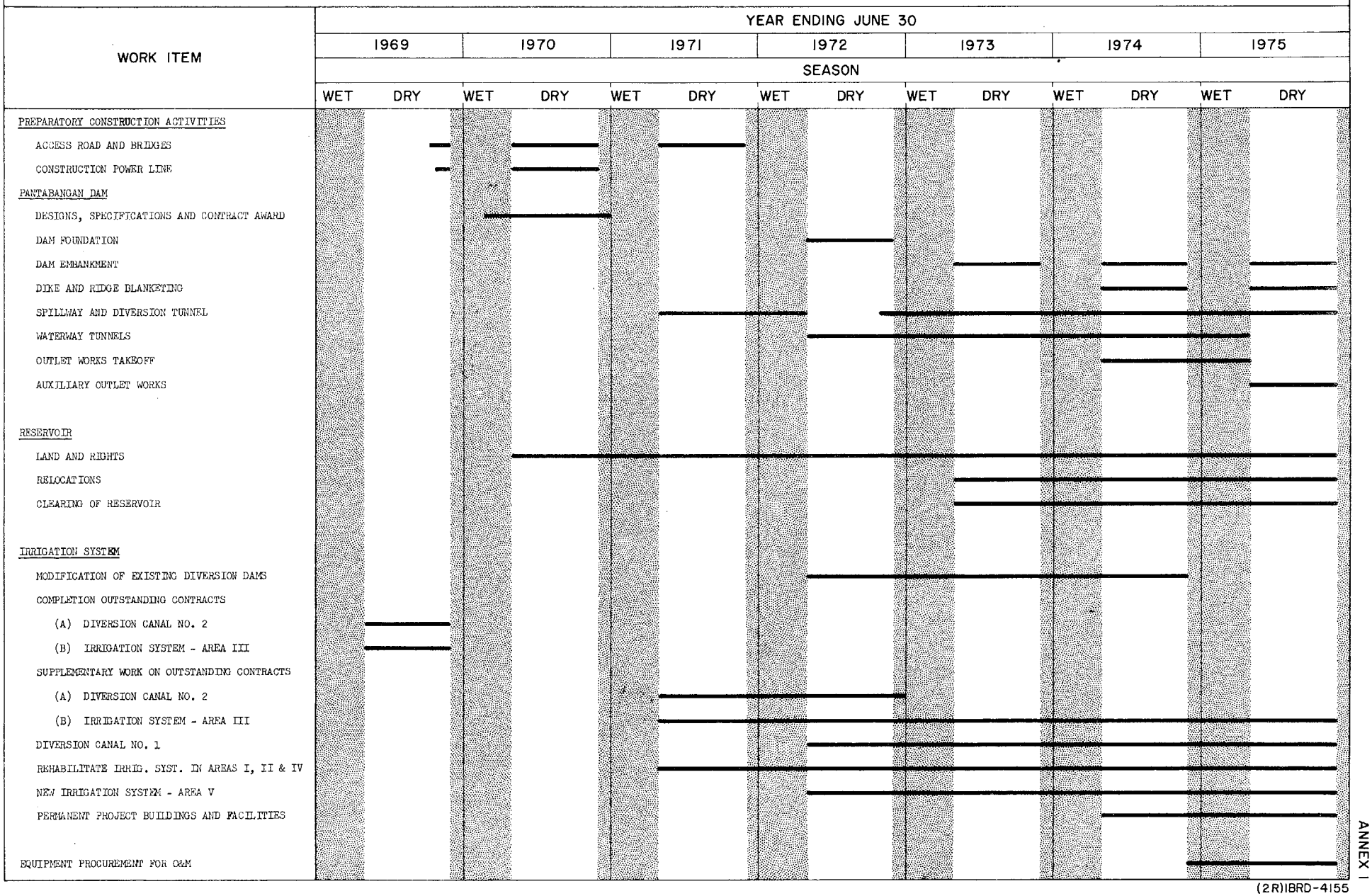
9.04 Among others, the following assurances were obtained during negotiations:

(a) The necessary water rights would be transferred to the NIA and that no private water rights which could adversely affect the project's water supply would be granted (para 4.15).

(b) A special fund would be set up, prior to the signing of the loan, for the project into which the Government would deposit every month the local currency requirements for the next three months (para 4.31).

July 30, 1969

PHILIPPINES: UPPER PAMPANGA RIVER IRRIGATION PROJECT
CONSTRUCTION SCHEDULE



ANNEX I

(2R)IBRD-4155

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Description of Works

1. The principal features of the project are:

(a) Pantabangan Dam, including spillway and outlet works, an access road and bridge, transmission line for construction power and service facilities at the dam site;

(b) a new diversion canal and supplemental work on a second diversion canal constructed in 1967 by the NIA;

(c) a new irrigation and drainage system to serve about 31,000 ha;

(d) modification of two existing diversion dams;

(e) rehabilitation of existing irrigation systems serving about 46,000 ha; and

(f) construction of permanent project facilities.

Pantabangan Dam

2. The Pantabangan Dam site is located in a canyon section of the Pampanga River immediately below the junction of the Carranglan and Pantabangan Rivers, about 10 km north of the town of Rizal. The proposed dam would be an earth and rockfill structure of impervious earth core and pervious outer shell, rising 110.5 m above streambed with a crest length of about 920 m and a base width of about 600 m. A cut-off trench would be excavated to bedrock along the entire length of the dam, and the impervious core of the dam would be carried to the bedrock level. A line of grout holes would continue the cutoff into the foundation. Embankment volume is estimated at 9,500,000 m^3. Along the left abutment ridge, a number of deeply eroded ravines would be filled with compacted earth and protected by rip rap to strengthen the abutment. Seven separate areas would be strengthened and would involve placing an estimated 1,100,000 m^3 of material. Construction materials for the dam and blanketing would be obtained from selected borrow areas in the vicinity of the dam site. Impervious and semi-pervious materials in sufficient quantity were located in the reservoir area about 3 km from the dam site. Pervious

sands, gravels and boulders are to be obtained from gravel bars in the river bed, both upstream and downstream from the dam site. Suitable rock for rip rap exists about 9 km northeast of the dam site.

Spillway and Diversion Tunnel Structure

3. The spillway would be located through the left abutment and consists of an inlet control structure, an inclined shaft, and a horizontal tunnel which would emerge at the river's edge, about 700 m downstream from the toe of the dam. The horizontal leg of the spillway tunnel would serve initially for diverting flows during construction by extending a connecting length of the tunnel to the river upstream from the dam. The diversion tunnel would be plugged at its juncture with the spillway tunnel upon completion of the dam embankment. The spillway inlet structure would have a fixed crest with radial gate controls, and would connect to the horizontal tunnel by an inclined transition tunnel. The diameter of the spillway tunnel would be 10 m. Two spillway gates would be provided, each 6 m wide and 12.8 m high. The gate sill would be below the reservoir flood control space level, so that the spillway gates would regulate releases for flood control purposes. The spillway discharge of 1,960 m^3/ sec of maximum water surface, together with 1,004 Mm^3 of surcharge space, would be adequate to pass the inflow design flood. A flip bucket at the tunnel outlet would dissipate the energy from the spillway discharges.

Outlet Works and Waterways

4. A single irrigation waterway would be constructed for the project. However, should the power studies indicate that a power plant at the site is justified, the irrigation waterway would be enlarged or a second waterway added along with a power penstock tunnel . If a second tunnel is to be added, its construction would be limited to a point downstream from a control gate installed in a shaft near the axis of the dam. The remaining length of the tunnel and the penstock needed to complete the second waterway would be constructed in conjunction with the power plant.

Access Roads

5. Access to the left side of the site is by way of the existing Rizal-Pantabangan unimproved road. This road would be replaced with a modern improved highway and a bridge crossing the Pampanga River near Rizal.

Construction Power

6. To provide construction power at the dam site, a 37km long, 69 kv woodpole transmission line would be constructed, tapping the existing National Power Corporation (NPC) 230 kv line at Munoz. In

the event that power facilities would be installed at Pantabangan, this line would be replaced with a 230 kv steel tower transmission line, and the 69 kv line would be salvaged and used elsewhere on the NPC power grid system.

New Irrigation Systems

7. New lands to be provided with an irrigation system under the project consist of 12,000 ha in Area III and 19,300 ha in Area V (see map). Construction of the distribution system for Area III was started in 1967 by the NIA and has been completed. Additional works required to upgrade the system would be constructed as part of the project. (See Table 2). The new systems would have a turnout for approximately each 10 ha unit. Delivery to individual holdings from the turnout would be through farm ditches to be constructed by the project. All canals in the system, with the exception of certain reaches of the main canals, would be unlined. Sufficient checks and structures are included in the system to enable close control of water delivery which is essential for the successful production of the new rice high yielding varieties.

Main Canals

8. Two main canals would supply the new lands, as well as supplement the supply to existing irrigated lands. Diversion Canal No. 1 would divert from the existing Pampanga system main canal a short distance downstream from the Rizal Diversion Dam and continue westward to serve about 25,000 ha of new lands. Its construction would involve 26 km of earthwork, 2 km of cut and cover section, a siphon at the Talavera River crossing, canal check and turnout structures and maintenance roads along both banks.

9. The second new main canal, Diversion Canal No. 2, diverts from the Pampanga-Bongabon main canal, a short distance downstream from the Pampanga-Bongabon Diversion Dam. Construction of this canal was undertaken by the NIA in 1967 and, with the exception of roadway surfacing, installation of gates and concrete lining in certain reaches, the works are completed. This canal generally parallels the right bank of the Pampanga River and is about 42 km long. The canal would serve about 16,500 ha of land, including the 12,000 ha of new lands in Area III. Remaining work on this canal would be carried out by contract to be let after international competitive bidding and is included in the proposed loan.

Modification of Existing Diversion Dam

10. The main canal take-off at Rizal Diversion Dam would be enlarged to increase its capacity from 33 m^3/sec to approximately 65m^3/sec.

This would be accomplished by a 1.08 m heightening of the existing diversion dam overflow crest in order to create additional head through the headworks structure, and by reducing canal losses and salvaging additional head by enlarging and lining about 1.0 km of the canal down to its juncture with the new canal entrance. Similar modifications would be made at the Pampanga-Bongabon Diversion Dam in order to increase the diversion capacity from 34.5 m^3/sec to 40.5 m^3/sec. This would be accomplished by a 0.2 m heightening of the existing diversion dam overflow crest and by a 1.4 m widening of the main canal for a distance of 2.4 km.

Rehabilitation and Improvement of Existing Irrigation Systems

11. The existing NIA irrigation systems in the project area serve about 46,000 ha and would be rehabilitated and improved to bring them up to the standards of the new systems (see Table 2).

Project Facilities

12. A permanent project headquarter would be constructed in Cabanatuan City. The headquarter would also serve as an operation and maintenance district office and would include a central repair shop. Three additional operation and maintenance offices would be set up at San Jose, Talavera and Santa Rosa in addition to an installation at the dam site to operate the reservoir. The various field offices would be linked by a communication network.

Table 1

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Statistical Data on Reservoir, Dam, Spillway and Outlet Works

Reservoir:

Sediment storage	130 Mm^3
Inactive 1/	188 "
Irrigation and power 1/	1,627 "
Flood control	486 "
Sub-total	2,431 "
Surcharge	1,004 "
Total	3,435 Mm^3
Reservoir Area - at top of surcharge pool	8,900 ha
- at top of flood control pool	6,930 ha
- at top of conservation pool	6,020 ha
- at top of inactive storage	1,900 ha

Dam:

Type	Zone Fill
Height above stream-bed	110.5 m
Crest length	920.0 m
Crest elevation	238.5 m
Maximum water surface elevation	235.5 m
Top of flood control pool	228.8 m
Top of conservation storage	215.3 m
Top of inactive storage 1/	172.1 m
Volume of embankment	9,500,000 m^3

Spillway:

Type	- inclined chute and tunnel
Gates	- 2 radical gates, 6 x 12.8 m
Design Capacity - at Elev. 215.3	- 260 m^3/sec
at Elev. 222.8	- 1,100 "
at Elev. 235.5	- 1,960 "
Spillway crest elevation	- 210.0 m
Elevation top of spillway gates	- 222.8 m

1/ On the basis that power generation would be included in the project plan. If power is omitted, these capacities would be converted to irrigation use. This space also includes about 10 Mm^3 for domestic water supply.

Table 1 (continued)

Outlet Works:

Type	- 4.25 m diameter outlet pipe in tunnel
Controls	- two 84" hollow jet valves discharging into stilling basin
Capacity	- 105 m^3/sec at minimum reservoir level
Auxiliary outlet works	- 2.25 m diameter pipe in spillway tunnel plug
Auxiliary outlet works capacity	- 20 m^3/sec at reservoir, Elev. 147
	- 70 m^3/sec at reservoir, Elev. 172

Table 2

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Construction Work On Irrigation System

		New Irrigation System 1/		Existing Irrigation System		Total
Item	Unit	III	V	I & IV	II	
Area	ha	12,000	19,300	34,200	11,500	77,000
Canals and laterals	km	240	276	700	234	1,450
Gate controlled farm turnouts	No.	1,200	1,930	3,420	1,150	7,700
Farm ditches	km	600	965	1,370	500	3,435
Operation and Maintenance and Feeder roads	km	160	260	455	155	1,030
Drains	km	50	55	140	50	295

1/ Area III has been partially completed by NIA and the works included in the above table represent additional works required to bring the area up to the standards set for the project.

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Hydrology

Water Supply

1. The project would derive its main water supply from Pampanga River regulated by storage at Pantabangan reservoir. Two major tributaries, the Digmala and Coronel, enter the Pampanga River above the existing Pampanga-Bongabon Diversion Dam and would also supply water for project use. Flows of the Talavera River would be available for use on areas served by diversions from that stream. Stored water from Pantabangan Reservoir would be delivered to provide the dry season supply, except the 5,000 ha lying above Diversion Canal No. 1. All these rivers have essentially the same flow pattern, and are influenced by the distinct dry and wet rainfall seasons. Low flows are normally experienced in the period November-June, while the major portion of the annual flow, about 75%, occurs in the wet months July through October.

2. The Pampanga River has a drainage area of about 845 km^2 above the Pantabangan Dam site. A gauging station was established about 3 km upstream from the dam site in April 1959, and continuous records are available from that date. An estimate of flows for the period 1949 to April 1959 was synthesized by correlation with other records. The flows for the period 1949 through 1965 as estimated and recorded are given in Table 1.

3. Gauging stations have been operated since 1959 on the Talavera River at Lomboy, the Digmala River at Labi and the Coronel River at Bongkerohan. These stations reflect inflow to the project area and are above major irrigation diversions. Wet season flows of these streams will be largely unutilized. Dry season flows to the extent available will augment the releases from Pantabangan Reservoir and allow a larger area to be irrigated than that which can be served dependably by Pantabangan Reservoir alone.

Water Requirements

4. The cropping pattern assumed for the project is based on two crops of paddy in each calendar year. The planting and harvesting dates are geared to the wet and dry seasons, with the dry season irrigation terminating around April 1 prior to harvest. Under this schedule, there would be about two months without irrigation demand during April and May, at which time all maintenance works could be

performed on the distribution system in the dry. The schedules for the two crops, showing the beginning and ending dates for the various field activities, would be as follows:

	Wet Season	Dry Season
Land Preparation	May 24 - July 15	Nov. 1 - Dec. 15
Planting	June 15 - July 15	Nov. 18 - Dec. 15
Harvest	Oct. 28 - Nov. 27	Apr. 2 - May 2

Project water requirements for each month were determined on the basis of the above cropping calendar and the consumptive use per crop described below:

	Dry Season		Wet Season
A. Land Preparation (20 days)	mm		mm
Saturation	51		76
Submergence	51		51
Evaporation	94		99
Deep percolation	64		63
Sub-total	260		289
Total Land Preparation		549	
B. Transplant to harvest (100 days of irrigation)			
Evapotranspiration 1/	639		410
Deep Percolation	292		274
Sub-total	931		684

For Year:

Total for Growing Season	1,615
Land Preparation plus Growing Season	2,164
10% Waste on Farm	216
Farm Water Requirement	2,380
Less Effective Rainfall (average)	980
Farm Delivery Requirement	1,400
Conveyance Losses 30%	600
Diversion Requirement	2,000

1/ Evapotranspiration during the growing season is taken as equal to the open pan evaporation for the particular month.

Operation of Pantabangan Reservoir

5. Several operation studies were made for Pantabangan Reservoir with various levels of irrigation demand imposed on the reservoir. The studies were made using inflows into the reservoir as estimated and gauged for the period 1949 through 1965, and imposing a variable irrigation requirement representing various sizes of service area. The per hectare diversion demand for irrigation was determined on a month by month basis for the same period using the recorded rainfall for the month to derive the required water to be supplied by irrigation. Differing assumptions were also used on active capacity of the reservoir useable for irrigation. The studies take only into account water supply from Pantabangan Reservoir and disregard the additional water which would be available from the Talavera, Digmala and Coronel inflows.

6. In all the studies, it was found that the critical years during the period under review were 1956, 1959 and 1960. Shortages in irrigation water were experienced when larger irrigation demands were imposed. The results of the studies were summarized as follows:

Results of Operation Studies for Irrigation Only

Active Capacity for irrigation	Service area	Shortages Mm^3 1956	1959	1960	Total
1628	60,000	0.0	0.0	0.0	0.0
1629	63,000	6.8	0.0	48.7	55.5
1628	65,000	74.7	0.0	138.6	213.3
1810	62,000	0.0	0.0	0.0	0.0
1810	68,000	33.2	115.0	203.5	351.7
1810	70,000	137.1	228.7	238.2	604.0

7. The shortages of 1956 occurred in June and July and are the result of low reservoir inflow of 1955 and delay of start of rains until August 1956. A similar situation existed in 1959. The shortages of 1960 occurred in February and March during the dry season irrigation.

8. A second series of operation studies were made where production of firm power was included in the project. These showed that, if water were released at times of no or reduced irrigation demand in sufficient quantities to generate 20 MW at 30% plant factor (7.2 hours per day), the same level of shortages as for the irrigation only studies could be achieved if the service area were reduced by 5,000 ha.

Size of Project and Adequacy of Supply

9. The level of shortages in irrigation supply experienced at 70,000 ha with 1,810 Mm^3 active storage, or at 65,000 ha with 20 MW

generation at 30% plant factor, are acceptable. In years of shortage, a restriction could be placed on the area to be planted for the dry season so that all areas planted would be assured a full supply. Such shortages would occur with a frequency of about one in ten years, but could occur in successive years as in 1959 and 1960. Since decision on inclusion of power in the project will not be taken until the power study has been completed (para 4.20) the lower figure of 65,000 ha is taken as the area which could be furnished an adequate dry and wet season supply from Pantabangan Reservoir.

10. Examination of flow records of the Digmala and Coronel Rivers indicate that in the dry season these rivers could dependably supply about 7,000 ha in addition to the area supplied from Pantabangan storage releases. The nominal project area then, for which there is an adequate water supply, is 72,000 ha in the dry season. The 5,000 ha of land served from the Talavera and lying above Diversion Canal No. 1 can be irrigated in the wet season, but would not have a dependable dry season supply. Thus, the project would provide a dependable water supply to 77,000 ha in the wet season and 72,000 in the dry.

11. The above determination of project area which is limited by the water supply is conservative and leaves a considerable margin of safety. If power is not developed, or is developed on the basis of irrigation releases only, a larger area could be served without increasing shortages. Also, if full advantage is taken of Talavera, Digmala and Coronel flows, more stored water would be available for use at critical times.

Quality of Water

12. Tests of water samples collected at the Pantabangan Dam site indicated uniformly good quality of water with total dissolved solids less than 300 ppm.

Floods

13. The inflow design flood developed for the project represents a maximum probable flood and was derived by imposing a design typhoon type storm on the drainage basin above the reservoir and estimating the resultant runoff by unit graph procedures. It shows a peak inflow of 12,045 m^3/sec and a 6 1/2 day volume of 1,646 Mm^3. This flood is adequate for design purposes to insure safety of the structure.

Sediment

14. The 100 year sediment deposition in the reservoir would be approximately 130 Mm^3, or less than 6% of the active reservoir capacity. This figure is based on analysis of sediment samples collected over a period of time at the gauging station 3 km upstream from the dam site. Sediment accumulation in the reservoir would not be in sufficient quantity to interfere with project operation in the foreseeable future.

Table 1

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Pampanga River Flows at the Pantabangan Dam Site

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1949	37	15	10	7	5	22	163	212	294	273	104	80	1,222
1950	69	20	13	13	65	76	300	583	199	472	89	35	1,934
1951	20	9	4	6	89	110	176	531	340	120	83	43	1,531
1952	17	11	6	13	49	89	78	299	245	232	93	36	1,168
1953	22	9	7	7	9	241	362	584	298	206	189	92	2,026
1954	35	13	11	13	15	21	48	249	293	204	230	108	1,240
1955	25	12	6	5	10	17	71	142	176	149	59	11	674
1956	18	7	6	12	26	20	57	149	343	228	221	157	1,244
1957	75	28	18	10	7	94	239	248	457	257	163	74	1,670
1958	30	17	13	8	9	102	111	194	431	157	88	34	1,194
1959	21	11	9	4	10	7	57	221	186	243	268	55	1,092
1960	17	15	23	7	14	108	90	868	399	347	54	26	1,968
1961	14	6	12	6	34	94	362	275	240	183	56	31	1,313
1962	13	6	7	9	8	16	310	324	365	143	61	26	1,288
1963	14	12	8	5	5	171	281	335	394	97	29	22	1,373
1964	14	9	8	6	15	49	90	291	210	208	140	224	1,264
1965	76	30	20	18	31	118	391	181	307	113	51	27	1,363
Mean	30	14	11	9	24	80	187	335	305	213	116	64	1,388
% of Annual	2	1	1	1	2	6	13	24	22	15	8	5	100

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Cost Estimate

	Local Costs	Foreign Exchange Costs	Total Cost
	(US$ Million Equivalent)		
I. Pantabangan Dam and Reservoir			
Dam and Structures	6.9	12.7	19.6
Access Roads and Bridges	0.2	0.5	0.7
Construction Power Line	0.1	0.4	0.5
Right of Way Acquisition	4.7	-	4.7
Relocations	0.9	-	0.9
Reservoir Clearing	0.4	-	0.4
Service Facilities	0.3	0.2	0.5
Engineering and Administration	3.0	-	3.0
Sub-total Dam and Reservoir	16.5	13.8	30.3
II. Irrigation System and Roads			
Modification of existing diversion dams and headworks structures	0.2	0.2	0.4
Diversion Canal No. 2 and Irrigation System Area III 1/	1.0	-	1.0
Completion of Irrigation System Area III 1/	0.7	0.4	1.1
Completion of Divers. Canal No. 2 1/	0.3	0.2	0.5
Diversion Canal No. 1	0.9	1.0	1.9
Rehabilitation of Irrig. System Areas I, II & IV	2.1	2.0	4.1
Construction of Irrigation System Area V	1.6	1.2	2.8
Roads	1.8	2.2	4.0
Permanent Project Buildings and Compounds	0.2	-	0.2
Irrigation Project Service Facilities	0.2	0.1	0.3
Engineering and Administration	1.8	-	1.8
Sub-total Irrigation System and Roads	10.8	7.3	18.1
III. Operation & Maintenance Equipment	0.2	1.5	1.7
IV. Consulting Services	.3	1.5	1.8
Sub-total I through IV	27.8	24.1	51.9
Contingencies about 20%	5.7	4.9	10.6
Total Investment Cost	33.5	29.0	62.5
V. Interest During Construction @ 7.0%	-	5.0	5.0
TOTAL Project Cost	33.5	34.0	67.5

1/ Construction of Diversion Canal No. 2 and the irrigation system in Area III (see map) have been partly completed by contract and force account. The cost of these works is shown as local currency expenditures. Remaining works on these features would be constructed by contract to be let following international competitive bidding procedures and are included in the loan.

Table 1

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Equipment, Materials and Supplies

Construction Equipment and Supplies For Force Account Work	Quantity	Total Cost CIF US$'000
Dragline 1/2 cu. - 40' boom	4	140
Hydraulic excavator	4	120
Tractor w/angle blade dozer (Medium)	4	140
Motor grader 110 hp	3	75
Wheeled tractor w/ ditcher and backhoe attachments	8	160
Sheepsfoot roller	2	5
Pull type rubber tired roller	3	6
Dump trucks	14	112
Flat bed cargo trucks	6	42
Front end loaders 1/2 cu. yd.	4	48
Equipment transporter 25 ton	1	30
Pickup trucks 3/4ton	6	24
Concrete mixers 1/2 cu. yd.	12	24
Vibrators	12	7
Pumps 2" to 6"	6	18
Fuel and service trucks 4x6 2 ton	3	60
Mobile shop repair truck	1	20
Misc. tools and equipment	lump	10
		1,041
Spare parts 15%		159
		1,200
Supplies for structures and reinforcement metal work and gates		450
		1,650
Contingencies 20%		350
TOTAL		2,000

Table 2

PHILIPPINES
UPPER PAMPANGA RIVER IRRIGATION PROJECT

Equipment, Materials and Supplies

Operation and Maintenance Equipment	Quantity	Total Cost CIF US$'000
Dragline 5/8 cu. - 50' boom	3	120
Dragline 3/8 cu. - 40' boom	3	90
Hydraulic Excavator	3	90
Tractor w/angle blade dozer (Medium)	3	105
Tractor w/angle blade dozer (Light)	6	120
Motor grader 110 hp	6	150
Flatbed cargo trucks	12	84
Dump trucks 4 cu.	18	144
Front end loader 1/2 cu.	6	72
Low bed trailer with tractor 25 ton	2	60
Pickup trucks 3/4ton	12	48
Station Wagon	3	12
Truck 4x4 ¼ton	12	36
Pull type rubber tire roller	3	6
Concrete mixer	6	12
Air compressor w/tools 105 cfm'	3	15
Portable vibrators	6	4
5 kw generator	6	8
Welder, 300 cmp	3	5
Pumps 2" to 6"	12	36
Submersible sand pump	6	36
Mobile shop - 4x6 2 ton, complete	3	90
Stationary shop, Mech. equipment	1	70
Shop equip. and misc. tools		30
Miscellaneous and spare parts		66
Subtotal		1,500
Contingencies 20%		300
TOTAL		1,800

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UPPER PAMPANGA RIVER IRRIGATION PROJECT

Present and Projected Yields, Production and Returns

	Area	Paddy Yield		Total Paddy Production		Paddy Price	Production Cost 1/	Return to Farmer
	ha	cavans/ha	Kg/ha	'000 cavans	'000 m ton	₱/cavan	₱/ha	₱/ha
I Wet Season								
A. Before Development								
Irrigated	46,000	40	1,760	1,840	80.96	15	350	250
Rainfed	31,000	28	1,232	868	38.19	15	350	70
TOTAL	77,000			2,708	119.15			
B. After Development								
Irrigated	77,000	87	3,828	6,699	294.76	15	745	560
II Dry Season								
A. Before Development								
Irrigated	7,000	40	1,760	280	12.32	15	350	250
B. After Development								
Irrigated	72,000	87	3,828	6,264	275.62	15	745	560

	Cultivated Area	Total Paddy Production		Gross Value of Production	Net Value of Production to farmers
	ha	'000 cavans	'000 m ton	₱ million	₱ million
III Total for Project					
A. Before Development	84,000	2,988	131.4	44.82	15.42
B. After Development	149,000	12,963	570.38	194.44	83.44
C. Increment (B-A)	65,000	9,975	438.91	149.62	68.02

1/ Production costs exclude land rent and water charges. All labor requirements - whether family or hired - have been costed at market value.

Paddy Production Budget

Production Costs Per ha **Per Crop**	Present	Estimated Future
	- - - - ₱/ha	- - - - - -
A. Direct Costs		
Seed	20	30
Land Preparation	60	100
Transplanting	50	60
Weeding	60	100
Fertilizer	30	135
Chemicals	20	100
Harvesting and Threshing	100	200
Hauling	10	20
Sub-total	350	745
B. Indirect Costs 2/		
Water Charges	25	75
Land Rent	120	60
Sub-total	145	135
TOTAL PRODUCTION COSTS	495	880
Return Per ha Per Crop		
Yield (cavans/ha) 1/	40	87
Price (₱/cavan)	15	14
Gross Return	600	1,218
Net Return	105	338
Return Per Farm of 3.2 ha (double cropped) 3/		
Gross Return	1,920	7,795
Total Production Costs	1,584	5,632
Net Returns	336	2,163
US$ Equivalents	86	555

1/ Present yield is for irrigated paddy; on rainfed fields average yield is about 28 cavans/ha. The future yield represents an average of the wet and dry season crop to be attained 11 years after **the adoption of the high yielding varieties by the farmer.**

2/ Future indirect costs are divided equally between the two crops.

3/ Present return is for a single crop since there is no double cropping in the area

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Organization and Management

1. Up to 1964, responsibility for the national irrigation systems in the Philippines was in the hands of the irrigation division of the Bureau of Public Works. At that time, in an effort to accelerate and intensify irrigation development in the country, all the division's functions, duties, personnel and assets and liabilities were transferred and assigned to a new agency, the National Irrigation Administration (NIA). The NIA which was set up under Republic Act No. 3601 has the following powers and objectives:

"(a) To investigate, study, improve, construct and administer all national irrigation systems in the Philippines;

(b) To investigate all available and possible water resources in the country for the purpose of utilizing the same for irrigation, and to plan, design and construct the necessary projects to make the following ten to twenty-year period as the Irrigation Age of the Republic of the Philippines; and

(c) To collect from the users of each irrigation system constructed by it such fees as may be necessary to finance the continuous operation of the system and reimburse within a certain period not less than twenty-five years the cost of construction thereof."

2. Overall responsibility for NIA is vested in a Board of Directors composed of the following members: The Secretary of Public Works and Communications, who is also the Chairman; the Secretary of Agriculture and Natural Resources; the Chairman of the Board of Directors of the National Power Corporation; the Director of Plant Industry; the Commissioner of Agricultural Productivity; and two other members appointed by the President of the Philippines for a term of six years. The Board of Directors has the following power and duties:

"(a) To prescribe, amend and repeal, with the approval of the President of the Philippines, rules and regulations governing the manner in which the general business of NIA may be conducted;

(b) With the approval of the President, to appoint, and fix compensation of, an Irrigation Administrator and an Assistant Irrigation Administrator, and by a majority vote of all the members, to suspend and/or remove the said officials for cause, with the approval of the President; and

(c) To approve, subject to the final action of the President, the annual and/or supplemental budgets of the NIA which may be submitted to the Board by the Irrigation Administrator."

3. The management of NIA's affairs is the responsibility of the Irrigation Administrator, who has the following powers and duties:

"(a) To direct and manage the affairs and business of the NIA, on behalf of the Board of Directors and subject to its control and supervision;

(b) To sit in all meetings of the Board and participate in its deliberations, but without the right to vote;

(c) To submit within sixty days after the close of each fiscal year an annual report, through the Board of Directors, to the President of the Philippines; and

(d) With the approval of the Board, to appoint and fix the number of such subordinate personnel as may be necessary for the proper discharge of the duties and functions of the NIA, and, with the approval of the Board, to remove, suspend, or otherwise discipline, for cause, any subordinate employee of the NIA."

4. NIA's organization structure is presented in the attached chart. A review of this structure as well as the agency's financial arrangements and other operational aspects would be undertaken by a management consultant firm (see para 6.03).

PHILIPPINES UPPER PAMPANGA RIVER IRRIGATION PROJECT
NIA ORGANIZATION CHART

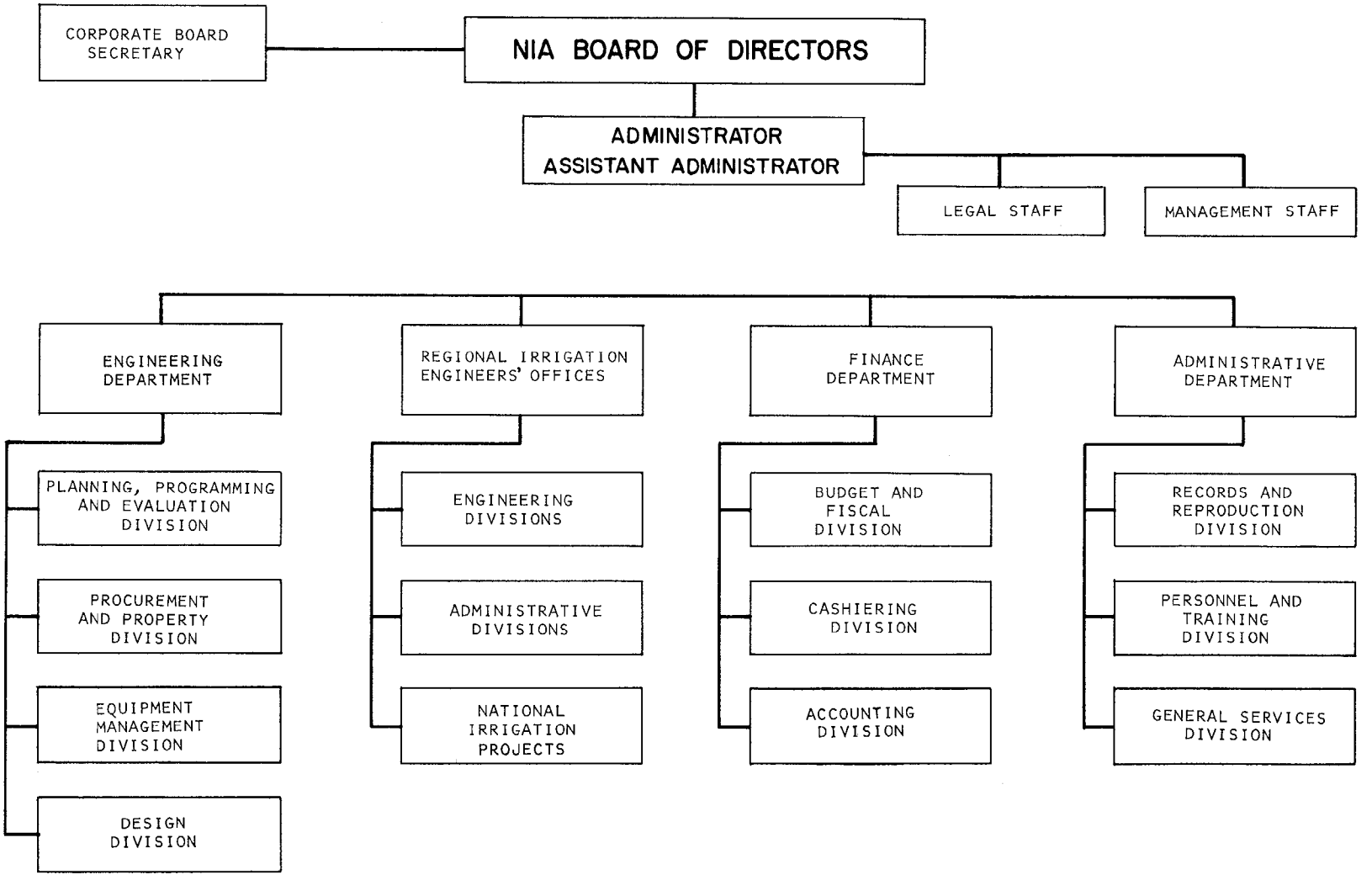

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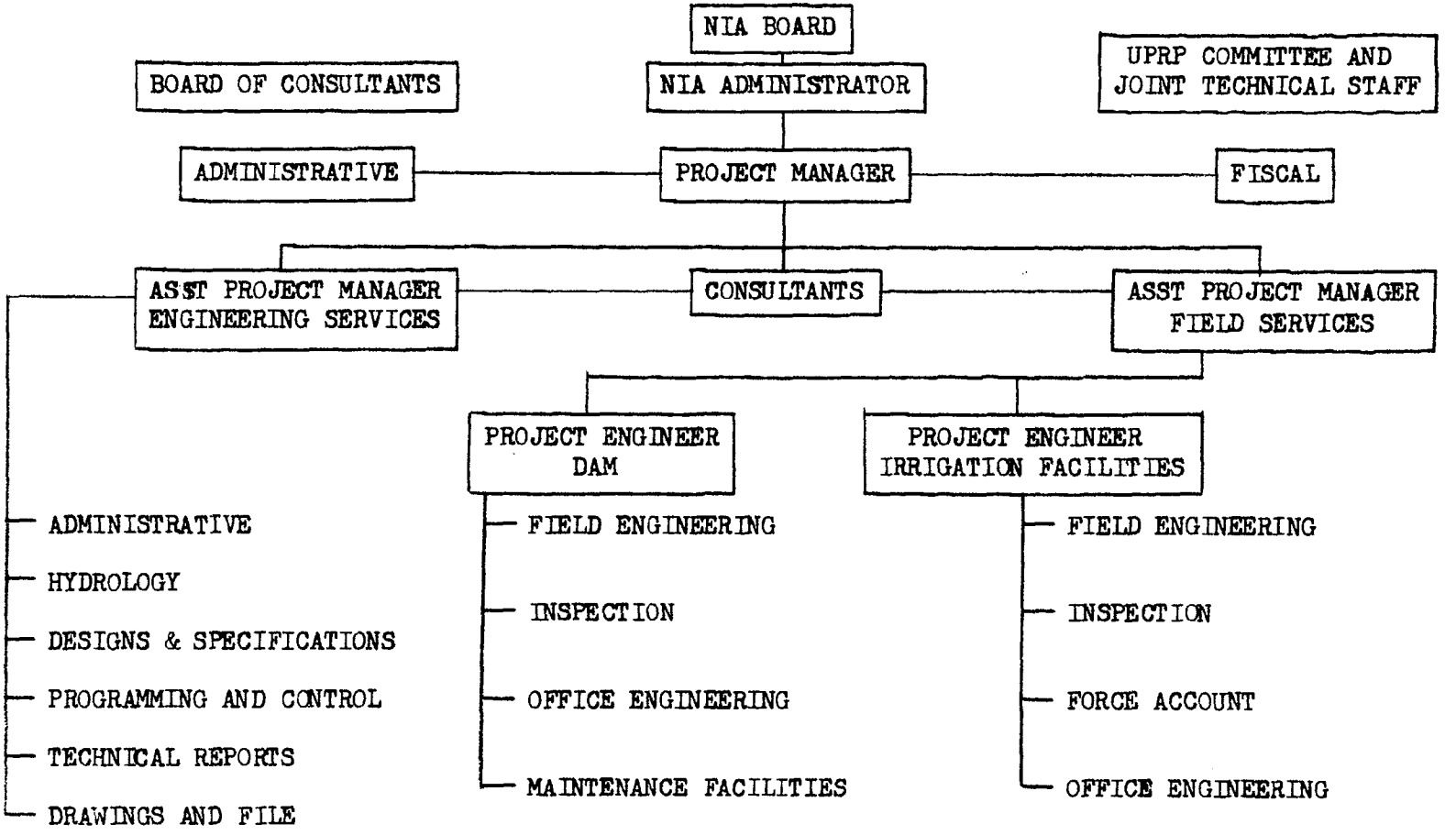
CHART I ANNEX 7

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

PROPOSED ORGANIZATION FOR PROJECT CONSTRUCTION

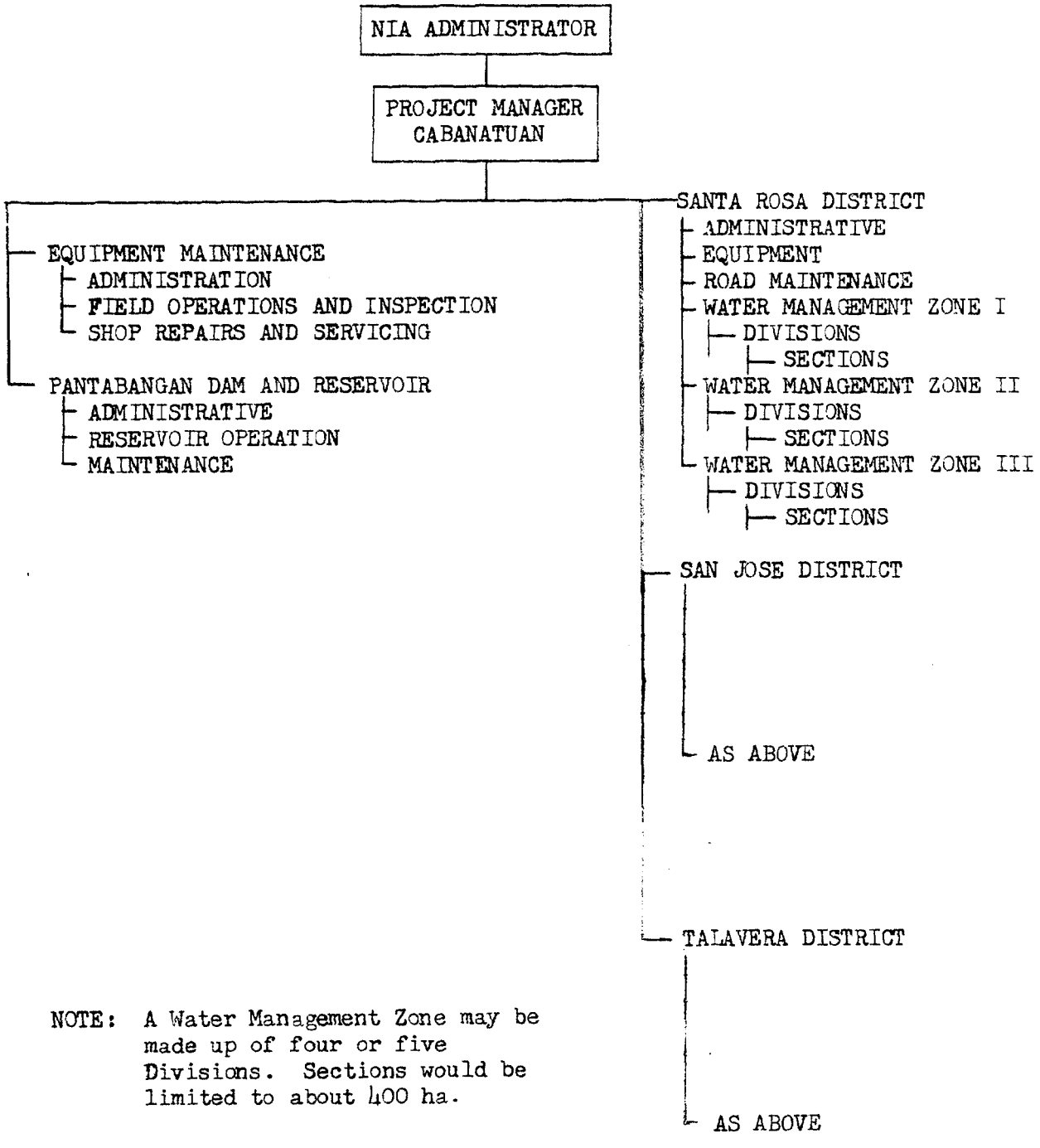


ANNEX 7
Chart 2

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

PROPOSED ORGANIZATION FOR OPERATION AND MAINTENANCE



NOTE: A Water Management Zone may be made up of four or five Divisions. Sections would be limited to about 400 ha.

PHILIPPINES

UPPER PAMPANGA RIVER IRRIGATION PROJECT

Economic Rate of Return

1. For the purpose of economic analysis, a total project investment cost of US$ 62.5 million was adopted. Annual operation and maintenance costs charged against the project represent the increase to the level projected at full development (US$ 950,000) over the current rate of expenditure (US$ 230,000). Farm production costs were adopted from Annex 6 with all farm labor requirements - family and hired - treated as a production cost at prevailing and projected wage levels.

2. The rice price used for economic analysis is US$ 126 per m ton (the equivalent price in Manila would be about US$ 2.00 higher; the difference is accounted for by transport costs). This price was derived from the average import price paid by the Philippines Government during 1961-67 (US$ 124 per m ton of milled rice CIF Manila), and current projections of world market price for rice in 1975 (US$ 140 per m ton of milled rice 5% broken FOB Bangkok). In order to convert the rice price into a paddy price, the prevailing milling efficiency of 65% was adopted. Assuming that milling costs would be covered by the value of by-products, the equivalent paddy price to US$ 126 per m ton of milled rice would be about US$ 82 per m ton (₱ 14 per cavan). Using a rice price of US$ 126 per m ton and milling efficiency of 65%, returns from the project would be as follows:

	Paddy Production	Milled Rice Equivalent		Production Cost	Net Value of Production to economy
	'000 m ton	'000 m ton.	US$ million	US$ million	US$ million
Present	131.5	85.5	10.8	7.5	3.3
Future	570.4	370.8	46.7	28.4	18.3
Increment	438.9	285.3	35.9	20.9	15.0

3. The shift from traditional rice varieties to the high-yielding varieties was projected to occur over the next six years for the wet season crop (i.e. the high yielding varieties would be introduced following the completion of rehabilitation works or the construction of a new system). In the case of dry season cropping, all lands brought under cultivation were assumed to be planted to the new varieties. The hectarage to be planted to the high yielding varieties (also the basis for computing incremental benefits) would be as follows:

Project Year	Wet Season		Dry Season[1/]
	Existing Systems	New Systems	
5	20,000	12,000	-
6	35,000	20,000	-
7	46,000	31,000	-
8	↓	↓	40,000
9			50,000
10			65,000

1/ Dry season area excludes the 5,000 ha above Diversion Canal No. 1, which would not be served by the project, and 7,000 ha already under irrigation during the dry season.

The projected yield level would be reached gradually over an 11 year period following the introduction of the high yielding varieties in any given area, while projected production costs for the same area would be incurred in the eighth year.

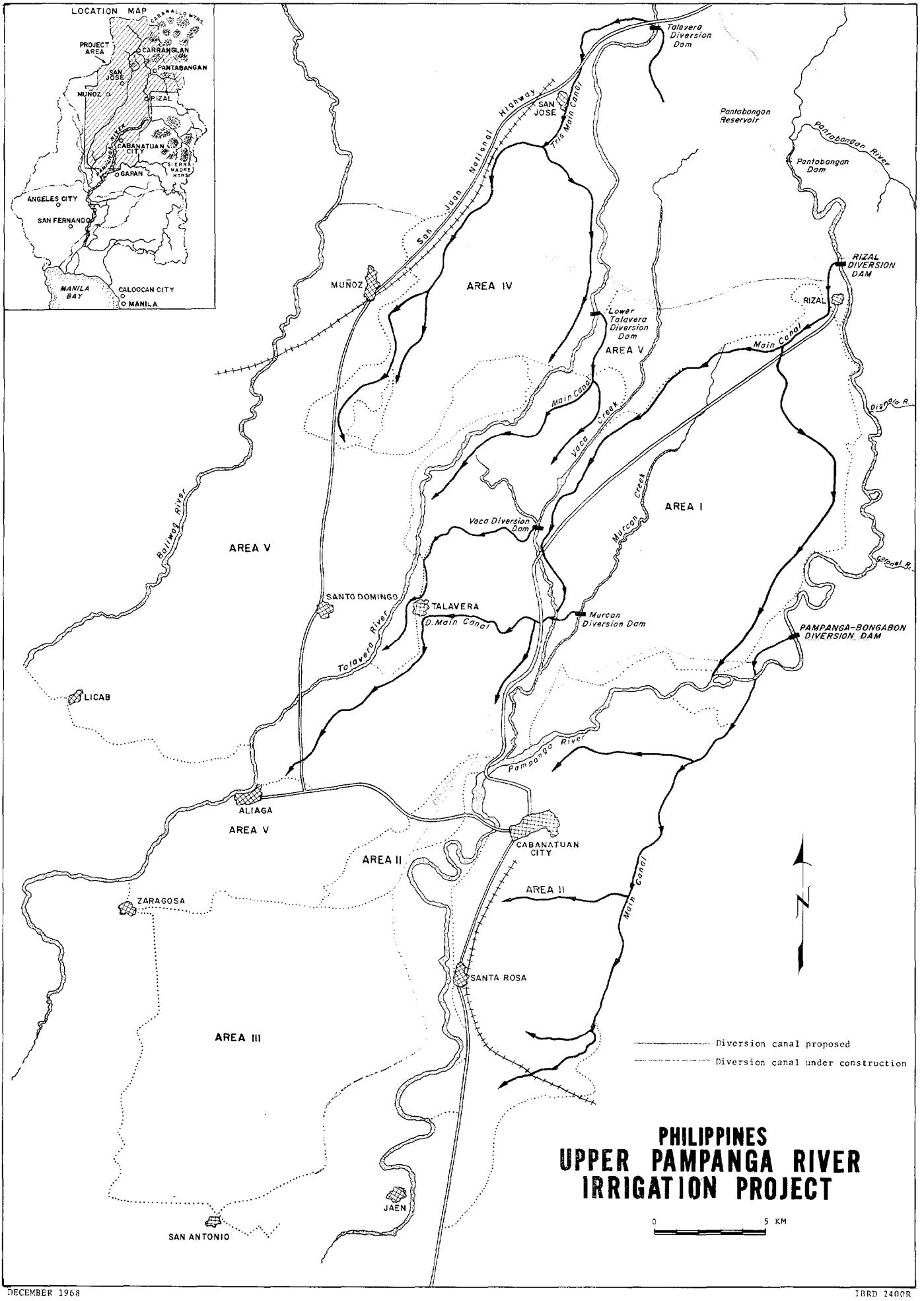
4. Flood control benefits were computed on the basis of area flooded, the frequency of each flood and corresponding annual losses. The flood reduction which could be achieved by use of the 486 Mm^3 space in Pantabangan Reservoir was then computed and used as the basis for flood control benefits. Annual benefits would be about ₱ 2 million (US$ 500,000) while the incremental cost of flood protection is US$ 2.5 million. The rate of return on this phase of the project taken in isolation would be about 12%.

5. The rate of return to the economy from the project, excluding power, would exceed 13%. The incremental net benefits and project cost streams used in calculating this rate are presented below:

Year	Project Cost 1/	Incremental Benefits 2/
	US$ million	
1	1.2	-
2	2.3	-
3	8.2	-
4	10.2	0.4
5	14.6	1.1
6	16.6	1.8
7	10.8	4.5
8	1.0	6.2
⋮	⋮	7.5
⋮	⋮	8.7
⋮	⋮	9.9
⋮	⋮	10.9
⋮	⋮	11.6
⋮	⋮	12.5
⋮	⋮	13.1
⋮	⋮	14.0
⋮	⋮	14.5
⋮	⋮	14.6
⋮	⋮	14.8
⋮	⋮	15.0
⋮	⋮	⋮
⋮	⋮	⋮
50	↓	↓

1/ Project costs from the eighth year onward represent annual incremental operation and maintenance costs.

2/ Excluding the specific flood control benefits (see para. 4) since flood protection is required to attain the level of yields projected in this report.



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