The construction of the Work Division-I and Division-II will be commenced in January 1984 and completed in June 1987 within 4 dry seasons. The irrigation water will be supplied from November 1987. The construction of the Work Division-III is commenced in January 1987 and completed in December 1989 within 3 years.

4.2.6 Cost Estimate

4.2.6.1 Construction Cost

The construction cost comprises direct construction cost, engineering cost, land aquisition cost and cost for operation and maintenance facilities. All of the costs are estimated based on the current prices in September 1981. A physical contingency of the cost estimate is 15% of the construction cost in principle. 10% of the construction cost is considered as a physical contingency for engineering cost. No physical contingency is taken into account for manufacturing cost of gates for the diversion dam. A price contingency applied is assumed 6.5% per annum for the foreign currency component and 10% per annum for the Peso currency component. Further, the ratio of foreign and Peso currency components of each unit price is estimated on the basis of the following assumption referring to NIA criteria.

(Unit: %)

Item	Foreign Currency	Peso Currency
Cement	75	25
Steel Bar and Hardware	80	20
Fuel and Oil	50	50
Equipment Rental	75	25
Sheet Pile and Steel Pile	100	0
Labour	0	100
Gate for Diversion Dam	100	0

The direct construction cost is estimated based on the detail unit price analysis and quantity calculation of the project works.

The total construction cost of the project facilities is estimated to be ₱432.5 million by financial basis, consisting of ₱191.8 million equivalent to foreign currency and ₱240.7 million of Peso currency.

The price contingency is estimated taking into account of annual price escalation rates and the cost disbursement schedule based on the construction schedule. Thus, the financial construction cost for the implementation of the project is estimated to be ₱628.1 million consisting of ₱256.5 million equivalent to foreign currency and ₱371.6 million of Peso currency as shown in Table 4.2.7.

4.2.6.2 Operation and Maintenance Cost

Annual operation and maintenance costs at the full stage of the project are estimated at ₱4.0 million comprising salaries and wages of staff and labours, office expenses, operation cost of vehicles and equipments, repairing cost of the project facilities.

4.2.6.3 Replacement Cost

Gates and attachments and the O&M equipments are to be replaced at a certain time within 50 years of the project life. The useful life is assumed to be 25 years for the gates and attachments and 10 years for the O&M equipments, respectively.

4.2.7 Irrigation Benefit and Farmer's Economy

4.2.7.1 Irrigation Benefit

Irrigation benefit to be expected is defined as the difference of primary profit from crops between future with project and without project conditions. On the basis of the estimated production cost and gross income, primary profit for crop per ha is calculated both on future with and without project conditions as follows:

(Unit: Peso)

Item	With Project			Without Project		
	Gross Income	Production Cost	Primary Profit	Gross Income	Production Cost	Primary Profit
1) Paddy						
Irrigated (wet)	8,415	3,206	5,209	4,413	2,422	1,991
Irrigated (dry)	9,350	3,334	6,016	4,899	2,534	2,365
Rainfed (wet)	-	-	-	3,871	2,273	1,598
2) Mongo beans	1,840	1,097	743	1,840	1,097	743

Applying the primary profit per crop estimated above the crop area, total primary profits accrued from agricultural production for the irrigation project are estimated both on without and with project conditions. Based on this result, irrigation benefit is calculated. The benefit will be expected to increase linearly year by year and reach the full benefit in and after five years after the completion of the project. The irrigation benefit at the full stage is estimated at about ₱93.4 million.

4.2.7.2 Farm Economy

In order to assess the irrigation project from farmers' economy view point, analyses of farm budget for typical farmer are examined under both the future without project and the future with project conditions.

After the implementation of the irrigation project, year round irrigation will permit double cropping of paddy per annum for the entire project area and increasing unit yield of paddy to 5 ton per ha for dry season paddy and 4.5 ton per ha for wet season paddy, respectively. As a result, drastic increase on farm income in the future with project condition can be expected in the typical farmer. On the other hand substantial increase on farm income will be expected in the future without project condition. The typical farm budgets in both future without and with conditions are as shown below.

a) Without Project Condition

(Unit: $P10^3$)

Item	Single Crop of Paddy (Rainfed)	Single Crop of Paddy (Irrigated)	Double Crop of Paddy (Irrigated)
I) Gross Income	14.3	14.8	19.4
1) Farm income	5.3	5.9	11.3
2) Off-farm income	9.0	8.9	8.1
II) Gross Outgo	14.0	14.6	18.9
3) Production cost	3.6	4.2	8.5
4) Living Expenses	10.4	10.4	10.4
III) Net Reserve (Capacity to pay)	0.3	0.2	0.5
IV) Net Farm Income (1 - 3)	1.7	1.7	2.8

b) With Project Condition

Item		₱10³
I)	Gross Income	29.9
	1) Farm income	21.2
	2) Off-farm income	8.7
II)	Gross Outgo	26.5
	3) Production cost	13.0
	4) Living expenses	13.5
III)	Net Reserve (Capacity to pay)	3.4
IV)	Net Farm Income (1 - 3)	8.2

Farm incomes with project on the typical farm under single cropping of paddy will be expected to become about 4 times of that of without project condition and about 2 times on the typical farm under double cropping of paddy.

Net farm incomes with project on the typical farm on single cropping of paddy will be expected to increase 5 and about 3 times on the typical farm under double cropping of paddy.

Annual net reserve or capacity to pay will be ₱200 to ₱300 on single cropping farm and ₱500 on double cropping of paddy farm in without project condition and become ₱3,400 in with project condition.

The increased net reserve will offer incentives to the farmers and substantial capacity to pay will enable them to pay irrigation fee.

From the productivities of land and labor, it is expected that the irrigation project will highly improve such productivities to 49 ₱/man-day of labor productivity and 6,300 ₱/ha of land productivity.

CHAPTER 5 ORGANIZATION

5.1 Flood Control Project

5.1.1 Present Organization

The river administration in the Philippines is centralized under the Ministry of Public Works and Highways (MPWH), and the Ministry have responsibilities in flood control and drainage.

At present, the flood control works of the Pampanga River are being managed under an organization which was established for the implementation of the Pampanga River Control Project in 1950. The organization at present is shown in Fig. 5.1.1, and the Pampanga River Control System-Project Management Office (PRCS-PMO) is located in Apalit, Pampanga. At present, however, PRCS-PMO deals not only with the construction works but also the operation and maintenance of completed river facilities such as levee, bank protection, flood gate and so on.

5.1.2 Organization in Implementation Stage

The MPWH will entirely be responsible for the implementation of the project, and necessary consultations will be made to the organization concerned. The present organization will be developed for implementing the new project as shown in Fig. 5.1.2.

The MPWH will be the executing agency for the new project. The Minister will take charge of coordination with all the relevant government agencies and regional administrative organizations in implementing the project.

5.1.3 Organization for Operation and Maintenance

After completion of the flood control facilities, the operation and maintenance of those facilities will be entrusted to the PRCS-PMO under the control of the MPWH. The present organization of the PRCS-PMO will be able to conduct the operation and maintenance for the project.

At present, during flooding time, an emergency force is organized for flood fighting activities as shown in Fig. 5.1.3. This emergency force would be enforced to cover the whole new project area in the future.

5.2 Irrigation Project

5.2.1 Organization for the Project Execution

The National Irrigation Administration is given responsibilities for planning, developing, operating and managing all national irrigation systems in the country. NIA's powers are exercised by a Board of Directors and an Administrator. The Administrator is responsible for management of the agency and is assisted by four Assistant Administrators.

The NIA will become the executing agency for the Proposed Irrigation and Drainage Project. It will be responsible for design, construction of project works and supervision for the Project. The Assistant Administrator for Project development and implementation will be responsible for overall execution of the Proposed Project, who will coordinate activities of all relevant governmental agencies in connection with implementation of the Project.

The Project Execution Office will be established in the irrigation development area. A project manager of the proposed project will manage all field works in the Project Execution Office, assisted by three divisions, construction management division, administrative and accounting division and engineering division. Necessary staff will be supplied by the NIA. The proposed organization chart is as shown in Fig. 5.2.1.

5.2.2 Organization for Operation and Maintenance

5.2.2.1 O&M Office

For operation and maintenance purposes, operation and maintenance office will be established and the project would be administrated by a project manager after the implementation of the Project. The project manager will be responsible for management of the irrigation service area divided into five irrigation districts being assisted by four support divisions which deal with administration, collection of irrigation fee, operation and agricultural development. The proposed organization is illustrated on Fig. 5.2.2. Staff necessary for the office accounts for about 200 persons as shown in Appendix IX.

Water management will be carried out for the area more than 50 ha of terminal irrigation unit by the O&M office. One ditchtender will manage two irrigation units (100 ha), while one water management technician would supervise five ditchtenders (500 ha). One irrigation district supervisor would be in charge of a water management division with five water management technicians (about 2,500 ha). For effective operation of irrigation water supply, measuring device will be installed at one turnout in each irrigation unit (50 ha) at least and irrigation water is recorded. Further the O&M office will install office computer programed irrigation water distribution diagrams for the irrigation service area according to the irrigation schedule decided in the Coordination Committee mentioned later. It will provide radio operation networks in the irrigation services area in which branches of networks

will be established by each 500 ha of irrigation area. Each branch will be facilitated with one set of meteological gauging equipment. The staff of each branch, usually water management technician, will inform daily rainfall and discharge of water to the O&M head office through radio operation network. The head office will calculate and modify diversion water requirement at each irrigation block with 500 ha by the office computer on the basis of the said rainfall and cropping calendar prevailing in the blocks and will direct gate operation at each said block. Through water management technician, gate operation will be directed in the irrigation block at lower level.

From the standpoint of staffing, it is inevitable for effective water management that qualities of ditchtenders be upgraded. For the purpose special education program for ditchtenders will be carried out in one irrigation district, Arayat irrigation district (1,333 ha), where irrigation and drainage facilities will be completed first.

With regard to maintenance of irrigation and drainage facilities, the O&M office will maintain these facilities. Rehabilitation of large scaled structures in these facilities, however, will be executed as a new project.

As far as collection of irrigation fee is concerned, collection service division will collect irrigation fee through the Project Federation of Irrigator's Group in the final stage, however, the collection service division will collect fee from each irrigator's group with joint responsibility at the initial stage. Management of collection fee will be done by introduction of the office computer mentioned before which will registrate name of beneficiaries and other any items necessary for collection of fee.

5.2.2.2 Coordination Committee

Farm management is one of the most essential factors for success of the Project through extension services and credit supply. It is proposed for the purpose that coordination committee at the field level will be instituted among the Project Manager, representatives from irrigator's group, Region III of Ministry of Agriculture, CBP, PNB, ACA and LBP. The Project Manager will be appointed Chairman of the Coordination Committee.

Through the Coordination Committee irrigation schedule for the land of each irrigator's group and program of Masagana 99 will be planned and decided. Extension services for the beneficiaries will be provided through Region III office of Ministry of Agriculture. Credit services will be supplied through CBP, PNB, ACA and LBP. Water management will be executed under responsibility of the Project Manager.

5.2.3 Farmer's Organization

For the management, operation and maintenance of irrigation and drainage systems below terminal irrigation unit of 50 ha, irrigator's group (IG) will be organized by beneficiaries in the irrigation development area. The IG will be organized by each irrigation unit of 50 ha consisting of about 20 beneficiaries and 220 of IGs will be established in the area. For good coordination and cooperation, one-project federations of irrigator's groups will be established through affiliation of irrigator's groups taking into consideration canal network and organization of O&M office. Further governmental agencies (O&M office) and irrigator's groups will be closely interlinked through the liaison between a supervisor of each irrigation district and a representative of each irrigation district federation and through the liaison between water management technician of each 500 ha irrigation block and a representative of each irrigator's group in view of technical aspect for the project-wide irrigation water control. Administratively the inter-linkage will be realized through the participation of representatives of project federation of irrigator's groups and project manager in field coordination committee meetings.

With regard to implementation schedule of irrigator's groups, irrigation district federations and project federation, organization of these will be executed for the period of two years from July 1985 to June 1987 after preparation of parcellary maps in the irrigation development area as shown in Fig. 5.2.3.

From the social aspects, the irrigator's groups will be organized by farmers who live in same administrative unit of Barangay under the help of project manager and Barangay captain. In their institutional process, the Project Manager should hold meeting with beneficiaries and inform the beneficiaries that the proposed project will be constructed for their own benefit and on their part and it is their obligation to improve and make the project productive. And he should stress to them that project investments incurred are their money and in return they should partly pay their obligation and dues for maintenance of the project. In the meeting, the beneficiaries will take part in designing of farm ditches and farm drains. Through the meeting, mutual agreement between the beneficiaries and the Project Manager will reach with regard to right of way of the canal facilities, how to manage irrigation water, collection of irrigation fee, etc.

CHAPTER 6 EVALUATION

6.1 General

The project formulation for both flood control and irrigation projects has been based on the development goal containing i) improvement of flood conditions in the South Candaba and lower coastal area, ii) rice production increase both for self sufficiency in the project area and rice supply to Metro Manila, iii) improving income and living standards of the rural population and iv) promoting employment.

In flood control sector, plan with 20-year design flood was studied. The irrigation project with diversion dam was studied for the area of 11,000 ha in net service area.

In this chapter, the evaluation of these projects is carried out in view of economic, financial and socio-economic aspect. Details are explained in Appendix X, Evaluation.

6.2 Flood Control and Irrigation Benefits

Flood control benefits are the expected reduction of flood damages for farm crops, fisheries, private properties, public facilities and so on, and the expected development effect for the land having not been utilized during the wet season. Irrigation benefits are expected to be the increment of farm income of crops between future with and without project conditions. The flood control and irrigation benefits to be expected from the projects are ₱91.9 million and ₱98.4 million respectively.

6.3 Economic Cost

Economic construction cost for the projects is estimated taking into consideration deducting tax and contractor's profit for the construction cost. With respect to compensation cost for the paddy field where river improvement facilities, irrigation and drainage facilities are installed, land compensation cost is evaluated in terms of negative benefit. The economic construction costs for flood control and irrigation projects are estimated at ₱639.8 million and ₱356.2 million, respectively.

6.4 Internal Rate of Return

Based on the benefit and economic cost, internal rate of return for the flood control and irrigation projects is calculated under the assumption of the project life of 50 years. The projects are expected to yield internal rate of reutrn of 10.8% in the flood control project, and 15.4% for the irrigation project.

6.5 Project Effect and Social Impacts

6.5.1 Flood Control Project

6.5.1.1 Stabilization of Peoples Livelihood

At present, the flood damage occurs every year. Many houses and farm lands in the project area suffer large damage from floods. After the proposed project completed, about 19,000 ha of land and 13,400 houses in the protect area will be relieved from floods.

The other unquantified benefit is reduction in casualty for human life. The casualty by flood in the Pampanga River has occurred almost every year. The casualty will be largely reduced by the implementation of the project.

6.5.1.2 Incremental Rice Production

The increase in the rice production by the project is expected from the reduction in flood damage and improved land conditions. The production increase will be expected to be 14,800 tons of rice per annum.

6.5.1.3 Employment Opportunity

The implementation of the project will provide employment opportunities to landless workers and farmers in and around the project area. The unskilled labor requirement for the project is estimated to be 1.5 million man-days during the construction period.

6.5.1.4 Fisheries

Even after the proposed levee completed along the South Candaba Swamp, its lower area of about 2,000 ha will remain as the same swampy condition. It is recommended that the lowest part of 20 ha will be digged at the depth of 1.5 m for the area of fish sanctuary during dry season. The remained adult fishes will breed enough eggs to increase the fish production of the said area of 2,000 ha during rainy season.

By dredging the lowest reaches of the Pampanga River, seawater intrusion will increase in the lower reaches. Accordingly, the productivity of the upper fishpond area will be increased at 30 - 40% from the present level, owing to supply of the high salined water to the said fishpond.

6.5.1.5 Relocation of Houses

There exist about 6,700 houses in the location of the proposed channel which are needed to shift to the highland newly created. The base mound area allocated to the two municipalities of Apalit and San Simon is planned to be 260 ha. The existing area of Apalit and San Simon amounts to 180 ha. Accordingly the area for relocation of two municipalities is sufficient.

6.5.2 Irrigation Project

6.5.2.1 Incremental Rice Production

The project will provide a basis on increasing unit yield and expansion of irrigated field through provision of irrigation and drainage facilities. The project will produce incremental rice production of 47,000 tons which plays an important role in self sufficiency of rice in the project area and rice supply to Metro Manila.

6.5.2.2 Employment Opportunity

It is estimated that the project will generate employment opportunities totalling about 1.9 million man-days during the construction period. Most of the manpower will be supplied from landless workers and farmers in and around the irrigation development area. In addition the project will create a demand for farm labor requirement accrued from increased farm activities due to intensive use of the land and high productivity. The incremental farm labor requirement is estimated at 1.5 million man-days per annum.

6.5.2.3 Farmer's Income

The farmer's income will be expected to improve considerably as a direct result of the increase of rice production. The net farm income on the typical farmer both in present and with project conditions represents in the following table.

Typical Farmer with 1.5 ha	Present (₱)	With Project (₱)
i. Rainfed land	1,377	8,199
ii. Irrigated land with single cropping of rice	1,491	8,199
iii. Irrigated land with double cropping of rice	2,291	8,199

The net farm income of the typical farmers on rainfed land and irrigated land with single cropping of rice will increase 6 times of the present farm income. For the typical farmer on irrigated land with double cropping of rice, the project will bring about 4 times of the present net farm income. Accordingly, net reserve for the farmers will be expected to be improved from present subsistence level to ₱3,400.

6.5.2.4 Fisheries

The proposed irrigation project with diversion dam will form a year round water body of about 1,800 to 2,600 ha located in the lowest part of the San Antonio Swamp. This reservoir will engage in an influential function of the Pampanga River eco-system. At the same time it is expected that potentiality of the fisheries resources will be highly increased by the following management of the reservoir; 1) Setting a year round fish sanctuary of about 1,000 ha, 2) Setting regulation on the minimum limit of gill net mesh and bamboo fence mesh, and prohibition of dynamite fishing in the reservoir, and 3) Establishment of a permanent research station to collect basic data on the eco-system of the Pampanga River system.

6.5.2.5 Social Impacts

Traditionally harvesting and threshing of paddy have been carried out by community activities so called "hunusan". Any villagers can take part in such farmings, from which a harvester gains one sixth of output that seems equivalent to the marginal product of labor at a market wage rate at present low productivity condition. After implementation of the irrigation project, introduction of improved irrigation farming in the project area will be expected to provide increasing land productivity, which will result in increasing unit yield of paddy to 4.5 tons/ha for wet season paddy and 5 tons/ha for dry season paddy. In such circumstances the one sixth of output for harvesting and threshing will become substantially larger than the prevailing market wage rate. Consequently farmer employers could increase their incomes by reducing harvester's share to lower than one sixth or replacing "hunusan system" by hired labor at the market wage rates.

It is, however, predicted that the "gama system", /1 a contractual arrangement wherein those who want to participate in harvesting agree to do weeding in the paddy field in exchange as a harvesters and receive one sixth of output, will be developed under a patron-client relation between farmer employers and landless workers in the project area without destruction of traditional system.

6.5.3 Seawater Intrusion

The implementation of the projects for both flood control and irrigation will promote seawater intrusion to the Pampanga River. As a result, the production from fishpond will increase owing to supply of high salined water to fishpond, on the other hand, it will give some adverse effect to ground water used as a source of water supply by inhabitants. The adverse effect varies depending on the volume of excavation of low-water channel by flood control project and intake water volume by irrigation project.

/1: Rapid diffusion of "gama system" are recognized in the irrigation projects around the Laguna de Bay.

To know the extent of adverse effect, the seawater intrusion distance and its affected period are estimated without and with project as shown in Table 6.5.1. The effects are summarized as follows:

a. The salinity condition near the water surface would not be much changed by the implementation of the projects for both flood control and irrigation.

b. Due to excavation of the channel, the seawater intrusion near the bottom of the channel will be extended to about 7 km in the basic plan and about 4 km in the stepwise plan.

c. Due to diverting water in the upstream by the irrigation project, the seawater intrusion near the bottom of the channel will be extended to about 6 km.

d. In the case of the condition after completion of the projects for both flood control and irrigation, the seawater intrusion near the channel bottom will be extended to about 10 km in the basic plan and about 8 km in the stepwise plan.

The new intrusion of seawater at the bottom of the river has a possibility to raise the salinity pollution to the ground water in the vicinity of river course where the saltwater will intrude. The behavior of polluted ground water is usually defined by many factors such as location and depth of intake well, intake water volume from a well, elevation of ground water surface, geological condition, permeability of ground and so on. Those factors can be only studied by the field survey in the vast area including boring test, hydraulic well test, long term field observation of ground water and others.

One of the solution of salinity pollution problems is construction of salinity control gates in the downstream of the Pampanga River and the Labangan Floodway. By the salinity control gates, the seawater intrusion to the upstream can be stopped perfectly, however much fund will be required to construct the gates. One of the economical countermeasure for the problem is to construct the facility of small water supply system for the area to be polluted by salinity.

On the other hand, the future development projects in the Pampanga River Basin and in the vicinity area such as the Balog-Balog Irrigation Project, the UPRIIS project and so on have a great effect to increase the discharge of the Pampanga River by newly created return flow. Accordingly, the practical solution will be found after the detailed investigation on the above mentioned various measures in the future.

6.6 Assessment of the Project

6.6.1 Flood Control Project

Implementation of the flood control project will be expected to provide large reduction of flood damages and effects to the stabilization of people's livelihood in the project area. The results of evaluation and effects for the project are summarized in Table 6.6.1.

The result of studies indicates that the flood control project is technically sound and economically feasible. The project is needed to implement for the regional development and the public welfare.

6.6.2 Irrigation Project

Implementation of the irrigation project will be expected to provide greater benefits and effects to the peoples in and around the irrigation development area. The results of evaluation and effects for the project are summarized in Table 6.6.2.

The result of studies indicates that the irrigation project is technically sound and economically feasible. The irrigation project is financially justifiable from the standpoint of farmer's economy.

Table 1.4.1(1) MEMBER LIST OF ADVISORY COMMITTEE, THE TEAM AND COUNTERPART GROUP

Advisory Committee

1.	Mr. Toshihiko Iwamoto	- Chairman of the Committee
2.	Mr. Ken-ichi Sasaki	- Chairman of the Committee
3.	Mr. Hideomi Ohi	- Advisor for River Engineering
4.	Mr. Hideo Tokuhiro	- Advisor for River Engineering
5.	Mr. Masakuni Kawamata	- Advisor for Irrigation
6.	Mr. Shigekazu Yoshida	- Advisor for Irrigation
7.	Mr. Hideki Abe	- Coordinator
8.	Mr. Hitonori Ono	- Coordinator
9.	Mr. Yukihisa Sakurada	- Coordinator

JICA Survey Team

1.	Mr. Tadashi Sakamoto	- Team Leader
2.	Dr. Akihiko Tsuchiya	- Senior River Engineer
3.	Mr. Tadaharu Murono	- Agro-Economist
4.	Mr. Kenjiro Onaka	- Agricultural Expert
5.	Mr. Yukinori Sano	- Irrigation Engineer
6.	Mr. Tadashi Ohori	- Irrigation Engineer
7.	Mr. Yukihiro Kawahara	- Irrigation Engineer
8.	Mr. Hiroshi Ono	- River Engineer
9.	Mr. Toshio Terashima	- River Engineer
10.	Mr. Yoshitada Ogawa	- River Engineer
11.	Mr. Kazuhiko Takebayashi	- Hydrologist
12.	Mr. Toshikatsu Imai	- Hydrologist
13.	Mr. Toshikazu Tay	- Project Economist
14.	Mr. Fumihiko Furuichi	- Project Economist
15.	Mr. Hideaki Mitsui	- Soil Mechanical Engineer
16.	Mr. Keisuke Sumikawa	- Soil Mechanical Engineer
17.	Dr. Torahiko Moritani	- Geologist
18.	Dr. Tamotsu Tomiyama	- Inland Fisheries Expert
19.	Mr. Masaru Yonai	- Survey Engineer
20.	Mr. Ryosaku Nagata	- Structual Engineer

- to be continued

Table 1.4.1(2) MEMBER LIST OF ADVISORY COMMITTEE, THE TEAM AND COUNTERPART GROUP

Counterpart Personnel Group

1.	Mr. Rogelio A. Flores	- Chief Counterpart, MPWH
2.	Mr. Jose C. Guanzon	- Chief Counterpart, MPWH
3.	Mr. Avelino Rivera	- Chief Counterpart, NIA
4.	Mr. Dioles Suelen	- Agro-Economist, NIA
5.	Mrs. Celester Escallera	- Economist, MPWH
6.	Mr. Leonardo T. Costa	- Agronomist, NIA
7.	Mr. William Reodica	- Irrigation Engineer, NIA
8.	Mr. Robert L. Jamilla	- River Engineer, MPWH
9.	Mrs. Sofia Santiago	- River Structural Engineer, MPWH
10.	Mr. Juanito P. Pacleb	- Senior Soil Technologist, NIA
11.	Mr. Miguel Lugue	- River Engineer, MPWH
12.	Mr. Armando Maulawin	- Irrigation Engineer, NIA
13.	Mrs. Trinidad R. Cutaran	- Sr. Hydrologist, NIA
14.	Mr. Milo Landicho	- Hydrologist, NIA
15.	Mr. Reynaldo L. Llamoso	- Hydrologist, NIA
16.	Mr. Restio V. David	- Hydraulic Engineer, MPWH
17.	Mr. Epifanio C. Gacusan	- Project Economist, NIA
18.	Mr. Rodolfs Galapan	- Soil Technologist, NIA
19.	Mr. Manuel Guiad	- Soil Technologist, NIA
20.	Mr. Danilo Fajardo	- Geologist, NIA
21.	Miss Sally Janga	- Fishery Biologist

Table 3.2.1 SUMMARY OF CLIMATIC CONDITIONS

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	ANNUAL
Mean Temperature (°C)													
San Miguel (1968 - 1979)	25.1	25.0	27.0	28.6	28.8	28.1	27.4	26.8	27.3	26.8	26.3	25.4	26.9
Baliwag (1970 - 1979)	24.1	25.1	26.2	27.4	27.4	27.7	27.2	26.9	27.0	26.7	26.4	25.5	26.5
Cabanatuan (1976 - 1979)/1	25.9	23.5	27.4	29.3	28.6	28.3	28.2	27.1	27.6	27.7	27.0	26.5	27.3
Mean Maximum Temperature (°C)													
San Miguel (1968 - 1979)	31.0	31.7	33.9	35.3	34.7	33.3	32.1	30.9	31.6	31.7	30.2	30.7	33.3
Baliwag (1970 - 1979)	29.6	29.5	31.9	33.0	32.6	32.1	31.1	29.4	31.2	30.7	30.7	29.7	31.0
Mean Minimum Temperature (°C)													
San Miguel (1968 - 1979)	18.8	19.0	20.3	21.9	23.1	23.2	22.8	23.2	22.6	22.3	21.6	20.2	21.6
Baliwag (1970 - 1979)	19.9	19.7	20.2	21.7	22.8	23.7	23.6	23.2	23.3	22.6	22.2	21.3	22.0
Mean Relative Humidity (%)													
San Miguel (1968 - 1979)/2	83.1	75.4	77.6	71.9	79.2	86.0	87.9	90.7	88.8	86.5	82.5	82.3	82.7
Cabanatuan (1976 - 1979)/1	73.1	67.8	66.1	63.1	76.8	80.4	83.8	88.0	85.6	81.9	77.9	75.6	76.7
Sunshine Hour (hr/day)													
San Miguel (1968 - 1979)	6.2	7.3	7.1	8.3	7.5	5.2	5.1	3.9	4.1	5.6	6.3	6.5	6.1
Mean Wind Speed (km/hr.)													
San Miguel (1968 - 1979)	2.7	3.1	3.2	3.1	2.2	2.0	1.7	1.6	1.4	1.7	2.6	3.4	2.4
Cabanatuan (1976 - 1979)/1	4.2	4.8	3.6	3.6	3.9	2.5	2.9	3.3	4.6	3.2	4.6	4.9	3.8
Evaporation (mm/month)													
San Miguel (1968 - 1979)	145.8	152.3	194.1	204.2	170.2	138.2	127.5	112.5	126.9	130.5	131.4	134.5	1,768.1
Baliwag (1970 - 1979)	143.5	141.1	177.6	191.1	171.4	152.2	141.3	133.0	152.4	143.3	133.7	134.3	1,815.0

/1: Data since 1949 are collected, analysis has not been completed so far

/2: Relative Humidity measured at 8:00 A.M.

Table 3.3.1 RAINFALL AT CABANATUAN CITY
(1951 - 1979)

(Unit: mm)

Month	Monthly Rainfall		
	Average	Maximum	Minimum
Jan.	7.4	67.3	0
Feb.	5.3	49.5	0
Mar.	10.9	69.8	0
Apr.	31.2	261.4	0
May	172.3	931.1	7.7
Jun.	262.8	590.8	64.2
Jul.	302.2	1,064.7	141.9
Aug.	406.6	622.7	213.0
Sept.	309.7	628.7	144.6
Oct.	173.4	514.1	12.2
Nov.	125.7	344.4	14.0
Dec.	52.0	197.0	0
Annual	1,868.6	2,369.5	1,338.9
Wet Season			
(May - Oct.)	1,627.0	-	-
Percent (%)	87.1	-	-

Source: PAGASA

Table 3.3.2(1) AVERAGE MEAN MONTHLY DISCHARGE

(Unit: m^3/s)

No.	Station Name	River & Catchment Area (km^2)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Obser. Period (yr.)
1.	Pantabangan N.E.	Pampanga R. 890	Ave.	15.0	7.3	5.7	4.8	10.6	34.3	79.8	95.7	138.0	761.	62.9	24.2	46.2	
			Max.	31.7	16.9	12.1	10.0	20.2	63.0	177.4	120.4	281.5	135.7	260.4	45.5	281.5	10
			Min.	5.9	0	1.5	1.0	3.9	10.4	13.4	66.8	13.4	0	6.6	0	0	
2.	Bongabon N.E.	Coronel R. 718	Ave.	31.1	18.7	12.4	8.6	23.7	31.3	53.5	73.5	68.1	82.0	71.0	59.8	44.5	
			Max.	73.3	55.1	42.9	28.9	168.7	85.0	175.0	163.5	137.5	119.0	152.1	93.5	175.0	11
			Min.	3.2	0.2	0	0	0	2.1	7.1	19.1	27.3	30.9	26.6	29.4	0	
3.	Cabanatuan City N.E.	Pampanga R. 2,482	Ave.	40.7	26.6	22.4	20.9	61.5	66.3	99.2	246.6	328.2	174.0	247.7	238.1	131.0	
			Max.	73.6	33.7	42.8	41.4	189.6	97.6	131.7	435.7	382.6	299.9	615.5	866.5	866.5	8
			Min.	23.9	16.4	12.2	8.5	14.6	28.4	52.6	74.6	288.3	75.2	36.9	37.4	8.5	
4.	Gen Tinio N.E.	Chico R. 152	Ave.	2.5	1.9	1.2	1.3	5.6	8.6	20.7	25.8	21.3	16.8	14.8	5.8	10.5	
			Max.	9.7	6.3	5.5	5.7	42.8	33.7	118.5	66.8	39.9	52.0	40.7	23.4	118.5	13
			Min.	0.8	0.6	0.1	0.1	0.3	3.0	2.7	6.3	0.9	0.7	4.2	0.4	0.1	
5.	Gen Tinio N.E.	Sumacban R. 299	Ave.	18.2	14.1	15.8	10.7	13.6	17.0	31.8	29.4	31.7	784.9	47.1	34.5	87.4	
			Max.	38.9	24.7	37.3	16.3	42.5	26.9	79.0	69.9	49.3	7,559.5	85.8	72.8	7,559.5	12
			Min.	7.4	7.3	8.3	6.6	3.5	9.0	14.5	11.8	9.9	16.3	15.9	11.7	3.5	
6.	San Jose N.E.	Penaranda R. 513	Ave.	13.7	4.1	3.7	2.6	20.9	22.3	50.2	38.4	22.2	50.2	67.8	54.9	29.3	
			Max.	62.2	18.7	12.6	7.6	96.0	130.6	191.9	54.0	40.8	260.7	226.3	240.2	260.7	9
			Min.	0.7	0.2	0.2	0.2	0.2	0.5	2.8	18.7	6.0	1.1	3.1	0.6	0.2	
7.	Gaban N.E.	Penaranda R. 568	Ave.	166.8	0.8	0.4	1.4	9.0	8.2	67.7	111.9	147.7	258.9	289.0	209.8	106.0	
			Max.	1,457.2	6.1	2.7	10.1	149.1	29.5	468.8	756.8	1,015.2	1,426.0	2,105.6	1,537.3	2,105.6	10
			Min.	0	0	0	0	0	0	1.2	0.3	0.4	0	1.3	0	0	
8.	Cabiao N.E.	Pampanga R. 3,512	Ave.	127.4	52.3	42.5	30.8	89.0	145.3	230.1	387.8	452.0	250.6	253.2	146.9	184.8	
			Max.	211.3	110.9	105.9	87.3	249.2	274.2	359.9	657.5	605.2	458.5	483.0	312.1	657.5	4
			Min.	32.4	20.8	12.9	6.1	7.7	19.6	84.3	191.1	332.8	112.0	75.6	44.0	6.1	
9.	Talavera N.E.	Talavera R. 401	Ave.	12.2	10.2	11.8	12.9	13.6	18.5	19.5	25.0	23.6	21.6	16.9	14.3	16.7	
			Max.	24.6	22.8	35.9	37.7	31.4	36.8	39.0	50.0	47.5	42.5	42.0	28.5	50.0	14
			Min.	0.7	0.7	0.8	1.9	1.8	5.1	5.6	4.9	6.9	3.4	5.6	2.4	0.7	
10.	Zaragoza N.E.	Rio Chico R. 1,675	Ave.	6.7	5.6	2.2	1.3	11.7	23.2	93.9	144.3	138.5	87.7	47.2	21.4	48.6	
			Max.	41.8	30.0	11.7	10.2	125.4	79.5	233.8	314.1	243.0	256.2	406.6	133.6	406.6	18
			Min.	0.1	0	0	0	0	0	0.8	60.5	49.3	11.4	0.6	0	0	
11.	Arayat	Pampanga R. 6,532	Ave.	79.2	36.1	24.6	22.5	78.3	165.1	417.1	606.6	606.1	504.6	302.8	158.4	250.1	
			Max.	299.7	73.4	43.9	51.7	634.8	434.2	1,612.8	1,548.0	1,538.0	1,042.7	906.1	358.3	1,612.8	14
			Min.	19.6	11.3	4.8	2.8	3.2	17.2	52.6	173.0	231.9	94.7	49.2	55.4	2.8	
12.	San Miguel Bul.	Bulu R. 60	Ave.	0.1	0.1	0.1	0.1	1.2	0.5	1.2	1.5	1.8	0.8	0.8	0.4	0.7	
			Max.	0.4	0.3	0.2	0.2	4.4	0.7	4.1	3.6	4.0	2.2	1.7	0.8	4.4	7
			Min.	0	0	0	0	0	0.1	0.1	0.7	1.0	0.3	0.1	0	0	

Table 3.3.2(2) AVERAGE MEAN MONTHLY DISCHARGE

(Unit: m^3/s)

No.	Station Name	River & Catchment Area (km^2)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Obser. Period (yr.)
13.	San Vicente Bul.	San Miguel R. 240	Ave.	19.5	13.5	8.1	3.2	12.8	19.9	32.5	35.5	29.9	27.8	30.7	23.6	21.3	
			Max.	55.9	35.2	31.3	17.2	42.3	71.2	126.7	105.8	72.1	67.8	56.3	62.0	126.7	13
			Min.	0.8	0.5	0.2	0.2	0	4.4	12.8	5.5	3.7	0.1	12.3	0.5	0	
14.	San Ildefonso Bul.	Garlag R. 86	Ave.	2.1	0.6	1.6	1.1	5.9	3.5	6.5	4.6	6.2	5.4	3.8	2.2	3.6	
			Max.	4.4	0.9	2.3	1.3	13.2	4.8	13.8	10.7	10.8	11.1	5.4	5.0	13.8	8
			Min.	0.1	0	0.9	0.9	1.4	2.1	0.8	0.9	3.2	1.7	1.8	0.7	0	
15.	San Rafael Bul.	Maasim R. 142	Ave.	1.6	0.8	20.0	0.3	3.5	14.4	28.0	32.2	27.2	17.2	13.9	3.6	13.6	
			Max.	5.2	2.6	215.0	0.7	31.2	32.0	130.9	78.5	81.2	43.6	46.5	10.6	215.0	11
			Min.	0.6	0.2	0.1	0	0	0.9	0.1	3.7	2.2	2.9	1.2	1.0	0	
16.	Candaba Pam.	Maasim R. 229	Ave.	4.3	2.2	1.8	1.5	5.9	10.2	20.4	25.5	18.5	16.4	10.0	7.2	10.3	
			Max.	13.0	5.4	6.1	4.5	28.6	23.6	54.2	61.1	60.0	28.5	29.3	19.6	61.1	12
			Min.	0.6	0.3	0.2	0.2	0.4	1.0	4.9	8.1	1.5	4.5	2.3	1.3	0.2	
17.	Norzagaray Bul.	Angat (below Ipo Dam) 629	Ave.	34.6	20.0	12.4	10.8	18.1	23.2	38.4	59.4	44.9	38.6	39.0	97.9	36.4	
			Max.	198.2	65.6	32.8	38.3	110.1	78.0	134.8	165.2	137.5	181.8	104.6	476.5	476.5	11
			Min.	1.4	1.0	0.2	0.1	0.1	0.1	0.9	2.4	2.7	1.5	1.4	1.4	0.1	
18.	Calumpit Bul.	Labangan R. 985	Ave.	26.2	20.2	22.4	26.0	55.5	59.7	146.8	135.8	165.9	117.1	92.7	62.1	77.5	
			Max.	94.9	31.5	34.4	37.7	212.6	132.5	674.4	293.0	508.5	353.9	216.3	151.0	674.4	15
			Min.	12.5	15.2	12.0	14.3	13.9	16.2	29.6	40.8	51.1	20.4	17.6	16.8	12.0	
19.	Bacolor Pam.	Pasig-Potrero R. 103	Ave.	3.6	4.0	4.4	4.0	7.0	2.7	8.7	5.0	3.6	2.1	7.3	2.9	4.6	
			Max.	8.9	9.3	9.3	9.3	9.3	8.7	31.6	18.9	8.7	4.8	48.1	8.6	48.1	9
			Min.	0.3	0	0	0	0.4	0.2	0.3	0.4	0.2	0.5	0.3	0.2	0	
20.	Florida-blanca Pam.	Porac R. 103	Ave.	1.3	1.3	1.4	1.5	2.4	4.5	4.8	7.1	8.2	4.0	3.1	1.9	3.5	
			Max.	2.0	2.0	1.9	2.5	7.2	11.3	8.5	17.5	20.8	8.1	7.9	4.7	20.8	8
			Min.	0.1	0.3	0.8	0.8	1.2	1.5	1.0	0.7	0.7	0.7	0.8	1.0	0.1	
21.	Florida-blanca Pam.	Gumain R. 122	Ave.	3.8	2.7	3.1	3.7	8.9	15.8	23.1	27.1	22.0	14.9	8.3	6.3	11.6	
			Max.	14.4	10.7	10.5	12.8	46.9	66.4	67.8	83.1	57.8	29.9	18.6	18.8	83.1	17
			Min.	0.1	0.3	0.7	0.1	0.7	0.7	5.6	11.6	6.6	1.5	0.2	0.2	0.1	
22.	Florida-blanca Pam.	Caulaman R. 92	Ave.	2.2	2.0	1.9	1.8	4.7	7.7	21.6	41.0	20.4	17.9	7.9	10.3	11.6	
			Max.	17.5	17.5	17.7	17.5	24.6	51.1	106.8	316.2	104.5	72.9	56.4	84.9	316.2	13
			Min.	0.4	0.2	0.2	0.1	0.1	0.1	0.4	3.7	1.9	1.5	1.0	0.7	0.1	
23.	Muñoz N.E.	Baliwag R. 208	Ave.	2.8	2.1	1.9	1.5	9.9	9.4	19.2	28.5	27.1	15.2	6.6	3.7	10.7	
			Max.	9.2	5.3	3.2	3.0	106.8	27.8	72.2	49.3	63.4	43.9	18.4	8.8	106.8	15
			Min.	0.9	0.7	0.8	0.1	0.9	1.9	4.4	10.5	8.8	3.6	1.7	1.3	0.1	
24.	Angat Bul.	Bayabas R. 69	Ave.	1.6	1.1	0.8	0.8	1.6	16.7	88.9	39.6	24.0	36.6	16.1	17.0	20.4	
			Max.	5.0	2.9	2.7	2.6	5.5	75.4	590.0	267.6	172.6	220.8	51.5	110.7	590.0	11
			Min.	0.2	0	0	0	0.1	0.4	0.5	4.1	1.3	0.7	1.0	0.4	0	

Table 3.3.2(3) AVERAGE MEAN MONTHLY DISCHARGE

(Unit: m^3/s)

No.	Station Name	River & Catchment Area (km^2)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Obser. Period (yr.)
25.	Pantabangan N.E.	Pantabangan R. 603	Ave.	13.9	10.7	10.6	6.6	21.0	16.8	44.6	46.4	42.5	31.8	18.7	18.5	23.5	
			Max.	26.1	23.2	19.7	12.8	75.0	21.5	83.3	95.1	66.9	4.3	28.9	29.3	95.1	8
			Min.	4.8	3.3	2.3	0.4	2.5	11.8	16.1	19.2	26.5	23.8	12.9	5.9	0.4	
26.	Apalit Pam.	Sulipan Cut-off Channel 7,715	Ave.	213.4	15.5	29.4	23.8	131.3	60.3	253.0	521.6	310.2	233.9	171.3	74.3	169.8	
			Max.	68.1	29.3	143.2	83.7	974.6	264.1	759.7	2,940.2	680.1	907.2	442.6	370.9	2,940.2	14
			Min.	0	0	0	0	0.3	0	4.9	29.6	7.1	1.5	1.6	0.3	0	
27.	Pulilan Bul.	Angat R. 918	Ave.	30.4	25.2	29.6	30.1	43.1	50.0	77.7	104.9	110.2	74.3	63.4	62.2	58.4	
			Max.	112.3	66.1	105.6	92.2	179.8	187.7	224.1	224.9	265.8	189.6	172.7	180.2	265.8	16
			Min.	2.5	1.2	2.6	4.6	1.7	6.7	10.4	28.2	21.5	2.6	1.9	0.1	0.1	
28.	Pasing Candaba Pam.	Pampanga R. 7,270	Ave.	46.1	46.2	48.0	43.0	101.9	128.5	290.6	468.0	541.2	376.0	276.2	166.0	211.0	
			Max.	79.0	78.0	93.1	76.1	466.8	268.2	712.4	676.2	945.7	817.4	584.4	376.8	945.7	9
			Min.	8.7	7.7	9.9	8.8	20.9	30.3	101.7	355.9	133.3	112.2	51.6	19.8	7.7	
29.	Apalit Pam.	Pampanga R. 7,714	Ave.	170.5	148.7	296.5	252.3	191.8	311.2	307.8	439.4	504.2	425.9	327.9	273.7	304.2	
			Max.	296.1	335.6	3,091.7	2,243.1	973.8	2,462.4	547.1	915.4	771.1	941.6	903.7	547.0	3,091.7	21
			Min.	116.6	111.1	117.2	116.7	109.4	145.5	149.8	220.2	330.8	214.7	126.9	120.2	109.4	

Table 3.3.3 (1) MEAN MONTHLY DISCHARGE

Station: Aravat (Unit: m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Mean
1965	92.2	58.5	29.1	22.1	30.8	152.0	893.6	389.4	552.7	259.6	220.3	77.6	231.1
1966	48.3	42.1	26.4	13.2	634.8	240.2	260.8	461.0	842.2	96.2	538.6	358.3	296.8
1967	117.6	41.7	29.8	20.3	16.9	215.5	233.5	1158.3	1038.4	638.0	468.9	67.7	337.2
1968	42.3	30.8	27.8	20.8	22.9	26.6	140.0	603.2	956.4	388.6	49.2	83.4	199.5
1969	34.2	21.7	13.7	13.8	14.1	36.2	156.7	727.7	390.5	213.5	68.9	55.4	146.8
1970	27.2	17.1	12.2	18.4	11.7	86.7	117.7	313.0	935.0	652.2	369.1	156.3	226.7
1971	44.4	31.1	33.5	18.7	55.3	382.0	709.9	428.1	261.7	1042.8	231.2	314.4	299.1
1972	299.7	60.5	29.4	27.6	38.6	74.3	1612.8	1538.0	594.5	94.7	107.4	63.3	382.1
1973	19.6	20.8	4.8	2.8	3.2	17.2	52.6	275.1	243.1	849.3	241.2	63.3	150.7
1974	21.5	11.3	14.6	10.5	12.0	215.3	287.9	833.9	231.9	707.7	906.1	324.1	300.0
1975	141.2	73.4	43.9	49.5	50.6	100.4	56.8	173.0	237.5	205.7	80.6	178.9	116.3
1976	157.6/1	40.1/1	21.7/2	16.5/2	624.9/2	259.9	483.4	517.4	523.9	430.7	303.3	87.1/3	290.3
1977	62.7	25.4	16.1	12.3/4	19.3/4	52.0/1	140.2/1	379.0	661.2	288.6/2	369.7/2	160.9/2	182.6
1978	88.3/2	73.7/2	37.9	51.7	48.7	162.1/2	329.6/2	700.7	1019.6	901.4	869.9/3	368.1/3	388.7
Average	85.5	39.2	24.4	21.3	113.1	144.3	391.1	607.0	606.3	483.5	344.6	168.5	252.4

/1: Estimated discharge from Bangkerohan, the Coronel River by use of correlation curue

/2: Estimated discharge from Zaragoza by use of correlation curue

/3: Estimated discharge from Bag-bag Calumpit

/4: Estimated discharge by use of interpolation curue

Table 3.3.3 (2) MEAN MONTHLY DISCHARGE

Station: Zaragoza (Unit: m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Mean
1960	-	-	-	-	-	-	-	314.1	144.3	63.9	1.8	0.3	-
1961	0.3	0.2	0.2	0.1	0	31.1	219.2	138.3	160.3	44.5	0.6	0.2	49.6
1962	0.1	0.1	0.1	0.1	0	1.0	131.7	140.9	96.2	46.2	3.3	0.5	35.0
1963	0.3	0.5	0.2	0.2	0.3	79.5	109.6	143.2	203.7	17.1	2.5	0	46.4
1964	0.1	1.1	1.0	0	0.1	6.6	77.8	129.7	104.7	145.9	140.4	133.6	61.8
1965	41.8	29.9	0.3	0	0	0.4	160.7	132.4	150.5	78.5	56.4	4.4	54.5
1966	1.4	0	0	0	106.1	37.4	41.0	75.8	142.1	12.3	89.3	58.0	47.0
1967	16.1	2.9	0.9	0	0	33.1	36.3	158.4	181.0	111.7	26.5	5.4	47.7
1968	4.1	3.2	2.3	1.1	3.2	4.9	38.9	155.3	114.7	64.9	1.2	6.9	33.6
1969	2.0	2.0	1.5	1.1	2.4	19.1	159.0	59.8	66.9	37.7	3.6	4.1	30.2
1970	3.2	2.6	2.1	0	1.5	16.6	26.4	82.3	184.2	70.4	21.1	9.0	35.0
1971	6.0	5.5	1.9	0	8.9	71.6	130.2	79.9	56.2	160.2	21.1	16.7	46.9
1972	19.5	7.5	4.5	1.6	7.0	18.0	233.9	278.7	148.2	19.2	4.5	4.1	62.7
1973	2.3	0.1	0.8	0.5	2.0	3.8	8.7	75.7	64.3	147.1	15.9	6.6	27.6
1974	4.4	4.0	1.1	1.5	1.5	32.7	45.3	168.8	48.8	162.3	14.8	125.1	51.5
1975	14.5	0	0	0	4.0	8.2	13.6	29.6	40.7	35.2	13.8	30.7	16.0
1976	30.7	5.5	3.7	2.8	125.3	72.1	118.8	125.9	120.2	100.6	8.0	4.2	60.2
1977	6.6	4.4	2.7	4.6	3.4	3.0	17.2	21.1	163.1	53.6	73.5	22.3	31.2
1978	15.1	12.6	11.7	9.6	9.3	22.6	63.7	269.9	243.0	256.2	192.7	71.7	98.7
Average	9.4	4.5	1.9	1.3	15.3	25.7	90.7	135.8	128.1	85.7	36.4	26.5	46.8

Table 3.3.4 ESTIMATED MEAN MONTHLY INFLOW TO THE SAN ANTONIO SWAMP

(Unit: m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Mean
1968	10.0	7.5	6.2	4.0	6.4	8.8	70.4	281.0	207.5	117.4	8.1	18.5	62.5
1969	6.8	4.9	3.4	3.0	4.4	34.6	287.7	108.1	121.1	68.2	13.2	11.8	56.2
1970	6.9	5.0	3.8	2.6	3.1	30.0	47.8	148.9	333.4	127.5	72.2	30.7	67.7
1971	12.1	9.8	6.5	2.6	16.6	129.5	235.6	144.6	101.7	290.0	53.1	60.3	89.4
1972	61.0	15.9	8.6	5.4	12.3	32.6	523.2	504.4	268.2	34.7	19.3	12.9	117.5
1973	5.1	3.0	1.5	0.9	2.5	6.8	15.7	136.9	116.4	266.3	49.3	15.4	52.1
1974	7.4	5.6	3.1	2.9	3.1	59.2	81.9	305.4	88.3	293.7	140.4	170.1	97.8
1975	34.0	10.2	6.1	6.9	11.0	14.8	24.7	53.6	73.7	63.7	25.0	55.5	31.8
1976	55.6	9.9	6.7	5.1	226.8	130.5	214.9	227.8	217.6	182.0	43.0	7.7	111.3
1977	15.2	7.9	5.0	8.3	6.0	5.4	31.2	38.2	295.2	97.1	133.1	40.3	56.7
1978	27.3	22.8	16.9	16.8	16.0	40.9	115.3	488.5	439.7	463.6	348.7	129.8	178.1
Average	21.9	9.3	6.2	5.3	28.0	44.8	140.8	221.6	205.7	182.2	82.3	50.3	83.2

Table 3.3.5 AVERAGE ANNUAL SEDIMENT YIELD AS ESTIMATED BY THE TEAM

River	Site	Catchment Area (km^2)	Ave. Annual Sediment ($t/km^2/yr$)
Talavera	Talavera Br.	401	262
Rio Chico	Zaragoza Br.	1,675	134
Bamban	Bamban Br.	206	1,213
Pampanga	San Isidro Br.	3,472	685
-do-	Arayat Br.	6,532	387
-do-	Candaba Br.	7,270	163
-do-	Sulipan Br.	7,715	59

Remarks:
1. Applied daily discharges during the period (1966-1975).
2. Applying the Sato-Kikkawa-Ashida formula for bed load estimated.
3. Applying a formula for suspended load established by the Team on the basis of the Engelund-Hansen Formula.

Table 3.6.1 BASIC SOCIO DATA IN THE IRRIGATION DEVELOPMENT AREA

	Municipality	Population 1975	Population 1980	Population Growth Rate 1975/80(%)	Area (ha)	Population Density (Person/km^2)	Total House-Hold	Family Size	No. of Farm	Percentage of Farm Household
A)	Municipalities Related to the Project Area									
	Apalit	41,283	48,264	3.17	6,147	785	7,682	6.3	2,139	22.7
	Arayat	52,739	56,770	1.48	13,475	421	8,726	6.5	2,049	30.9
	Candaba	48,458	52,643	1.67	20,870	252	8,086	6.5	1,857	52.4
	Mexico	48,805	53,488	1.85	11,741	456	8,051	6.6	3,602	31.2
	Minalin	25,428	27,326	1.45	2,908	940	4,000	6.8	1,198	25.0
	San Fernando	98,382	110,423	2.34	8,119	1,360	17,358	6.4	352	7.3
	San Luis	23,866	25,698	1.49	5,683	452	3,929	6.5	1,664	50.9
	San Simon	21,553	23,537	1.78	5,736	410	3,682	6.4	1,838	34.5
	Sta. Ana	22,595	25,342	2.32	4,596	551	4,392	5.8	984	23.9
	Sto. Tomas	21,320	24,945	3.19	2,129	1,172	4,169	6.0	358	9.4
	TOTAL	404,429	448,436	2.09	81,404	551	70,075	6.4	16,041	22.9
B)	Project Area	94,400	104,700	2.09	14,000	750	16,390	6.4	4,600	27.4

Source: National Census and Statistic Office Region III

Table 3.7.1 PRESENT LAND USE IN THE DEVELOPMENT AREA

	Category	Area (ha)	Proportional Extent (%)
(1)	Paddy Field/1	11,500	82.2
	Rainfed area	2,300	16.5
	Irrigated area	9,200	65.7
	- double cropping of paddy	(2,300)	
	- single cropping of paddy	(6,900)	
(2)	Grass Land	100	0.7
(3)	Swampy Area	900	6.4
(4)	Village/Road/Rivers/Others/2	1,500	10.7
	Total	14,000	100.0

/1: Net area

/2: Containing the land of about 300 ha where existing canal facilities, feeder roads and farm levee are installed in the paddy field

Table 3.10.1 RESULTS OF FARM ECONOMIC SURVEY OF TENURIAL STATUS AND ESTIMATED VALUE IN THE IRRIGATION SERVICE AREA

Farm Size (ha)	Owner Operator		Amortized Owner		Lessee		Share-tenant		Total Farm Household		Total Area		Average Farm Size (ha)
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	(No.)	(%)	(ha)	(%)	
Below 0.25	1	0.18	-	-	-	-	-	-	1	0.7	0.18	0.1	0.18
0.25 - 0.75	-	-	-	-	4	2.00	-		4	2.9	2.00	0.6	0.50
0.75 - 1.25	4	4.00	5	4.96	13	13.25	-	-	22	15.7	22.21	6.5	1.01
1.25 - 1.75	4	6.00	9	13.06	14	22.80	1	1.50	28	20.0	43.36	12.6	1.55
1.75 - 2.25	2	4.00	9	17.33	9	18.70	-	-	20	14.3	40.03	11.6	2.00
2.25 - 2.75	4	10.00	2	5.00	8	20.00	-	-	14	10.0	35.00	10.2	2.50
2.75 - 3.25	3	9.00	7	20.81	9	27.25	-	-	19	13.6	57.06	16.6	3.00
3.25 - 3.75	1	3.50	3	9.50	1	3.50	1	3.50	6	4.3	20.00	5.8	3.33
3.75 - 4.25	3	12.30	2	8.00	4	16.00	-	-	9	6.4	36.30	10.6	4.03
4.25 - 4.75	-	-	4	18.25	-	-	-	-	4	2.9	18.25	5.3	4.56
4.75 - 5.25	-	-	6	30.00	2	10.00	-	-	8	5.7	40.00	11.6	5.00
5.25 - 5.75	1	5.50	1	5.50	1	5.50	-	-	3	2.1	16.50	4.8	5.50
5.75 - 6.25	-	-	1	6.00	-	-	-	-	1	0.7	6.00	1.7	6.00
6.25 - 6.75	-	-	-	-	-	-	-	-	-	-	-	-	-
Over 6.75	1	7.00	-	-	-	-	-	-	1	0.7	7.00	2.0	7.00
Total	24	61.48	49	138.41	65	139.00	2	5.00	140	100.0	343.89	100.0	2.46
Share (%)	17.1	17.9	35.0	40.2	46.5	40.4	1.4	1.5	-	-	-	-	-
Estimated value in the Irrigation Service Area	790	2,060	1,610	4,620	2,140	4,650	60	170					

Table 3.13.1 DISTANCE FROM THE RIVER MOUTH

(Unit: km)

Location	Distance
River Mouth	0
Bifurcation of Bebe Sn. Esteban C.O.C.	18
Bifurcation of Hagonoy River	21
Sulipan Bridge	26
Apalit	27
North Manila Expressway Br.	30
San Simon	36
San Luis	42
Candaba	50
Arayat Bridge	61
Confluence of Pampanga and Rio Chico Rivers	66
Candaba-Cabiao Floodway	71
San Isidro Bridge	86
Cabanatuan	140
Zaragosa (Rio-Chico River)	101

Note: The distance is measured along the center line of low water channel, on the map of a scale of 1:50,000

Table 3.13.2 CARRYING CAPACITY OF RIVER CHANNEL UNDER THE EXISTING CONDITIONS

(Unit: m^3/s)

	River	Stretch	Carrying Capacity (Bankful)
1.	Pampanga River	River mouth - Masantol	500
		Masantol - Sulipan	2,200
		Sulipan - Candaba	1,800
		Candaba - Arayat	2,500
		Arayat - Cabiao	2,000
		Cabiao - San Isidro	2,500
2.	Bebe San Esteban Channel	River mouth - Masantol	1,700
3.	Hagonoy River	Hagonoy - Diversion Point	70
4.	Labangan Floodway	River mouth - Calumpit	700
5.	Angat River	Calumpit - Expressway Br.	900
6.	Maasim River	Confluence to Pampanga R. - Bahay Pare	100
7.	Candaba - Cabiao Floodway	Candaba Swamp - Diversion Point	4,000
8.	San Fernando River	Sexmoan - San Fernando	200
		San Fernando - Mexico	50

Table 3.13.3 STATUS OF IMPLEMENTATION OF MPW FLOOD CONTROL SCHEME BY THE END OF 1979 (APPROXIMATE ESTIMATE IN PERCENTAGE OF TOTAL AMOUNT OF WORK)

Name of Works	Completion	
	Percentage	Year
Arayat-Apalit-Masantol Setback Levee	100%	1975
Calumpit-Plaridel-Bustos Levee	100%	1975
Bebe-San Esteban Channel, Dikes, Floodgates	100%	1975
Arayat-Cabiao Ring Levee (including improvement)	80%	-
Cabiao-Candaba North Dikes	100%	1977
Cabiao-San Isidro Levee	100%	1975
Luyos-Bagong Sikat Cutoff Channel	100%	1975
San Antonio-Cabanatuan Levee	0%	-
Rio Chico River Control System	20%	-
Quitangil River Control	15%	-
Parua Floodgate	100%	1979
Pasig-Potrero River Control	75%	-
Gumain-Porac Diversion Channel	86%	-
Sapang Maragul Floodgate	100%	1979
Labangan Floodway	50%	-
Abacan River Control	20%	-

Table 3.13.4 PROBABLE FLOOD DISCHARGE OF MAIN STATION IN PAMPANGA RIVER BASIN AS ESTIMATED BY TEAM

River	Station	Catchment Area (km^2)	Discharge (m^3/s)					Remarks
			5-yr	10-yr	20-yr	50-yr	100-yr	
Pampanga Main Stream	Cabanatuan	2,482	1,977	2,365	2,725	3,205	3,572	
	San Isidro	3,472	2,408	3,051	3,641	4,315	4,857	
	Cabiao	3,512	2,424	3,071	3,668	4,349	4,895	
	Arayat	6,532	2,349	2,731	3,068	3,451	3,734	After control by Swamp
	Sulipan	8,907	2,654	3,517	4,779	6,111	7,039	- do -
Rio Chico	Zaragoza	1,675	1,061	1,497	1,883	2,422	2,840	
	Inflow to San Antonio Swamp	3,020	1,508	2,212	2,853	3,721	4,368	Before control by Swamp
Peñaranda	Confluence to Main Stream	601	529	732	864	1,046	1,192	
Angat	Longos	895	737	1,015	1,367	2,050	2,429	
Gua-Gua	San Fernando	445	272	353	423	566	682	
	Rivermouth	945	326	470	573	774	1,004	

Table 3.14.1 FLOOD DAMAGE TO FISHPOND IN THE DELTA (1976-1980)/1

Item	1976 May	1977 Nov.	1987/2 Aug.	1979 -	1980 Nov.
1. Name of Typhoon	Didang	Unding	Heling & Iling	-	Aring
2. Location of Damage Sampling	All Bulacan	All Bataan	All Bataan	- -	Hagonoy Bulacan
3. Affected Area covered by Interview Survey (ha)	687	493	(901)	-	756
4. Producer's Price of Marketable Milkfish (₱/ha)	1.22	2.05	(1.43)	-	3.01
5. Fish Quantity of Damage (x 10^3 pcs)	4,849	1,223	787	-	3,609
6. Value of Damage					
to Production (x ₱10^3)	1,821	1,269	549	-	2,768
(₱/ha)	2,650	2,574	609	-	3,662
to Facilities (x ₱10^3)	367	388	122	-	171
(₱/ha)	534	787	135	-	227
to Total (x ₱10^3)	2,188	1,657	671	-	2,939
(₱/ha)	3,184	3,361	744	-	3,889

Source: Survey reports on typhoon damage to fishpond by Provincial Fishery Office, Bulacan in 1976 and 1980, Bataan in 1977 and 1978.

Remarks: /1: Based on the data obtained from interview to pond operators

/2: This data was not used for the estimation of flood damage because of its abnormally low damage compared with affected area.

Table 4.1.1 SUMMARIZED WORK QUANTITIES (STEPWISE PLAN WITH 20-YEAR DESIGN FLOOD)

	Unit	Stretch		Total
		Candaba Sulipan	Below Sulipan	
1. Excavation of Low-water channel				
- Length	KM	18.0	22.6	40.2
- Volume				
Pampanga R.	$10^3 m^3$	16,590	15,890	32,480
2. Embankment of New Levee				
- Length	KM	35.3	61.7	97.0
- Volume	$10^3 m^3$	1,700	3,620	5,320
Pampanga R.	$10^3 m^3$	850	1,810	
Maasim R.	$10^3 m^3$	550	-	
Bagbag R.	$10^3 m^3$	260	340	
Angat R.	$10^3 m^3$	40	-	
Labangan R.	$10^3 m^3$	-	1,470	
3. Embankment of Height-ening				
- Length	KM	12.8	22.8	35.6
- Volume	$10^3 m^3$	360	990	1,350
Pampanga R.	$10^3 m^3$	360	330	
Bebe C.O.C.	$10^3 m^3$	-	660	
4. Embankment of Base Mound				
- Length	KM	17.6	31.2	48.8
- Volume	$10^3 m^3$	12,420	10,440	22,860
5. Outlet				
- Type A/1	nos.	1	1	2
- Type B/2	nos.	7	7	14
- Type C/3	nos.	1	2	3
Intake of Fishpond	nos.	-	26	26
6. Revetment	KM	2.5	1.5	4
7. Bridge	place	2	-	2

Remarks: Dredged material is used for Embankment and Heightening of Pampanga R., Left of Bagbag R.

/1 Size of Culvert: W - 5 m, H - 4.5 m, L - 42 m, 3 cell and w/sluice gate

/2 Size of Culvert: W - 2.5 m, H - 2.5 m, L - 48 m, 2 cell and w/flap & sluice gate

/3 Size of Culvert: W - 2.5 m, H - 2.5 m, L - 48 m, 1 cell and w/flap & sluice gate

Table 4.2.1 ALTERNATIVE PLANS FOR OPTIMIZATION OF IRRIGATION DEVELOPMENT

Parameters / Alternative Plans	Irrigation Service Area (ha)	San Antonio Reservoir Plan						Pampanga Pump Plan	
		Dam Axis		Maintaining Nat'l Flood Retent'n Volume in Swamp		Dead Capacity Utilization			
		Down-Stream	Upper Stream	Dam Capacity Increase	Downstream Improvement	No Use	Used by Pump	Return Flow	Present Flow
1	36,000	0	-	0	-	0	-	-	-
2	36,000	0	-	0	-	-	0	-	-
3	36,000	0	-	-	0	0	-	-	-
4	36,000	0	-	-	0	-	0	-	-
5	26,700	0	-	0	-	0	-	-	-
6	26,700	0	-	0	-	-	0	-	-
7	26,700	0	-	-	0	0	-	-	-
8	26,700	0	-	-	0	-	0	-	-
9	36,700	-	0	-	0	0	-	-	-
10	27,700	-	0	0	-	0	-	-	-
11	27,700	-	0	-	0	0	-	-	-
12	20,000	-	0	0	-	0	-	-	-
13	20,000	-	0	-	0	0	-	-	-
14	38,200	-	-	-	-	-	-	0	-
15	11,000	-	-	-	-	-	-	-	0

Table 4.2.2 FUTURE LAND USE IN THE IRRIGATION DEVELOPMENT (IN GROSS)

(Unit: ha)

Present Condition		Future Condition	
Item	Area	Item	Area
Rainfed	2,300	Irr. paddy field/1	2,000
		Right of way/2	200
		Rainfed area/3	100
Irr. paddy field	9,200	Irr. paddy field/1	8,100
		Right of way/2	800
		Irr. land/3	300
Grassland	100	Irr. paddy field/1	100
Swampy area	900	Irr. paddy field	800
		Right of way/2	100
Village/Road/Rivers/ Others	1,500	Village/Road/Rivers/ Others	1,500
Total Total	14,000		14,000

Remarks: /1: Irrigated land under the project

/2: The right of way for the land where new irrigation facilities are installed.

/3: The rainfed and irrigated land where are not contained in the project.

Table 4.2.3 DESIGN CRITERIA OF PROPOSED FARMING FOR PADDY WITH PROJECT

1.	Varieties	IR series
2.	Growing period	130 days
3.	Amount of seed	60 kgs
4.	Nursery period	15 - 20 days
5.	Area of nursery fed	1/20 - 1/25 of paddy field
6.	Land preparation	One times of ploughing, and 3 times of hallowing-leveling
7.	Planting method	Transplanting
8.	Planting density	30 cm x 15 cm, 3 seedlings per hill
9.	Planting depth	Within 3 cm from the surface
10.	Fertilization	
	Nursery bed	2 kgs of N/ha
	Paddy field	- 68 kgs of N/ha and 20 kgs of P/ha for wet season paddy
		- 88 kgs of N/ha and 20 kgs of P/ha for dry season paddy
	Time in paddy field	
	All P	Basic dressing
	35% of N	Basic dressing at transplanting time
	25% of N	First top dressing at two weeks after transplanting time
	40% of N	2nd top dressing in the late period of a young panicle formation stage
11.	Application of chemicals	2 //ha
12.	Weeding	Two time about 25th and 50th day after

Table 4.2.4 FUTURE UNIT YIELD OF PADDY

(Unit: ton/ha)

Item	Without Project	With Project
1) Paddy		
Irrigated land		
Wet season paddy	2.36	4.5
Dry season paddy	2.62	5.0
Rainfed land		
Wet season paddy	2.07	-
2) Mongo beans	0.4	0.4

Table 4.2.5 FUTURE CROP PRODUCTION AT FULL STAGE FOR THE IRRIGATION PROJECT

(Unit: ton of paddy)

Item	with Project	Without Project	Increment Diversion Dam Scheme
1) Paddy	104,500/1	25,100	75,300
Irrigated land			
Wet season paddy	49,500	13,000	36,500
Dry season paddy	55,000	12,100	42,900
Rainfed land			
Wet season paddy	0	4,100	-4,100
2) Mongo beans	0	300	-300

Remarks: /1: equivalent to 54,200 tons of milled rice

Table 4.2.6 10-DAY MEAN DISCHARGE AT ARAYAT

(Unit: m^3/s)

		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Jan.	1	115.8	54.5	163.1	46.8	36.7	32.7	56.1	739.3	23.2	27.7	151.8	223.1	77.9	81.7
	2	83.8	40.5	88.5	41.6	36.1	28.3	42.0	114.2	19.4	21.3	109.1	159.9	64.7	91.1
	3	79.3	50.1	102.8	38.8	30.1	23.1	33.9	68.8	16.5	16.1	160.8	96.0	47.2	91.7
Feb.	1	85.0	46.7	48.1	35.8	28.4	20.7	31.6	78.9	23.8	12.3	101.1	56.6	32.3	87.6
	2	47.9	41.7	39.8	29.8	19.1	16.2	32.2	66.0	22.4	11.2	59.3	37.6	23.1	72.4
	3	38.6	37.1	36.5	28.2	16.5	13.7	28.8	34.1	15.0	10.2	56.4	24.5	19.8	57.8
Mar.	1	32.9	32.7	36.8	28.1	13.6	12.9	22.9	25.4	6.7	19.8	42.8	27.4	17.8	33.2
	2	26.9	26.1	27.7	32.7	14.6	11.4	53.7	26.7	5.0	13.5	40.7	23.3	15.8	37.9
	3	25.2	20.9	23.0	23.0	12.9	12.4	24.9	35.4	2.9	10.9	47.7	15.2	14.6	42.3
Apr.	1	22.0	17.7	19.6	22.3	14.6	20.2	21.7	34.8	2.6	8.7	43.8	13.4	13.5	47.3
	2	19.6	12.3	18.4	20.1	16.1	20.1	19.0	25.6	3.5	7.5	43.2	23.3	12.2	52.0
	3	24.6	9.6	23.0	19.9	10.8	14.9	15.3	22.4	2.4	15.2	61.4	12.8	11.1	55.9
May	1	36.2	11.4	15.6	22.6	9.4	11.3	64.3	21.0	2.1	18.2	44.5	15.8	10.1	59.5
	2	22.6	127.1	17.8	21.2	15.8	11.1	54.2	23.1	4.1	7.7	41.6	28.6	9.2	44.8
	3	33.2	1,663.1	17.4	24.6	16.9	12.8	48.0	68.6	3.4	10.3	64.4	1,720.7	36.9	42.6
Jun.	1	198.9	417.6	275.8	28.1	22.4	24.8	278.9	73.1	4.4	42.8	117.5	277.0	46.1	113.2
	2	123.7	144.6	282.3	25.3	60.9	133.9	507.3	79.5	19.2	538.7	81.5	244.5	39.0	153.2
	3	133.5	158.6	88.3	26.3	25.4	101.3	359.9	70.2	28.1	64.3	102.1	255.4	70.8	220.0
Jul.	1	471.9	131.9	159.7	46.4	29.7	75.1	304.4	704.0	19.8	40.3	84.8	969.2	89.1	169.1
	2	1,195.5	300.6	174.1	36.9	43.6	188.5	711.8	2,070.8	92.4	199.3	41.2	280.0	92.9	307.7
	3	1,002.6	341.9	354.6	318.7	375.0	92.1	1,076.8	2,022.7	46.3	666.3	45.5	226.7	231.4	495.5
Aug.	1	622.5	38.2	1,149.2	399.0	1,318.0	177.8	583.4	1,897.2	45.5	145.1	62.3	336.6	364.9	281.3
	2	328.3	631.1	1,224.6	463.0	778.0	290.0	590.7	1,438.9	144.3	1,102.4	240.1	642.0	336.4	662.3
	3	233.1	322.7	1,106.2	916.3	144.4	456.9	139.0	1,301.5	602.8	1,216.0	212.5	568.6	430.5	1,117.0
Sep.	1	293.4	598.1	1,073.5	1,365.5	284.3	1,429.5	195.6	566.1	372.0	336.2	150.6	394.8	640.2	1,087.0
	2	588.8	1,437.1	902.5	855.9	585.7	1,032.5	263.0	728.0	219.0	253.5	202.5	524.9	726.8	896.0
	3	776.0	491.4	1,069.8	647.9	301.0	342.9	326.5	489.3	138.3	106.0	359.4	651.9	616.5	1,075.9
Oct.	1	483.0	108.3	647.4	829.7	339.5	405.4	354.8	789.9	354.8	95.4	159.0	559.5	500.3	1,030.0
	2	235.1	68.6	696.5	261.6	207.5	933.9	1,730.2	57.4	1,496.2	974.6	84.0	376.2	242.0	1,074.9
	3	78.9	39.4	576.3	103.0	104.4	620.5	596.9	42.1	710.8	1,021.7	358.7	363.1	138.1	626.9
Nov.	1	365.2	85.5	889.0	53.9	43.2	500.0	125.5	160.7	64.6	1,323.6	173.7	367.3	110.0	1,727.3
	2	209.3	171.2	402.9	42.7	33.0	215.6	119.3	94.8	63.8	990.1	41.9	347.2	111.6	475.4
	3	86.6	1,359.3	114.9	51.0	130.4	391.8	488.7	66.6	595.1	404.6	26.3	195.4	887.6	407.1
Dec.	1	65.6	740.1	83.2	171.8	50.5	243.7	445.1	97.9	94.8	345.3	41.9	98.2	221.7	429.6
	2	91.1	166.7	65.2	48.8	76.2	136.5	219.3	63.1	63.7	391.1	98.7	94.4	131.6	375.1
	3	76.3	203.2	55.9	34.5	41.0	94.9	282.0	32.0	34.4	243.8	376.3	70.4	132.4	305.9
Average		231.5	296.8	337.2	199.2	144.7	226.4	296.1	378.4	149.4	298.1	116.0	309.4	176.9	396.4

Table 4.2.7 SUMMARY OF FINANCIAL CONSTRUCTION COST FOR IRRIGATION DEVELOPMENT

(Unit: ₱10^6)

Item	Foreign Currency	Peso Currency	Total
1. Direct Construction Cost	(146.43)	(160.53)	(306.96)
(1) Diversion Dam	86.00	63.97	149.97
(2) Irrigation Facilities	25.19	33.40	58.59
(3) Drainage Facilities	28.44	42.88	71.32
(4) Farm Road	6.15	6.64	12.79
(5) On-Farm Development	0.65	13.64	14.29
2. Cost for O&M Facilities	4.10	4.50	8.60
3. Compensation Cost for Land Acquisition	-	33.00	33.00
4. Engineering Cost	22.10	12.30	34.40
Sub-Total	172.63	210.33	382.96
5. Physical Contingency	19.17	30.37	49.54
Total	191.80	240.70	432.50
6. Price Contingency	64.70	130.90	195.60
Grand Total	256.50	371.60	628.10

Table 6.5.1 DISTANCE AND AFFECTED PERIOD OF SEAWATER INTRUSION ON PAMPANGA RIVER (Average 1968 - 1978)

Channel Condition	Discharge Condition			
	Present		Irrigation Project /1	
	Intruded Distance (km)	Affected Period (day)	Intruded Distance (km)	Affected Period (day)
1. At Channel Bottom				
a. Existing Channel	22.7	145	28.9	156
b. Improved Channel /2 (Basic Plan)	29.6	163	32.7	173
c. Improved Channel /3 (Stepwise Plan)	26.9	157	30.5	169
d. Improved Channel /4 (First Phase, Stepwise Plan)	24.6	153	29.1	167
2. At 1 m below Water Surface				
a. Existing Channel	1.3	138	2.3	155
b. Improved Channel (Basic Plan)	2.5	149	3.4	161
c. Improved Channel (Stepwise Plan)	2.2	146	3.2	161
d. Improved Channel (First Phase, Stepwise Plan)	1.8	146	2.8	159

Remarks /1: Diversion dam scheme of irrigation project.
/2: Improved channel by basic flood control plan with 100-yr design flood.
/3: Improved channel by stepwise flood control plan with 20-yr design flood.
/4: Improved channel by first phase, stepwise plan corresponding 10-yr flood.

Table 6.6.1 SUMMARY OF EVALUATION AND EFFECTS ON FLOOD CONTROL PROJECT

Item	Stepwise Plan with 20-Year Design Flood
1. Internal Rate of Return	10.8%
2. Average Annual Benefit	₱91,900,000
3. Construction Cost	
Economic Cost	₱639,800,000
Financial Cost	₱796,900,000
Local Currency	₱413,500,000
Foreign Currency	₱383,400,000
4. Annual O&M Cost	₱4,000,000
5. Decrease in Inundation Area	19,000 ha
6. Increase of Paddy Production	14,800 tons/yr
7. Decrease in Inundated House	13,400 houses
8. Employment Opportunity during Construction Period	1,500,000 man-days
9. Increase of Fish Production	2,400 tons/yr

Table 6.6.2 SUMMARY OF EVALUATION AND EFFECTS ON THE IRRIGATION PROJECT

	Item	
1.	Internal Rate of Return (%)	15.4
2.	Irrigation Benefit (₱10^6)	98.4
3.	Cosntruction Cost (₱10^6)	
	- Economic	356.2
	- Financial	432.5
	- Financial with price contingency	628.1
4.	Annual O&M Cost (₱10^6)	4.0
5.	Irrigation Service Area (ha)	
	- Wet Season	11,000
	- Dry Season	11,000
6.	Annual Incremental Rice Production (ton)	47,000
7.	Employment Opportunity (10^6 man-days)	
	- Construction Period	1.9
	- Annual Increase Due to Farm Activities	1.5
8.	Incremantal Net Reserve for Typical Farm (₱/household)	3,369
9.	Irrigation Fee (₱/household)	545
10.	Balance between 8 and 9 (₱/household)	2,824
11.	Potentiality for Fisheries Development	to be expected
12.	Paddy Field to be Submerged (ha)	100

Fig. 3.3.1 MEAN ANNUAL RAINFALL MAP

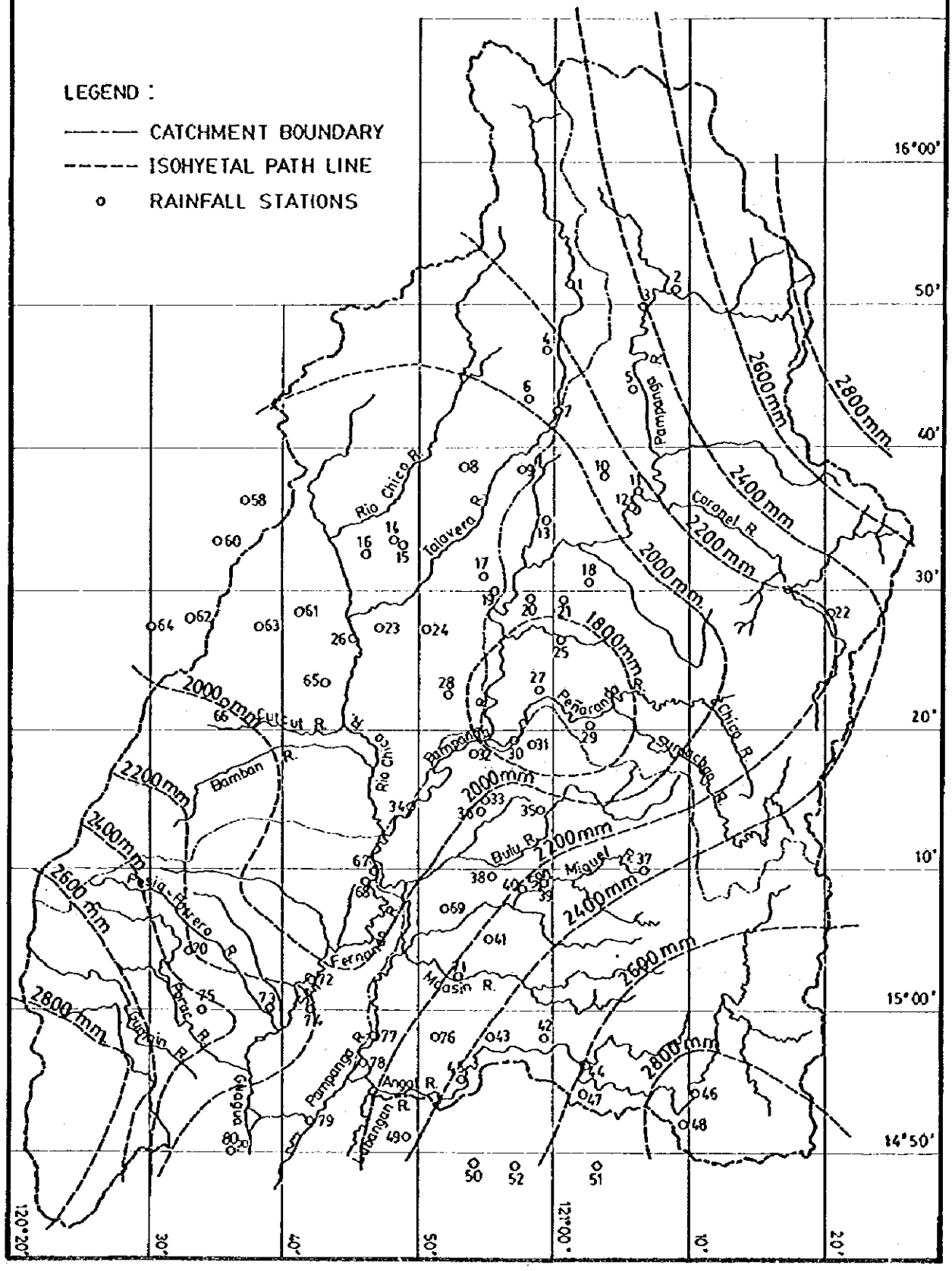


Fig. 3.3.2 ANNUAL PATTERN OF MEAN MONTHLY DISCHARGE

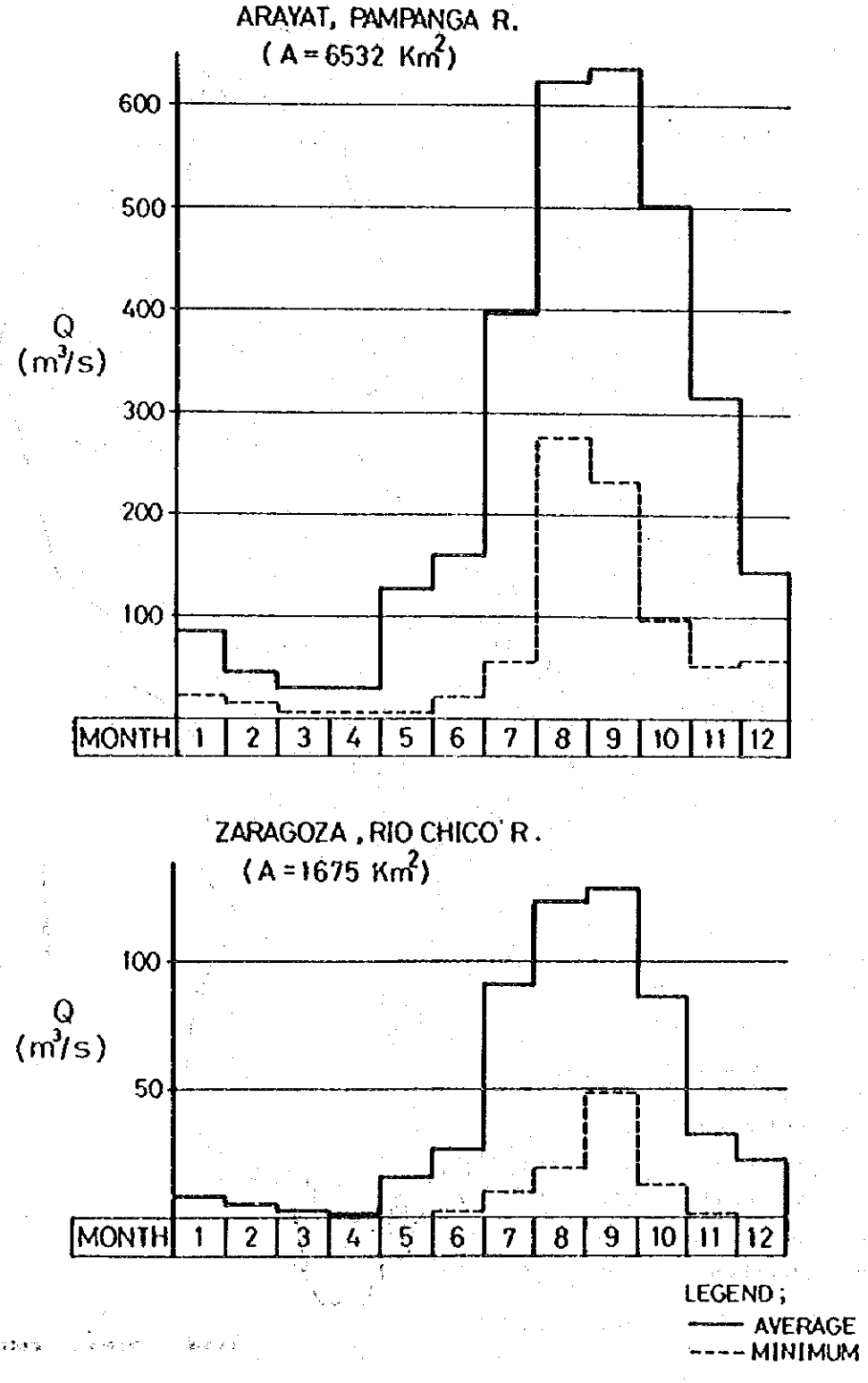


Fig. 3.4.1 SOIL AND LAND CAPABILITY MAP IN THE IRRIGATION DEVELOPMENT AREA

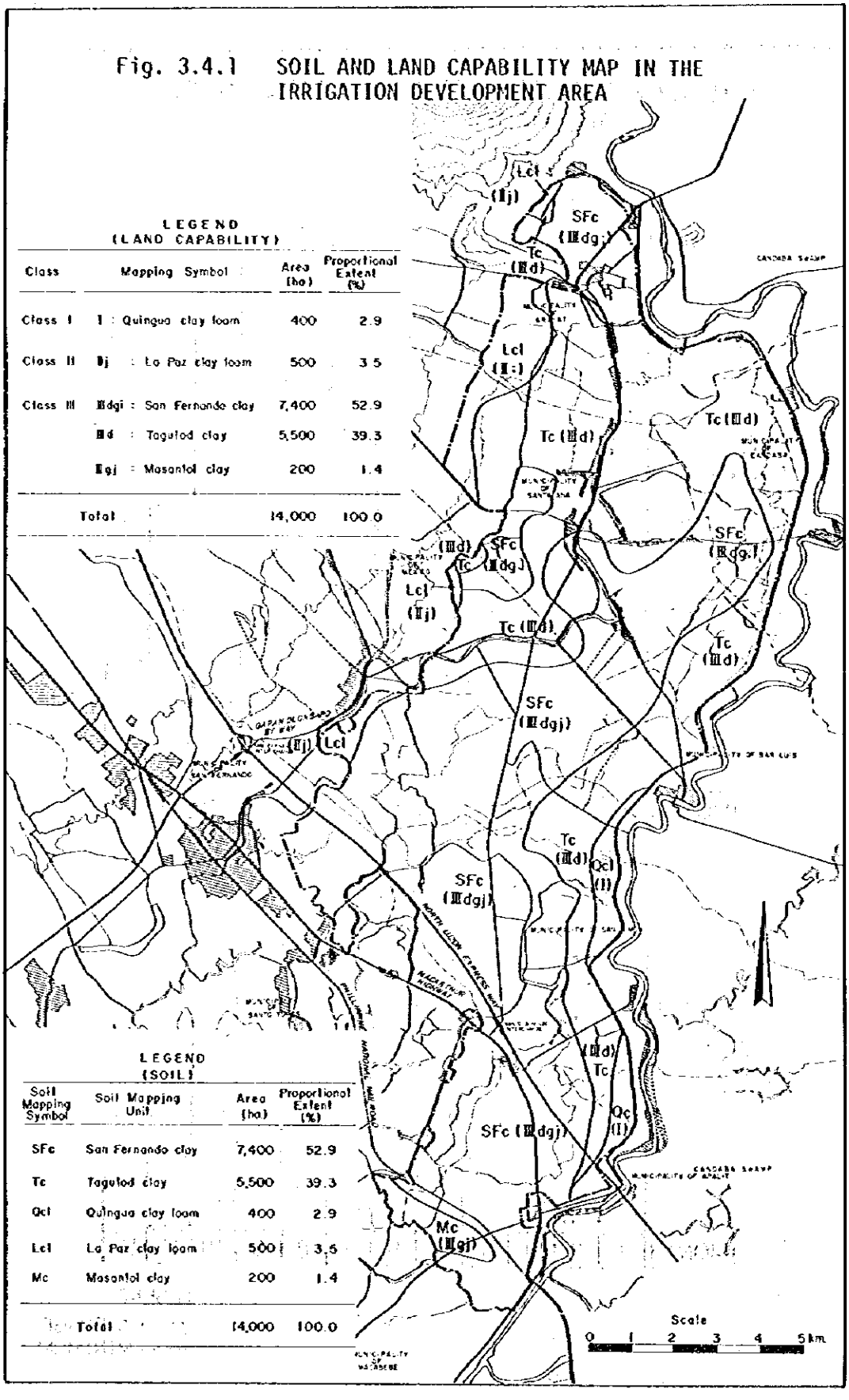


Fig. 3.7.1 PRESENT LAND USE IN THE IRRIGATION DEVELOPMENT AREA

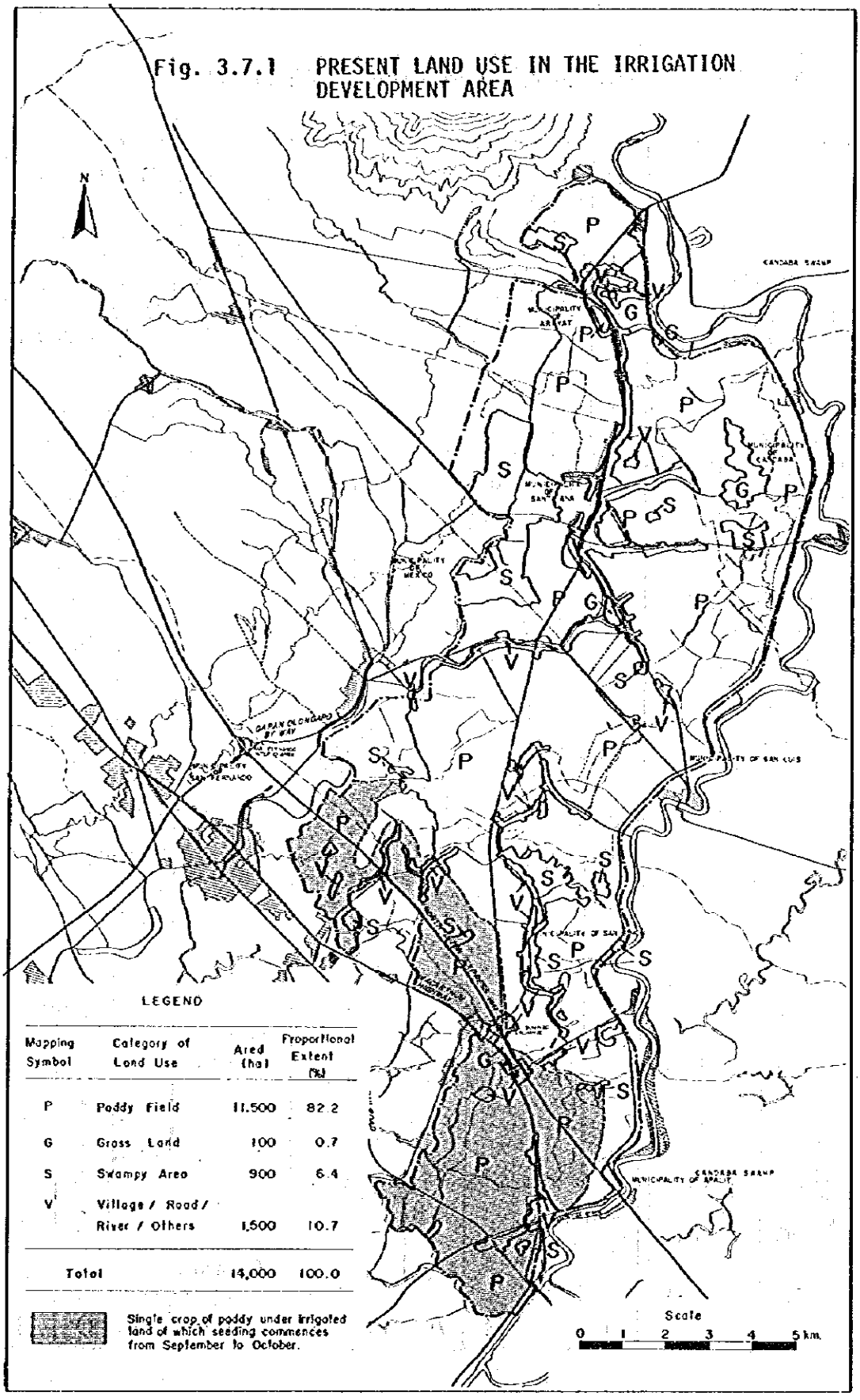


Fig. 3.7.2 PRESENT CROPPING PATTERN

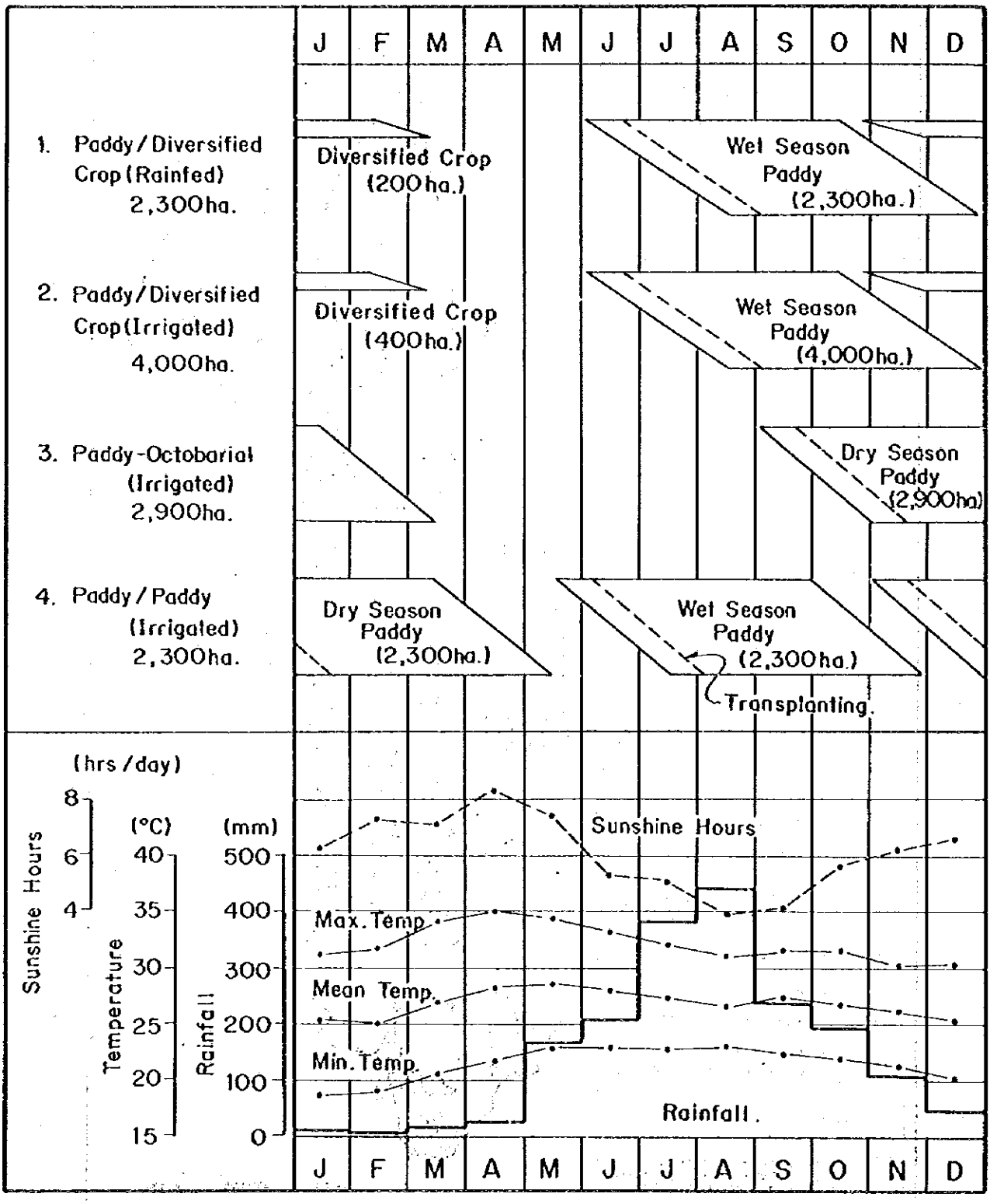
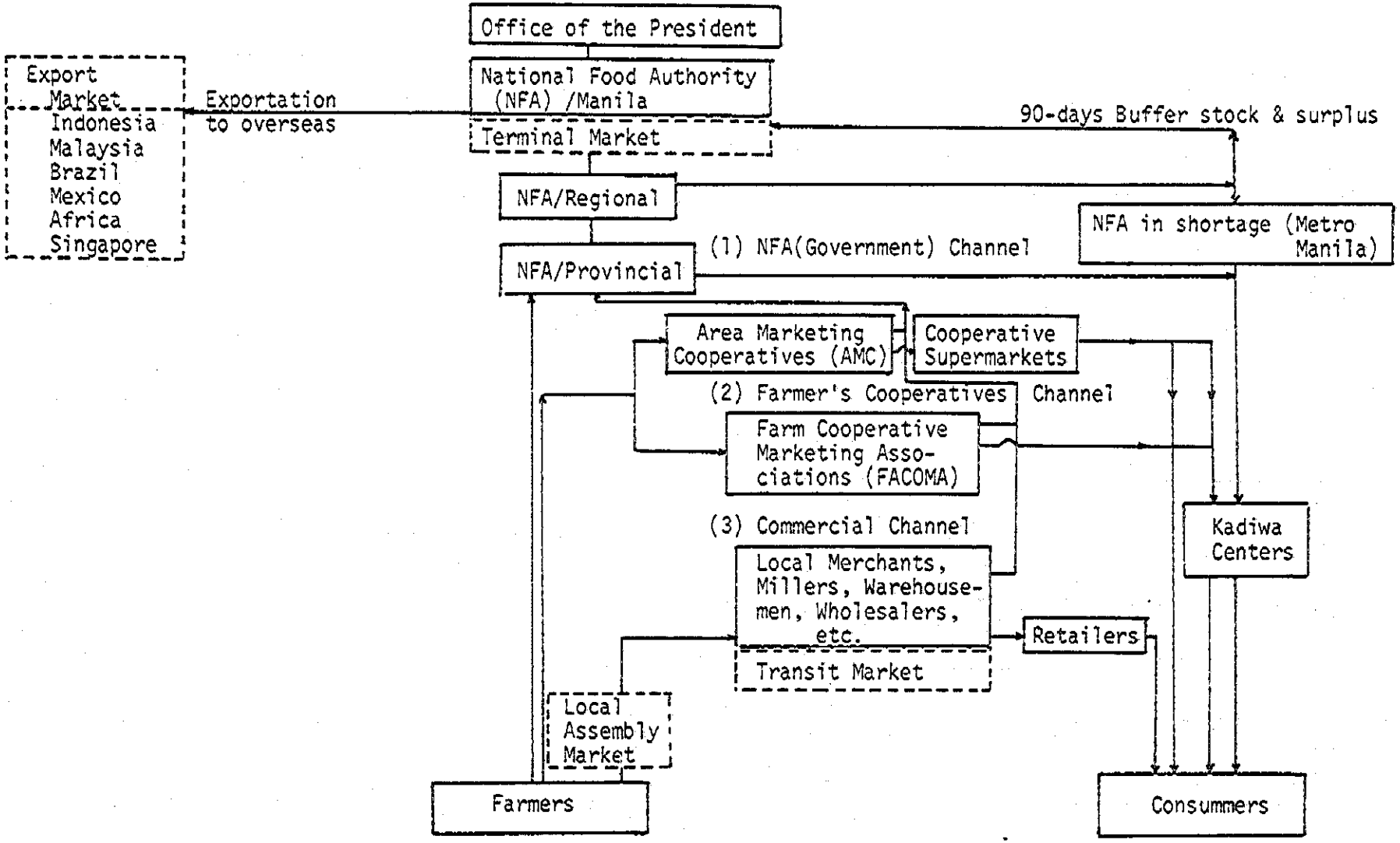
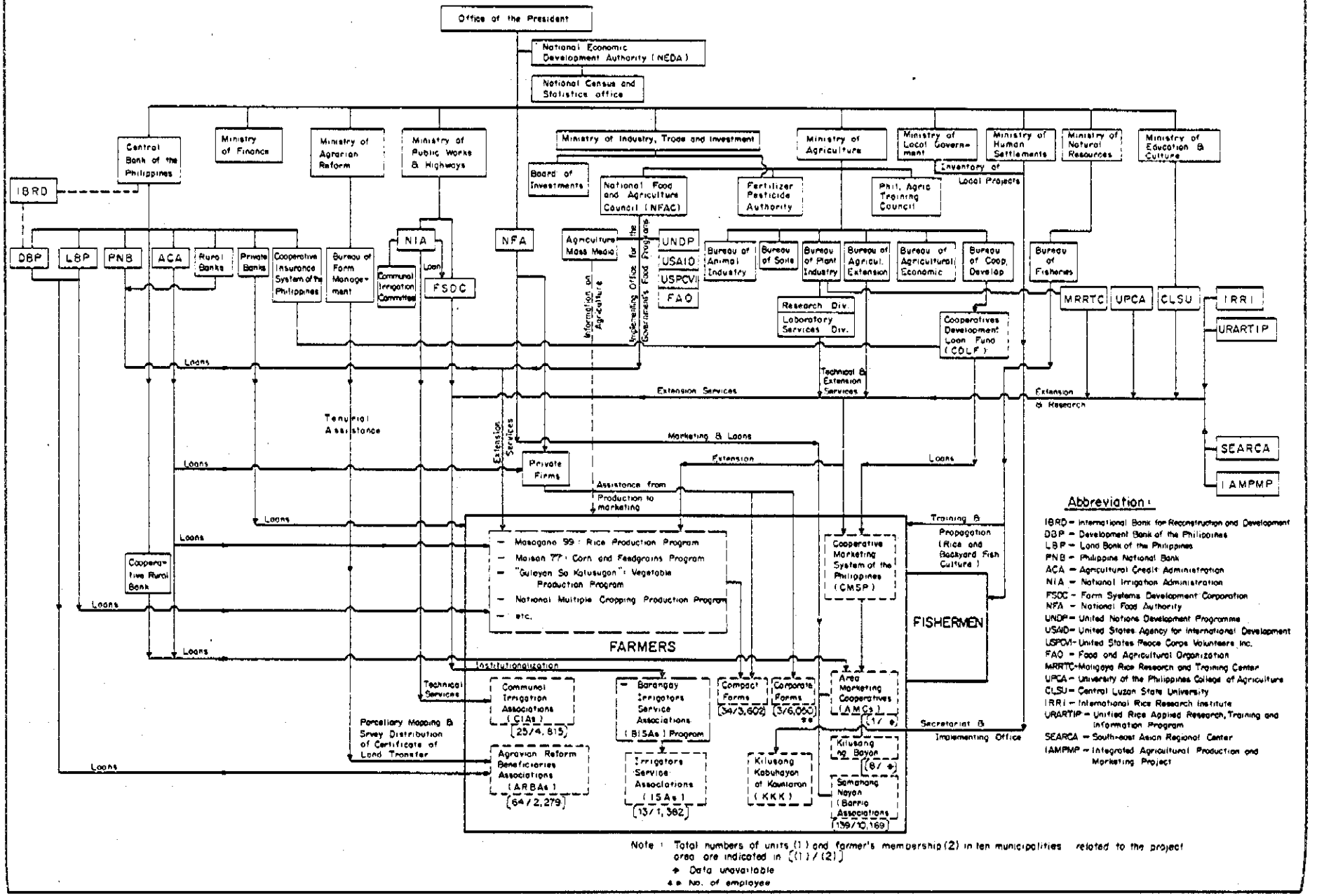


Fig. 3.11.1 MARKETING FLOW CHART OF RICE (OR PADDY)



Source: National Food Authority, Statistics Department, Manila

Fig. 3.12.1 NATIONAL DEVELOPMENT ORGANIZATION FOR AGRICULTURAL & FOOD PRODUCTION PROGRAMS



Note : Total numbers of units (1) and farmer's membership (2) in ten municipalities related to the project area are indicated in (1)/(2)

* Data unavailable

** No. of employee

Fig. 3.13.1 PAMPANGA AND PASAG RIVER BASINS GENERAL MAP

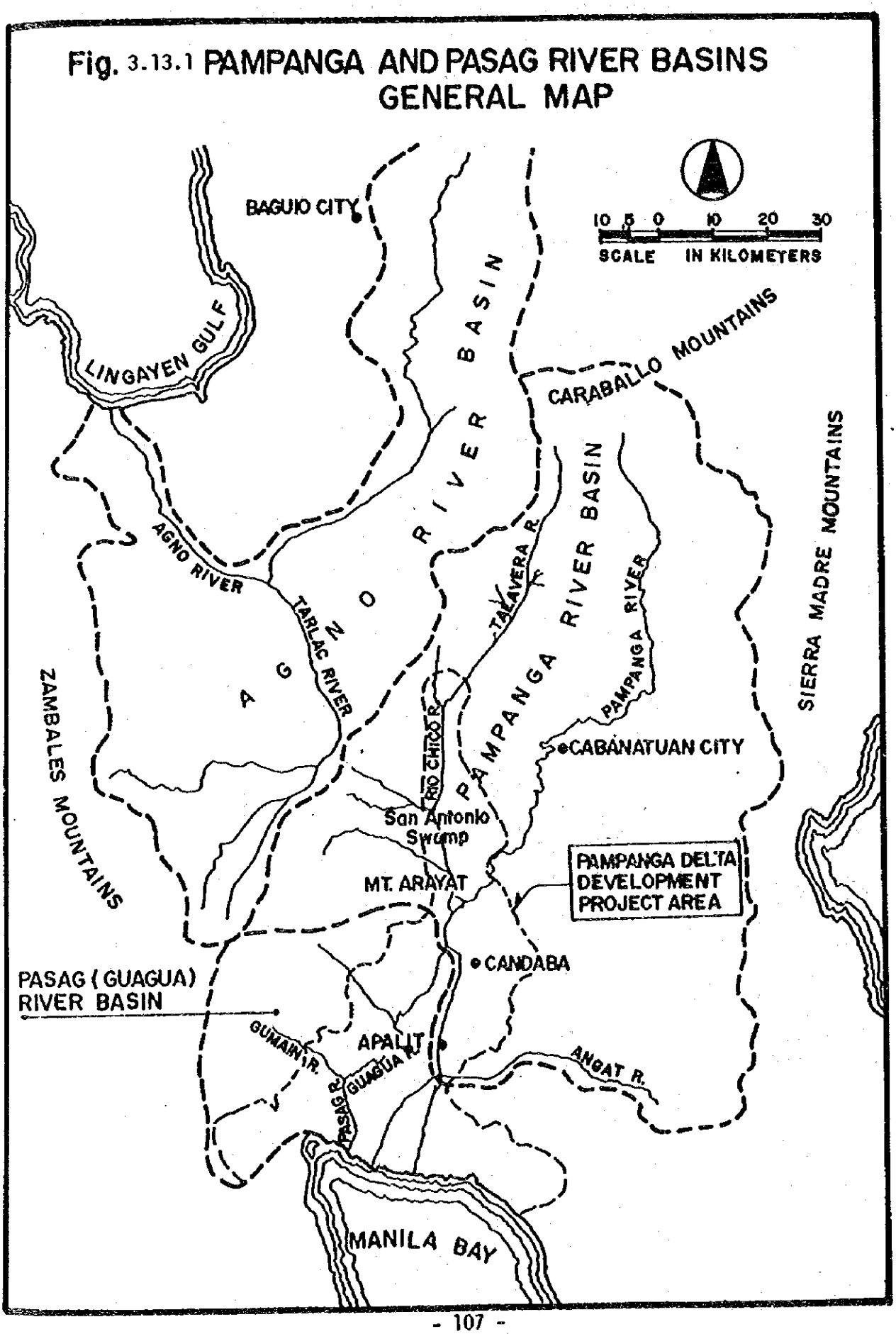


Fig. 3.13.2 PAMPANGA AND PASAG (GUAGUA) RIVER BASINS
MAIN HYDROGRAPHIC NETWORK AND CATCHMENT AREAS

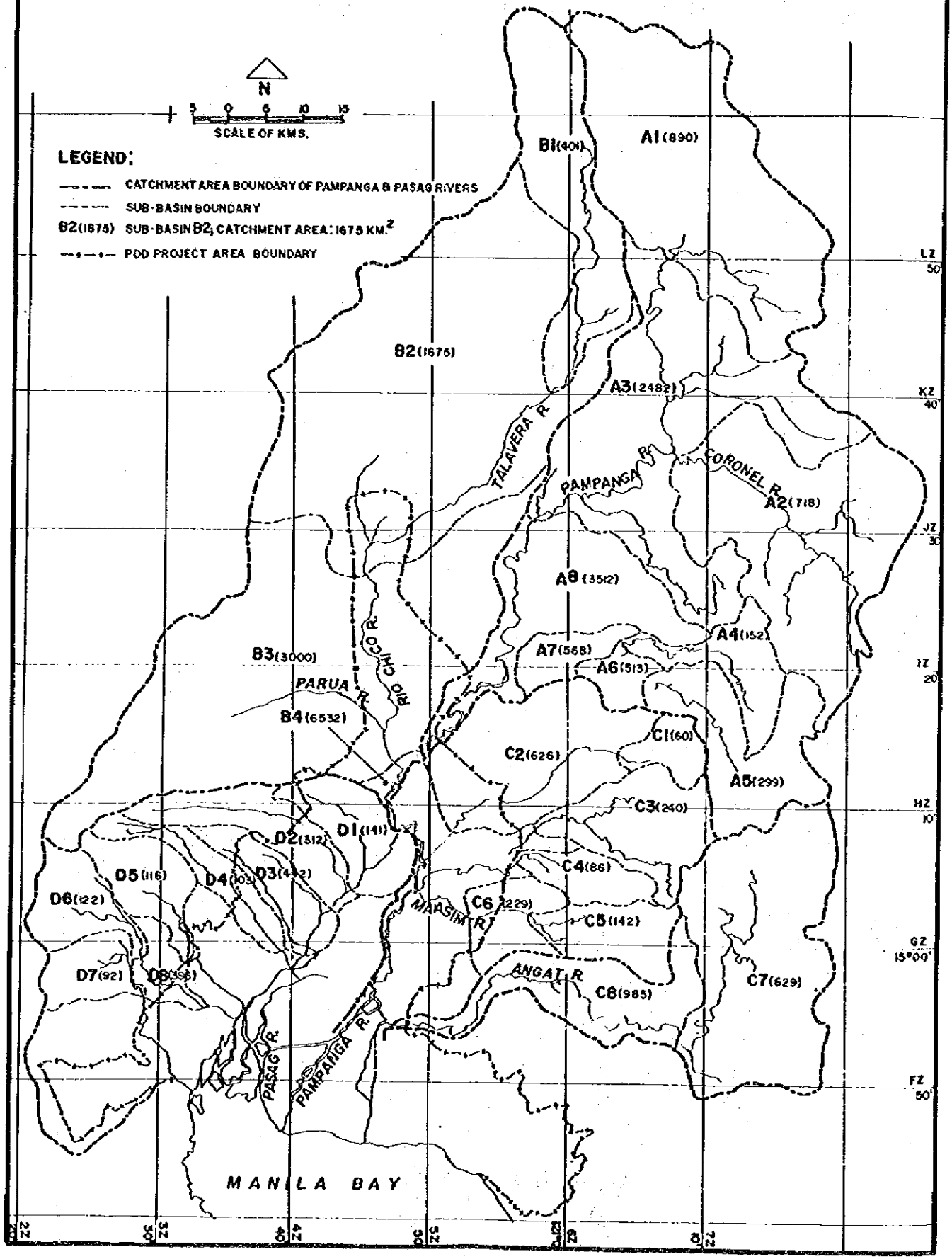


Fig. 3.13.3 LONGITUDINAL PROFILE OF PAMPANGA AND RIO CHICO RIVERS

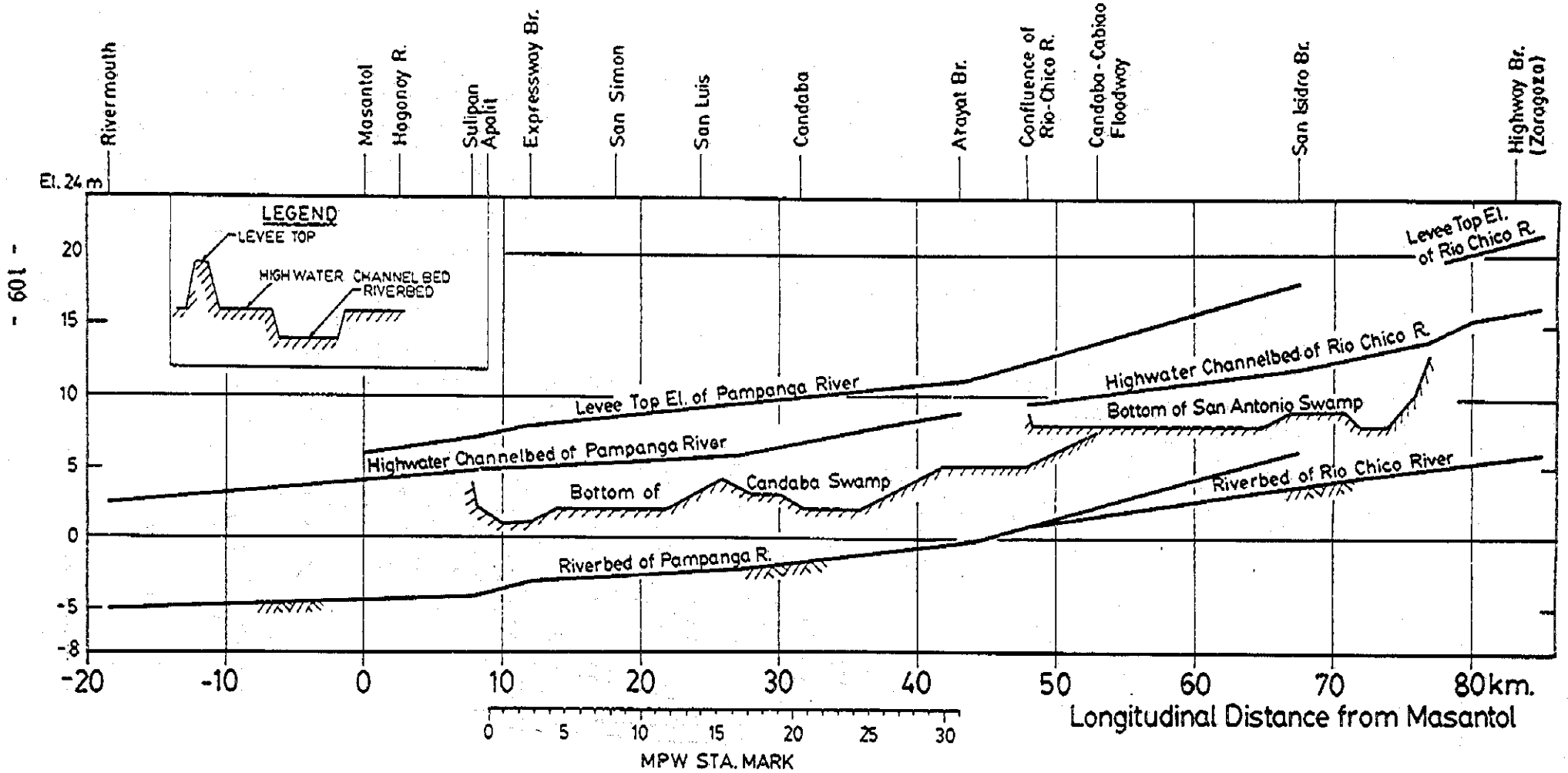


Fig. 3.13.4 MPW SCHEMATIC FLOOD FLOW DIAGRAM

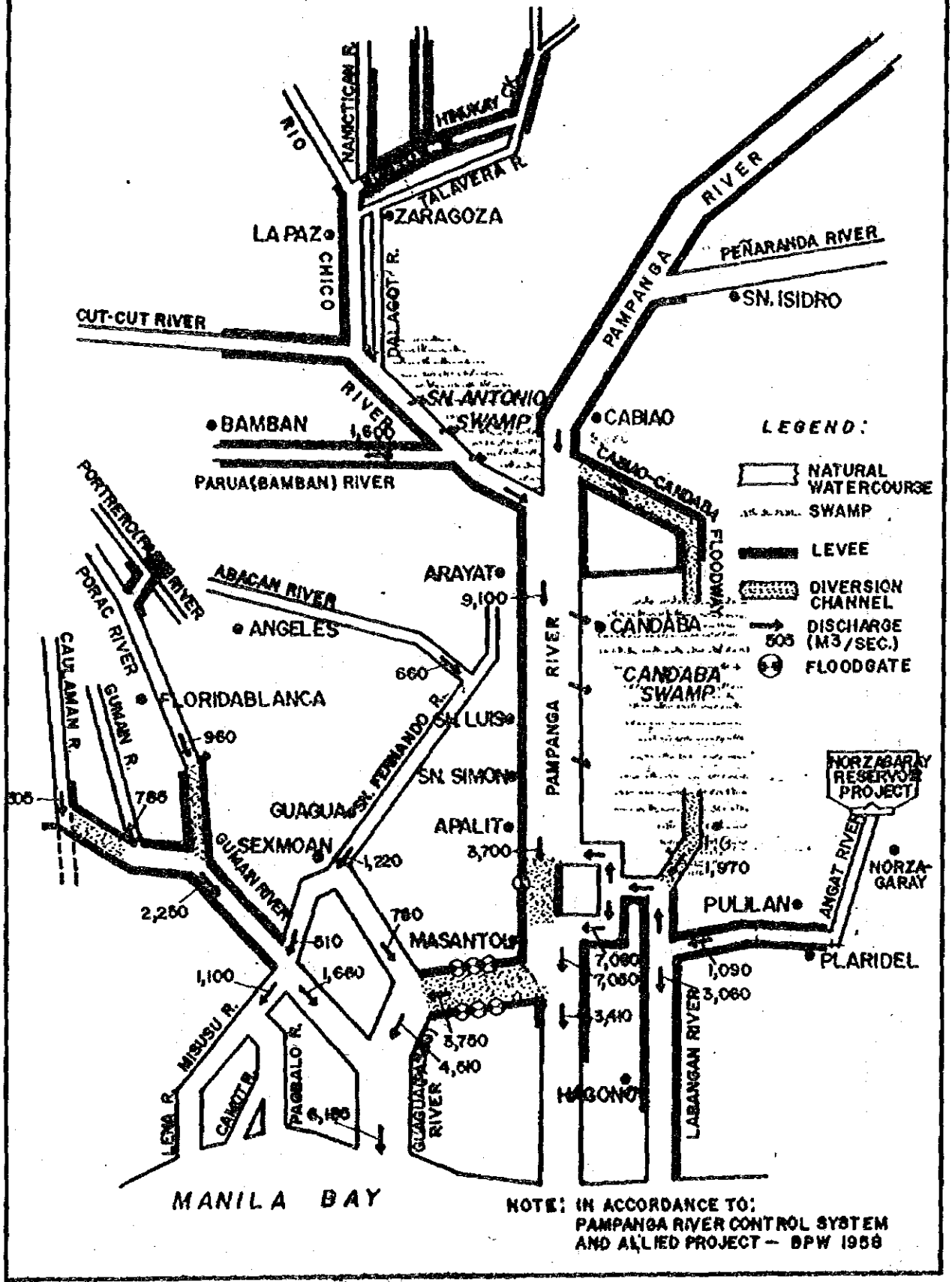


Fig. 3.13.5 MPH FLOOD CONTROL AND DRAINAGE WORKS IN THE PAMPANGA DELTA AREA

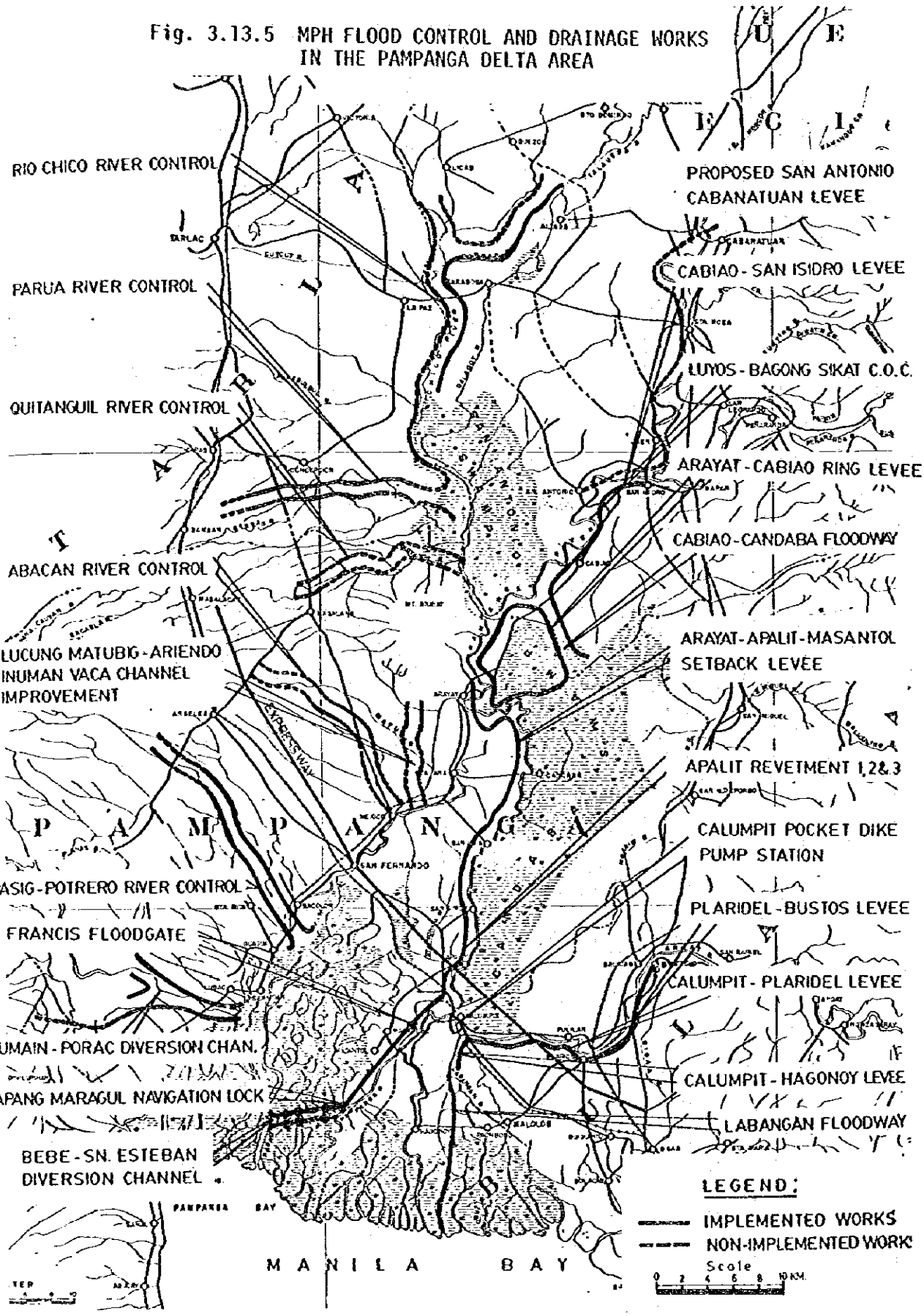
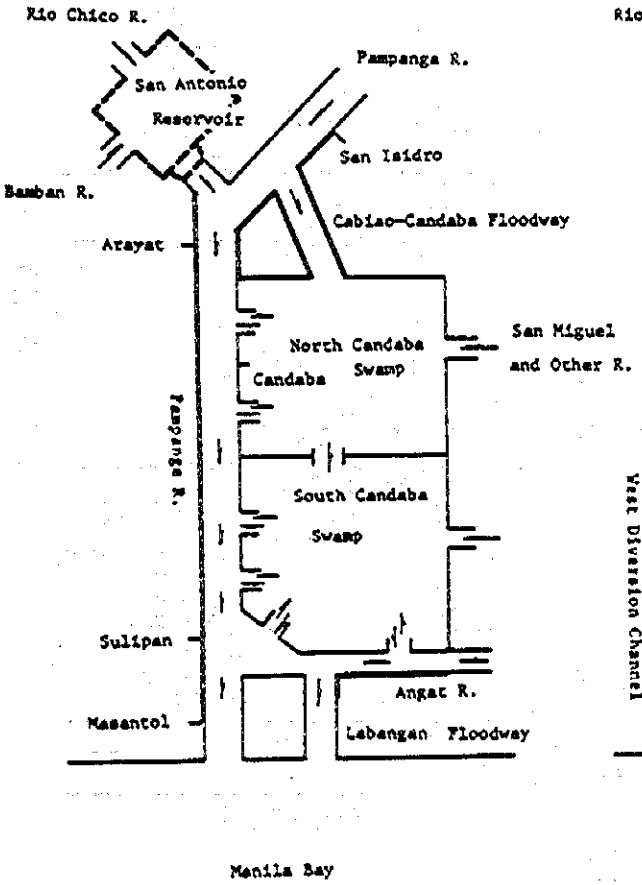


Fig. 3.13.6 POSSIBLE INUNDATION AREA AND TYPICAL FLOOD FLOW DIRECTIONS

Fig. 4.1.1 HYDRAULIC SIMULATION MODEL FOR FLOOD CONTROL PLANS

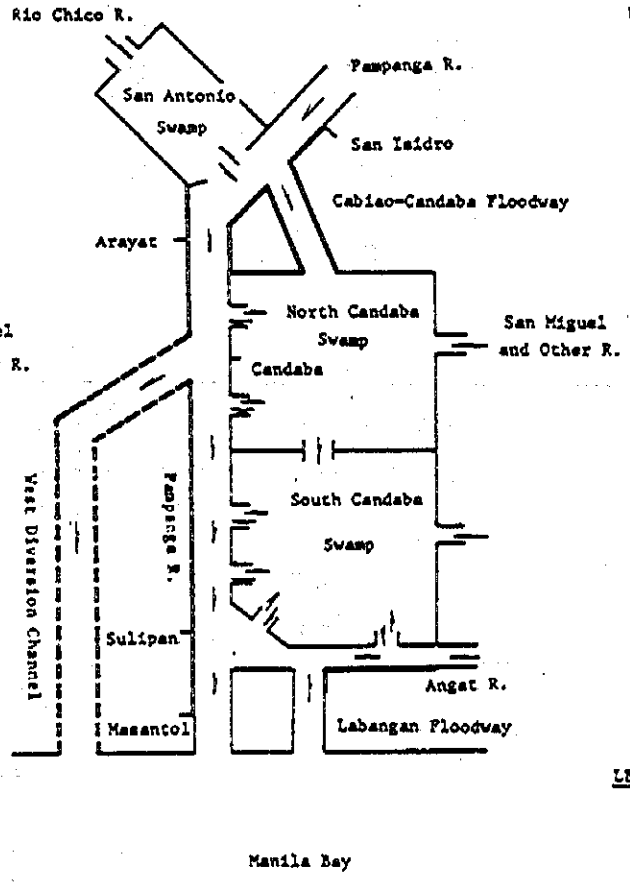
Case 1 :

Flood Control by San Antonio Reservoir



Case 2 :

Flood Control by West Diversion Channel



Case 3 :

Flood Control by Channel
Improvement of Main Pampanga River

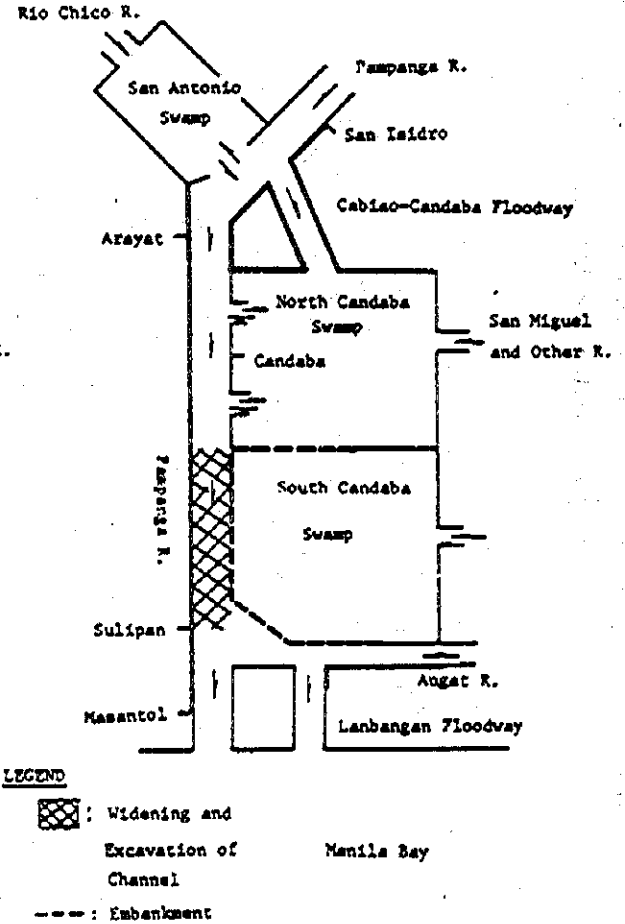


Fig. 4.1.2 FLOOD DISCHARGE DISTRIBUTION FOR BASIC PLAN

(Plan with 100-yr. Design Flood)

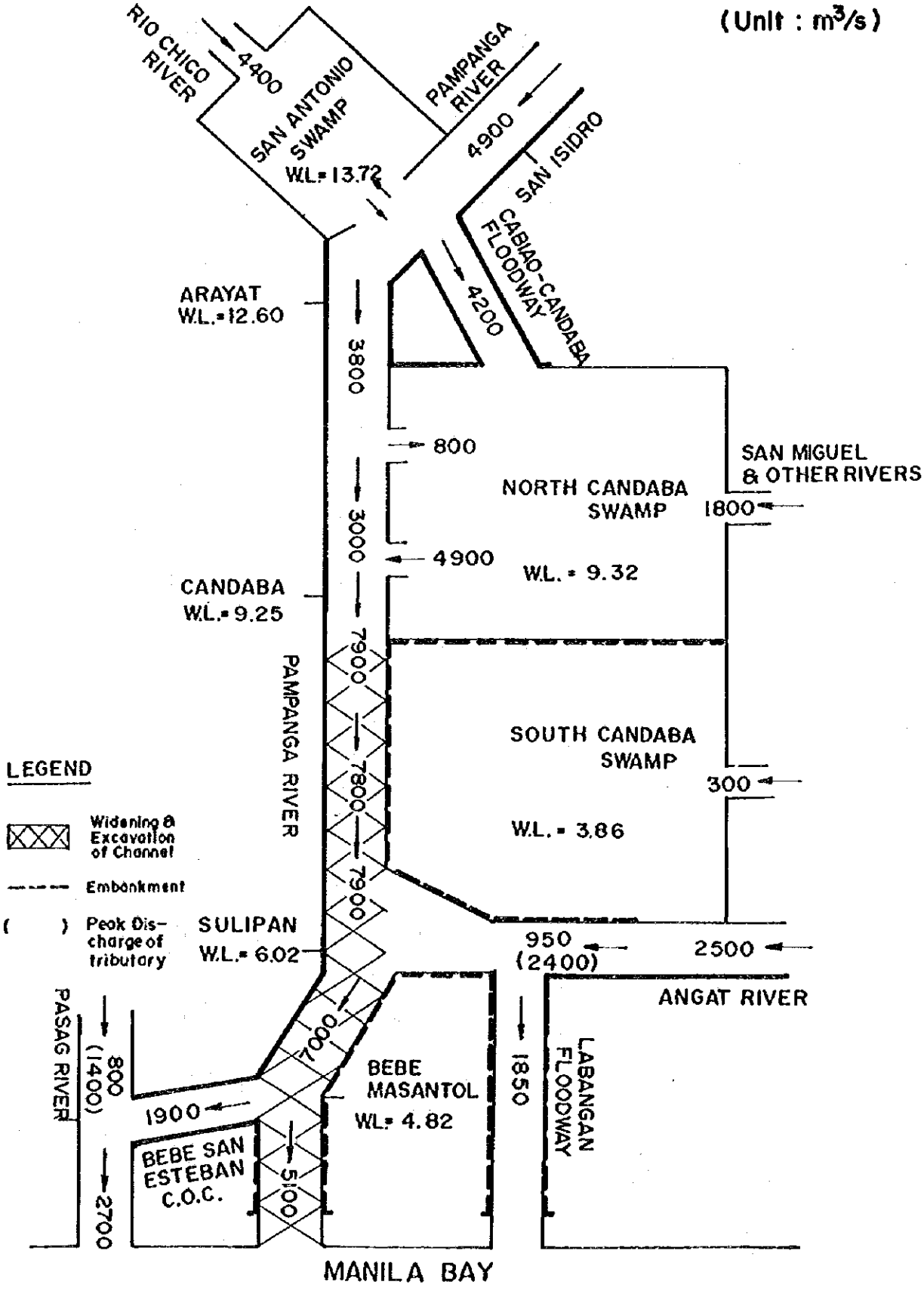


Fig. 4.1.3 FLOOD DISCHARGE DISTRIBUTION FOR STEPWISE PLAN
(Plan with 20-yr. Design Flood)

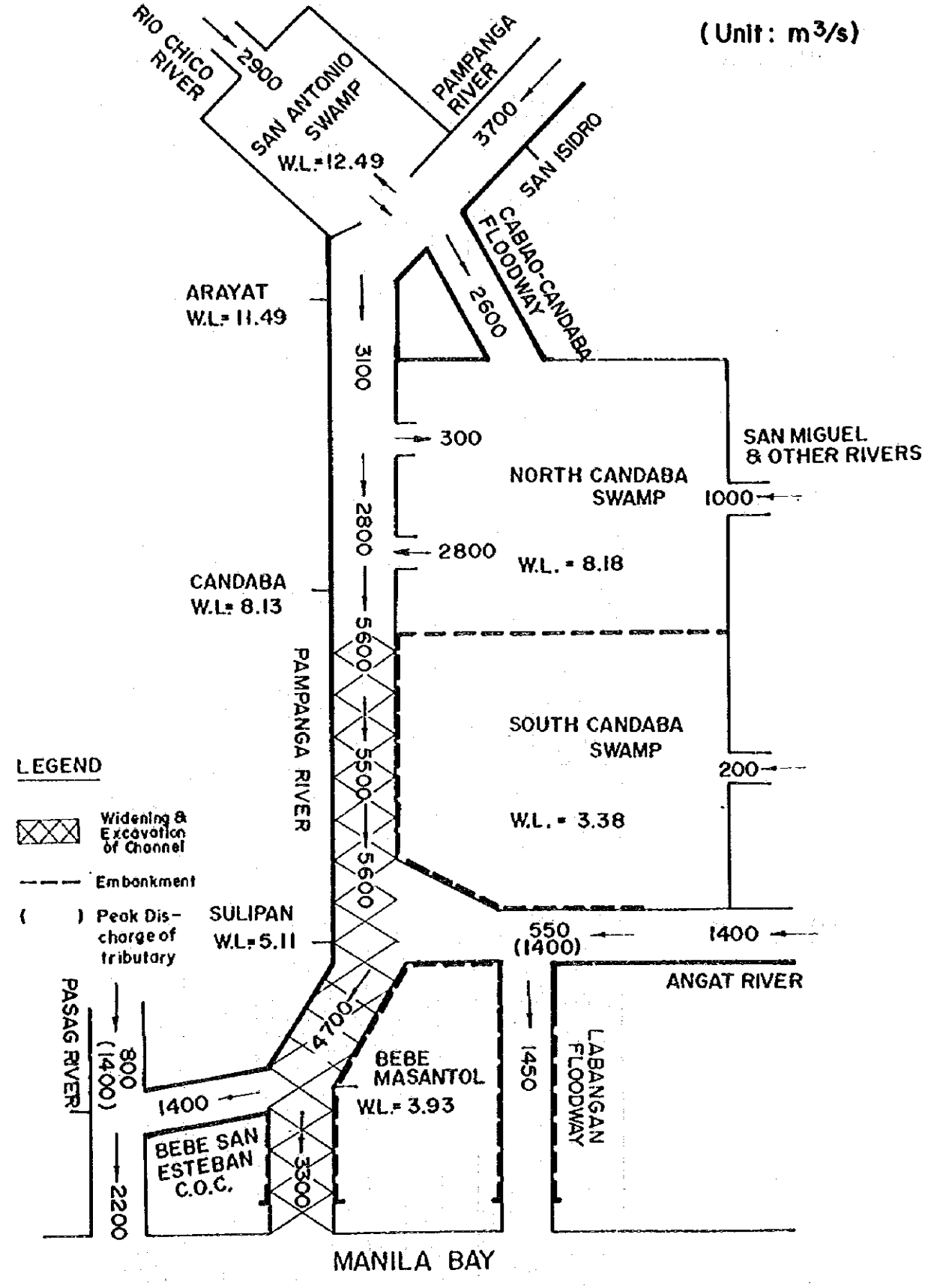
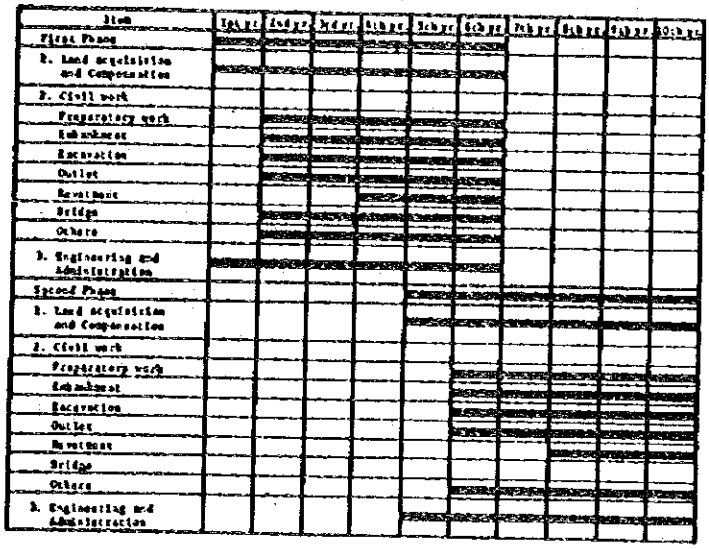
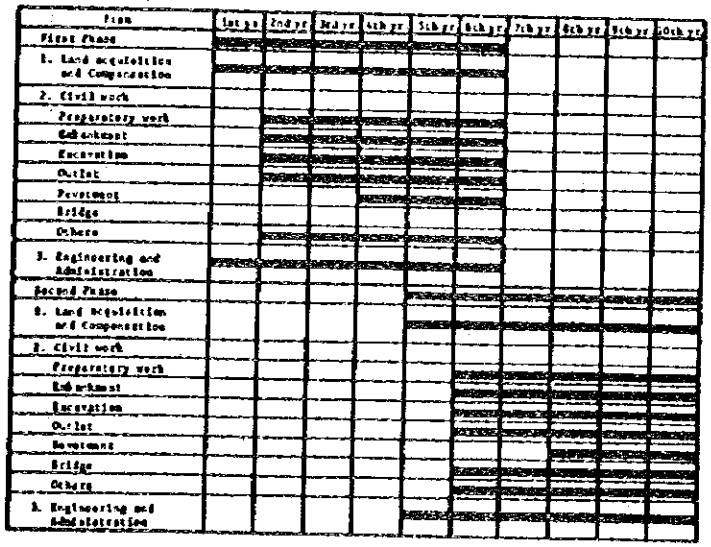


Fig. 4.1.4 CONSTRUCTION SCHEDULE

Alternative - 1



Alternative - 2



Alternative - 3

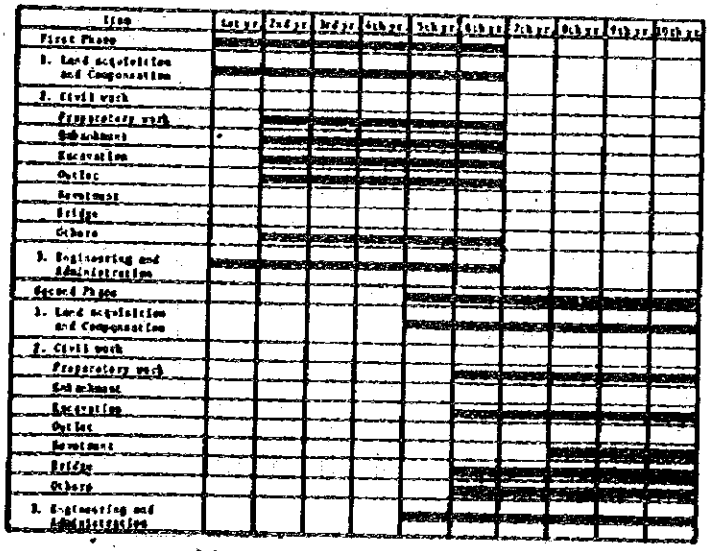


Fig. 4.1.5 (1) FLOOD DISCHARGE DISTRIBUTION

(Plan with 20-yr. Design Flood,
First Phase Alternative I)

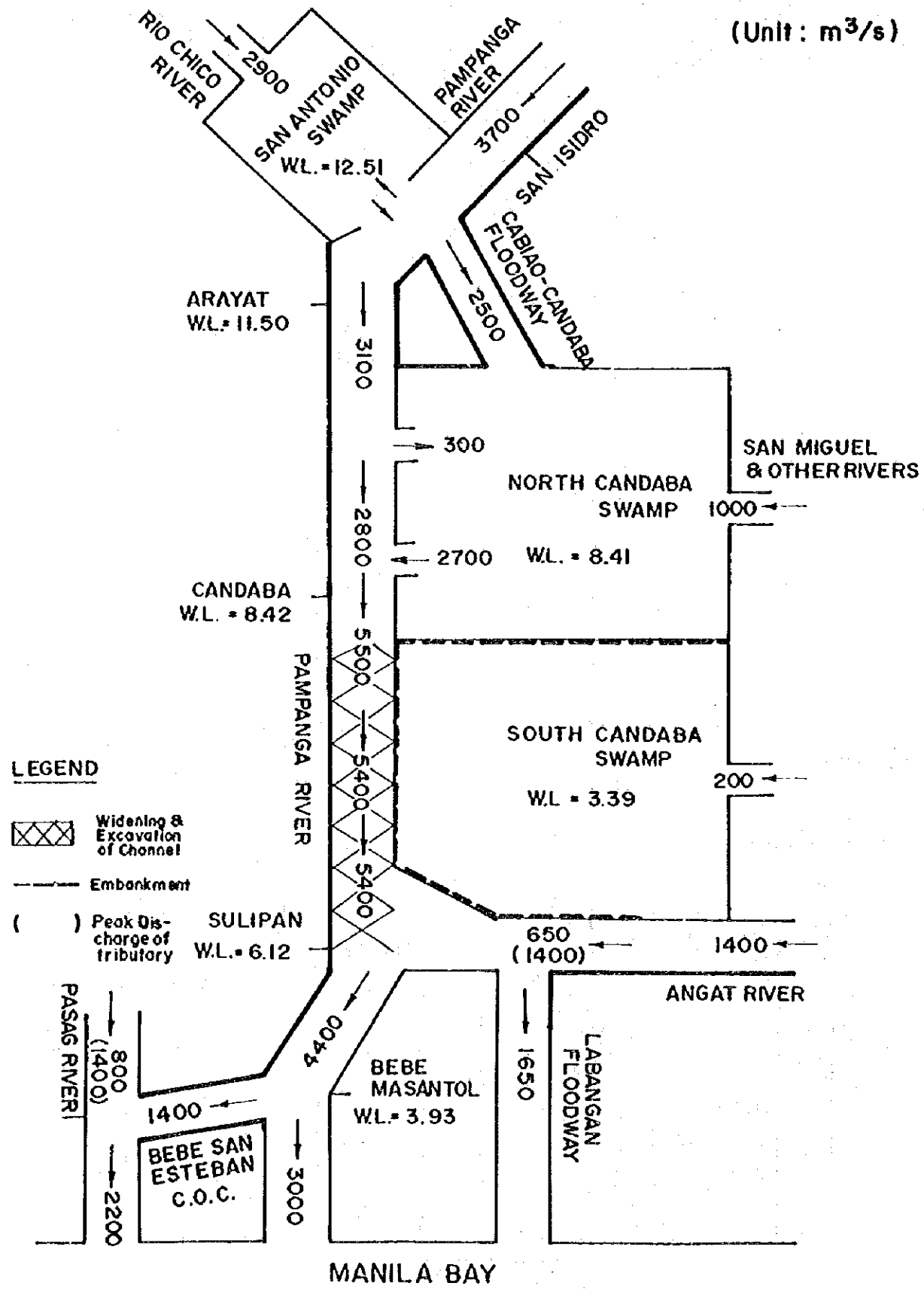


Fig. 4.1.5 (2) FLOOD DISCHARGE DISTRIBUTION
(Plan with 20-yr. Design Flood,
First Phase Alternative 2)

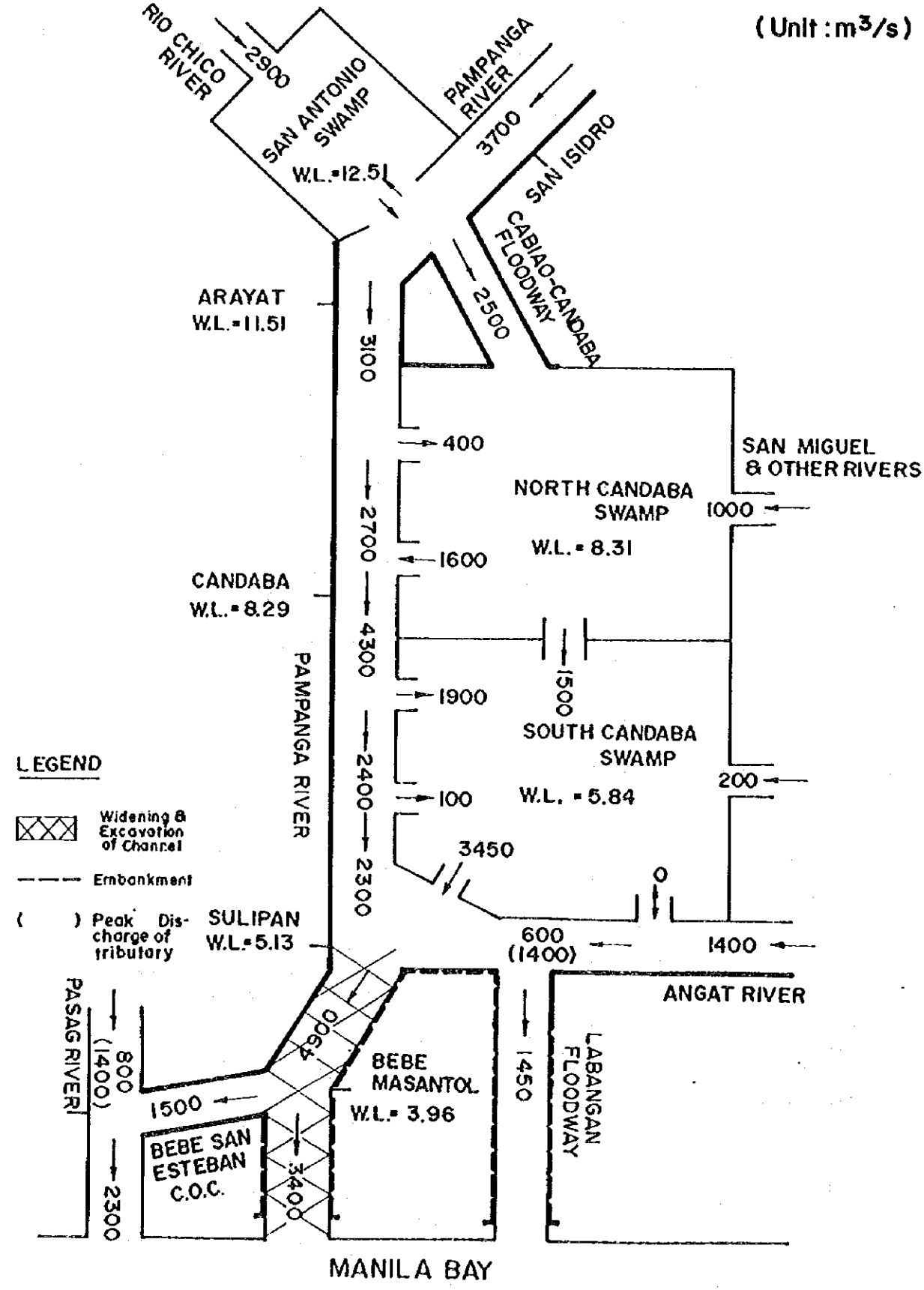


Fig. 4.1.5 (3) FLOOD DISCHARGE DISTRIBUTION
(Plan with 10-yr. Design Flood,
First Phase Alternative 3)

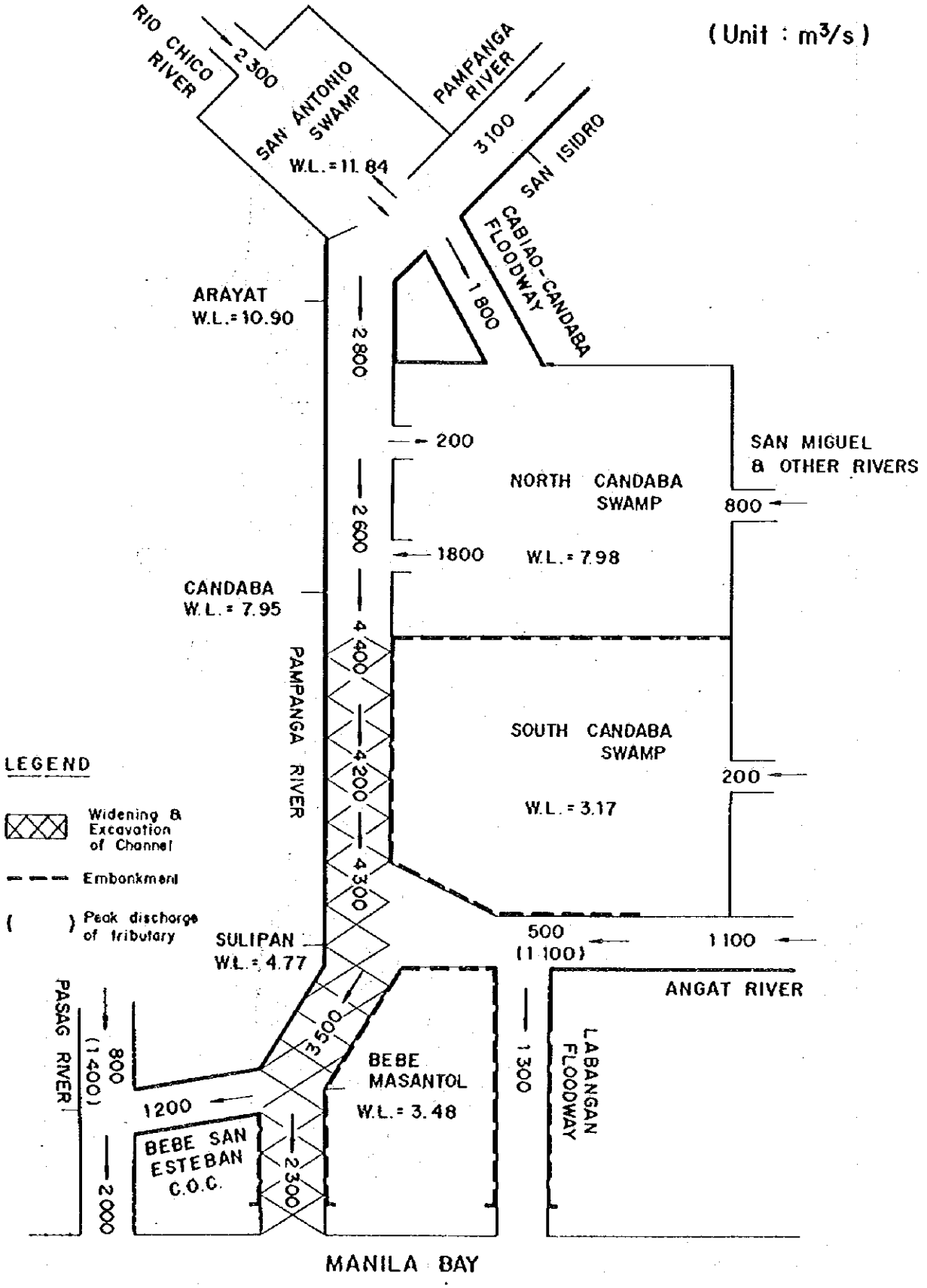


Fig. 4.2.1 GENERAL LAYOUT OF IRRIGATION PLAN

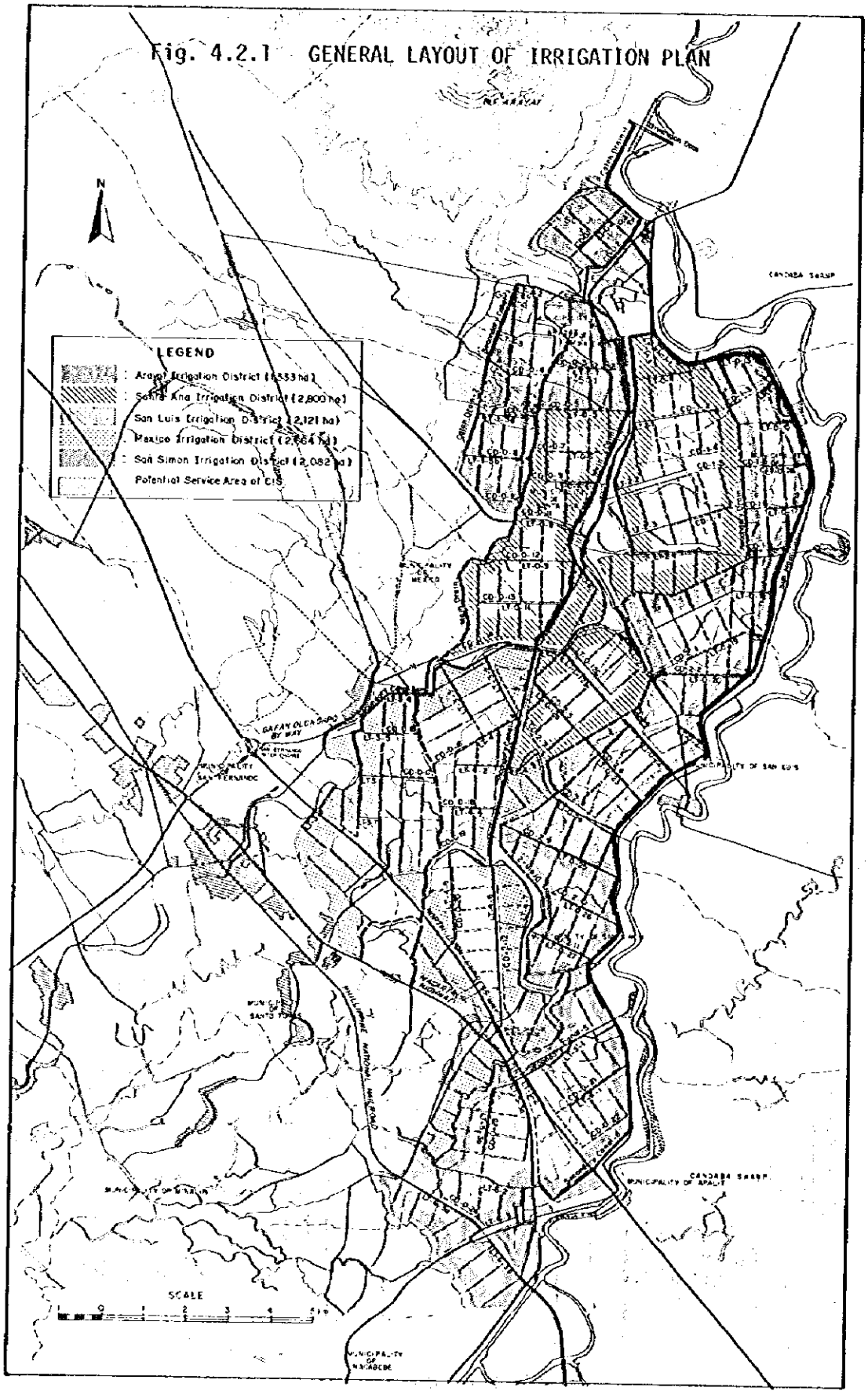


Fig. 4.2.2 PROPOSED CROPPING PATTERN

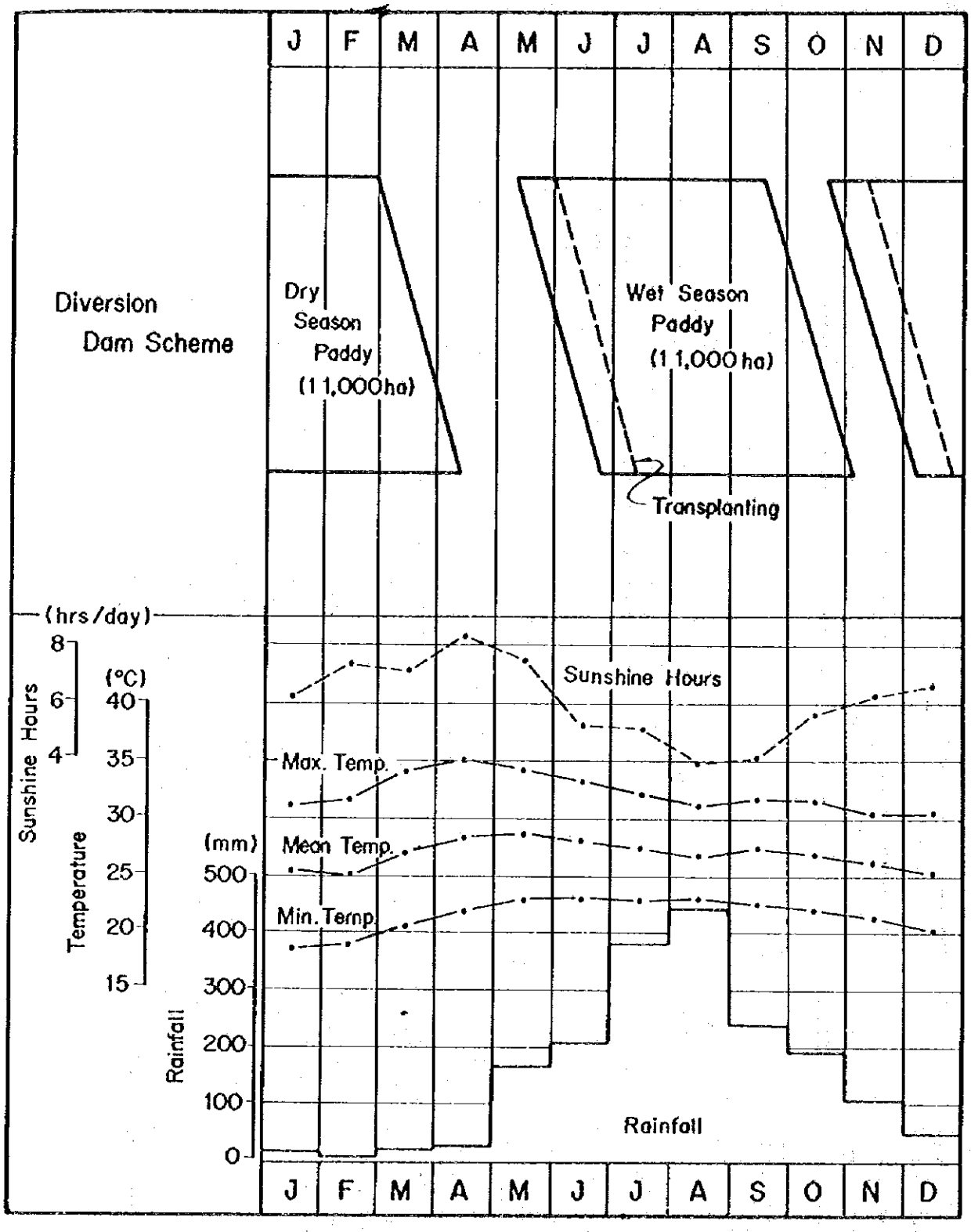


Fig. 4.2.3 IMPLEMENTATION SCHEDULE FOR THE SCHEME

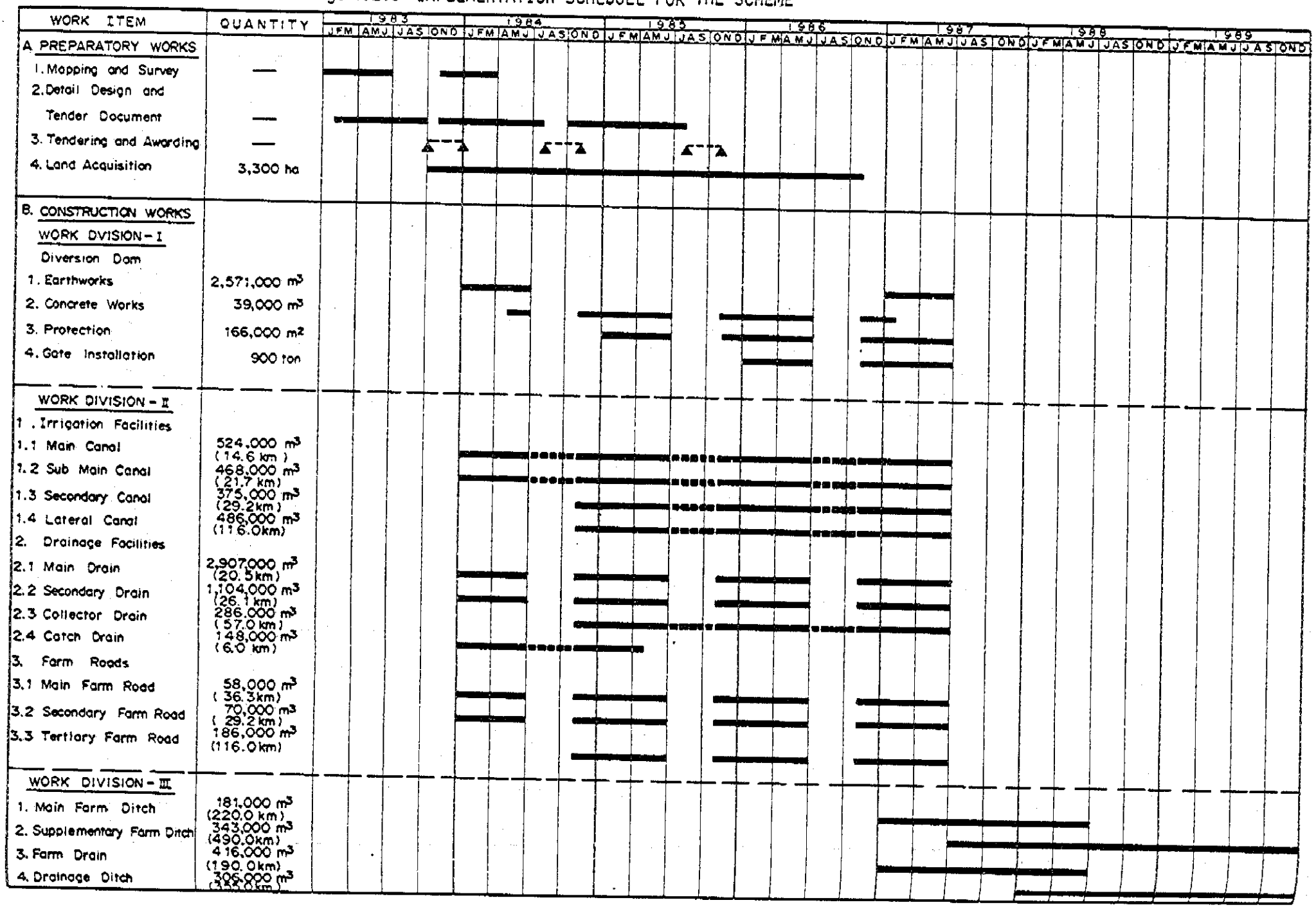


Fig. 5.1.1 PRESENT ORGANIZATION CHART OF PAMPANGA RIVER CONTROL SYSTEM-PROJECT MANAGEMENT OFFICE (PRCS-PMO)

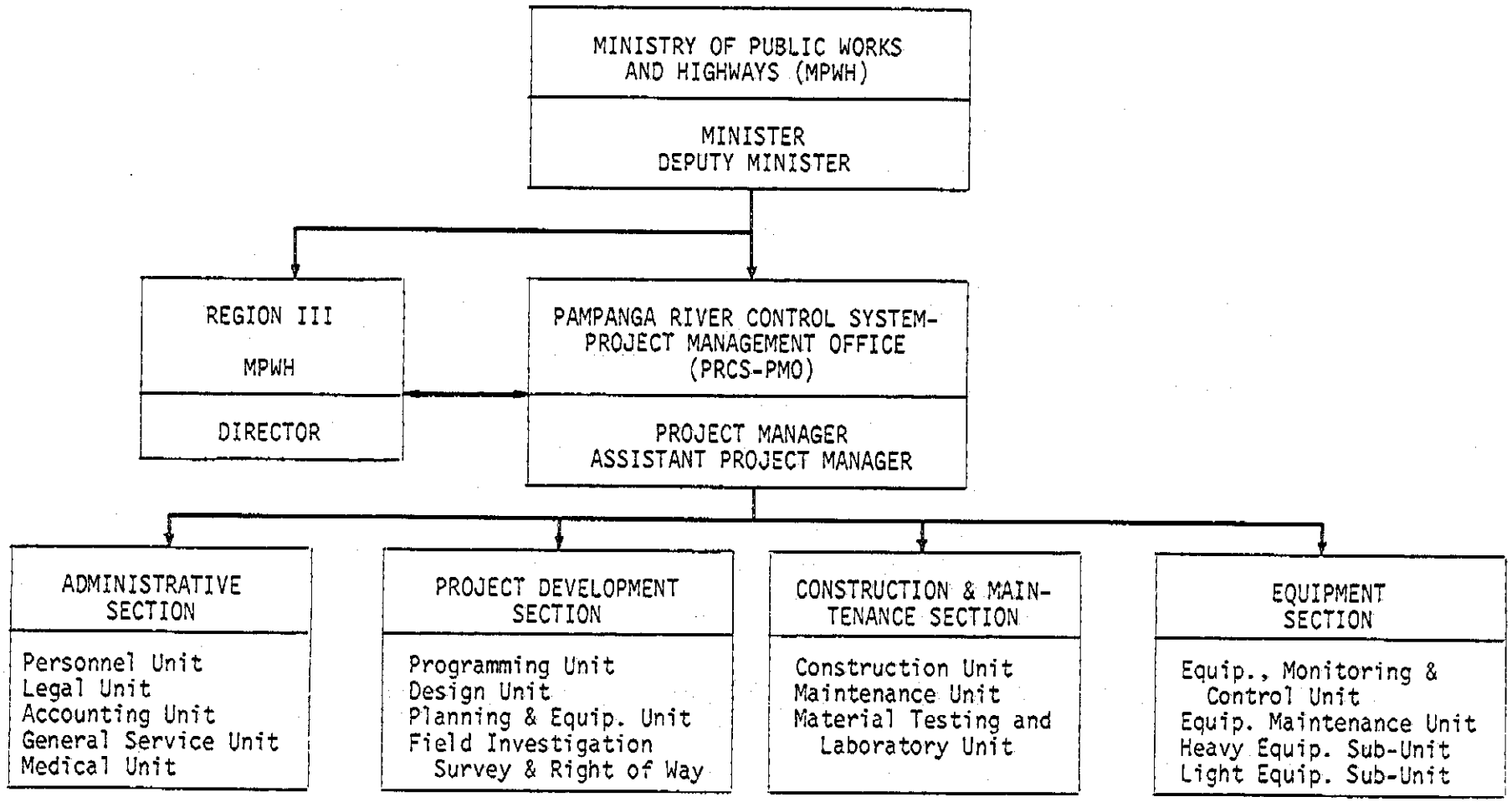


Fig. 5.1.2 ORGANIZATION CHART AT IMPLEMENTATION OF FLOOD CONTROL PROJECT

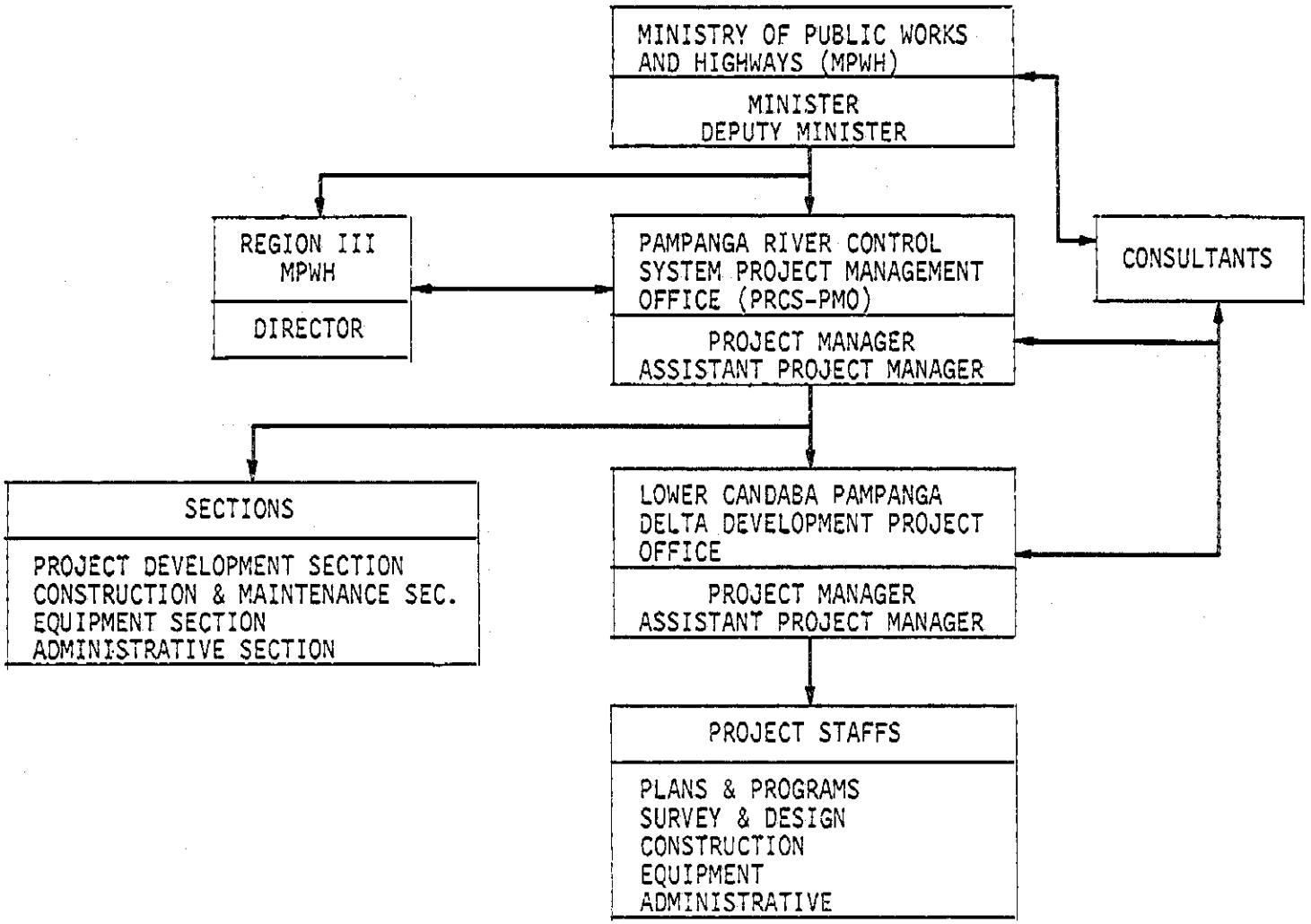
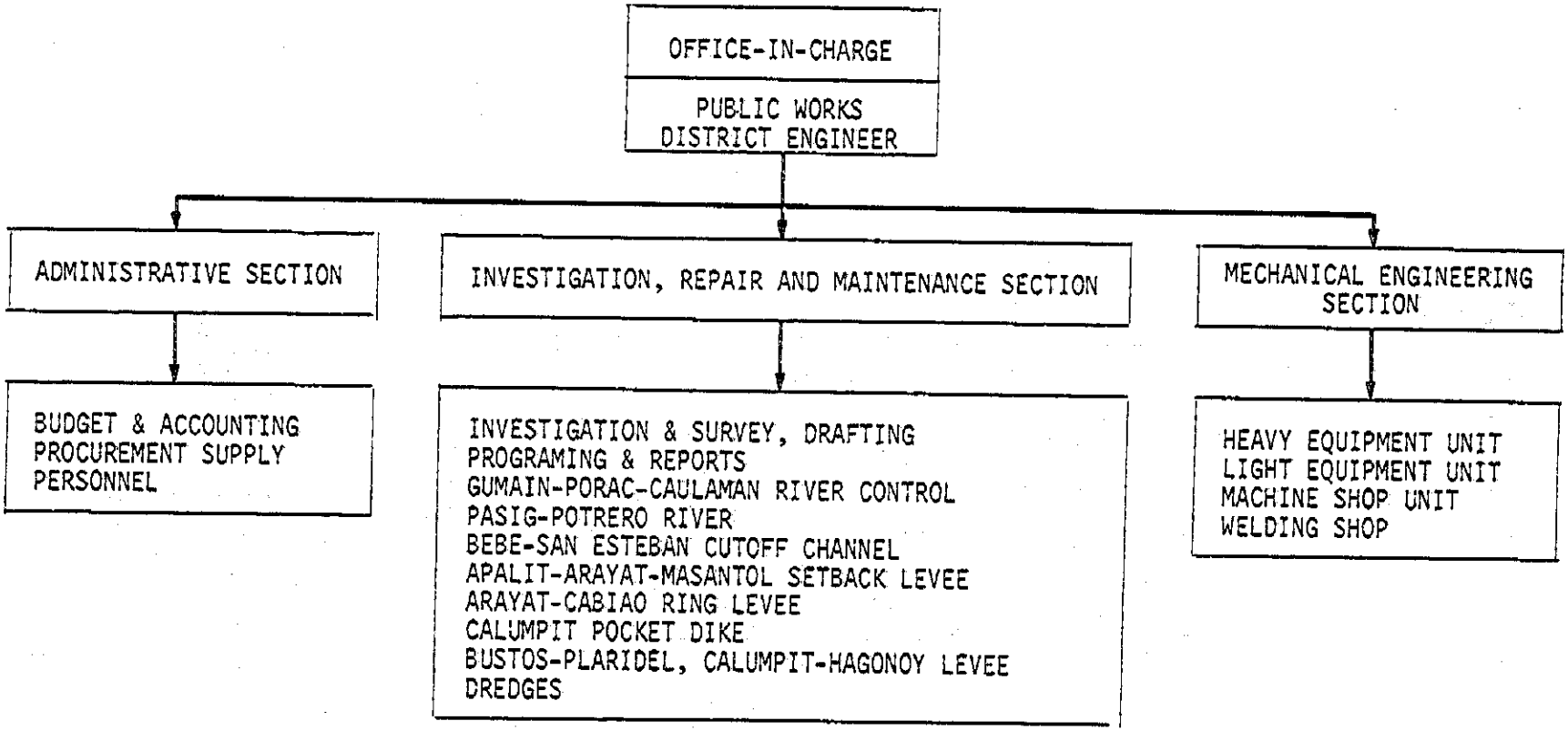


Fig. 5.1.3 EMERGENCY ORGANIZATION OF PAMPANGA RIVER CONTROL SYSTEM



LEGEND: Flood Stages along Pampange River-Mobilization of Personnel

Stage - I, Bank levee: All heads only will patrol their respective assignment
Stage - II, Bank overflow: All heads and one aide will patrol their respective assignment
Stage - III, Arnedo Dike overflow: All personnel will patrol their respective assignment

Fig. 5.2.1 PROPOSED ORGANIZATION FOR CONSTRUCTION FOR THE IRRIGATION PROJECT

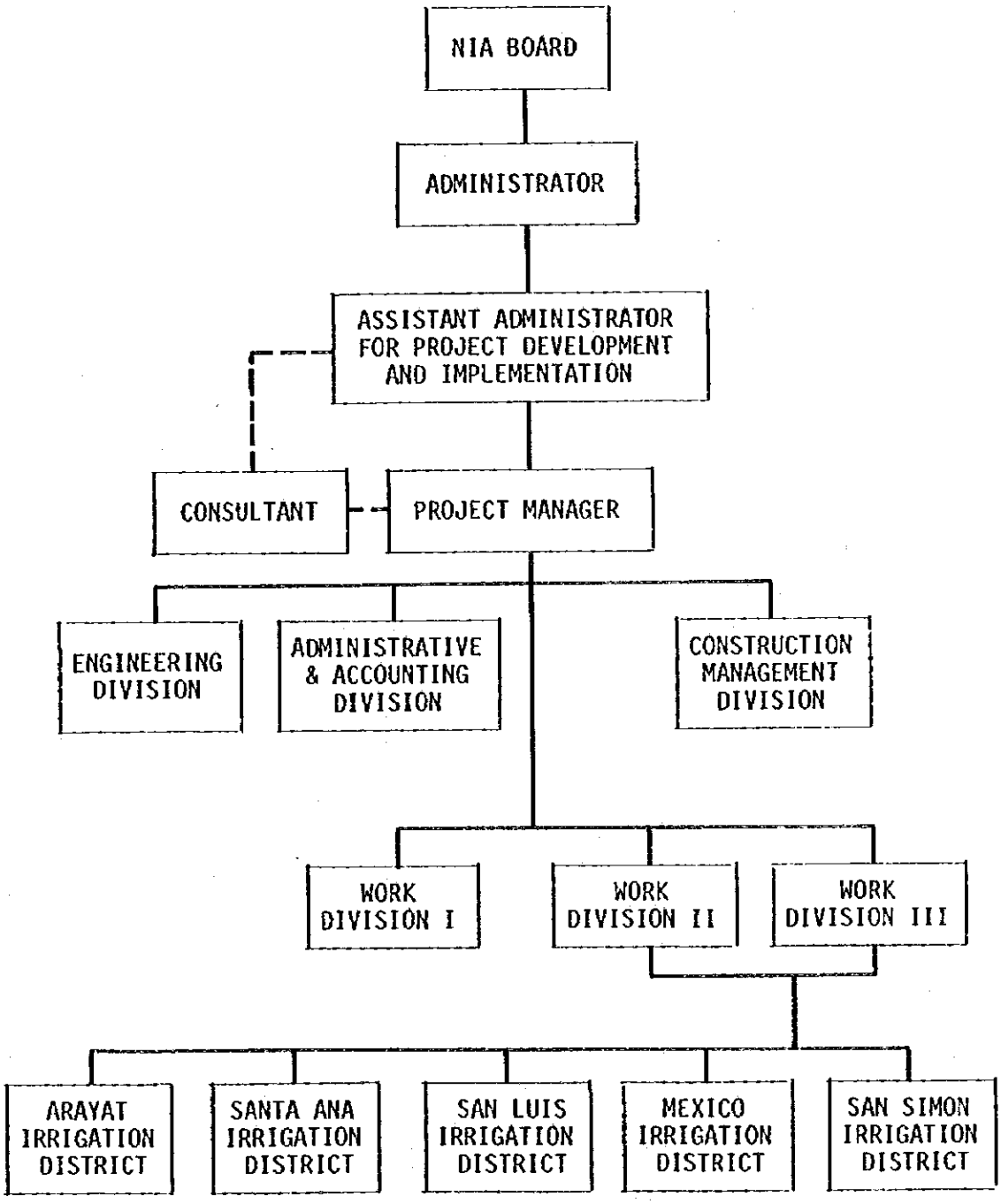


Fig. 5.2.2 PROPOSED ORGANIZATION FOR OPERATION AND MAINTENANCE OF THE PAMPANGA IRRIGATION PROJECT

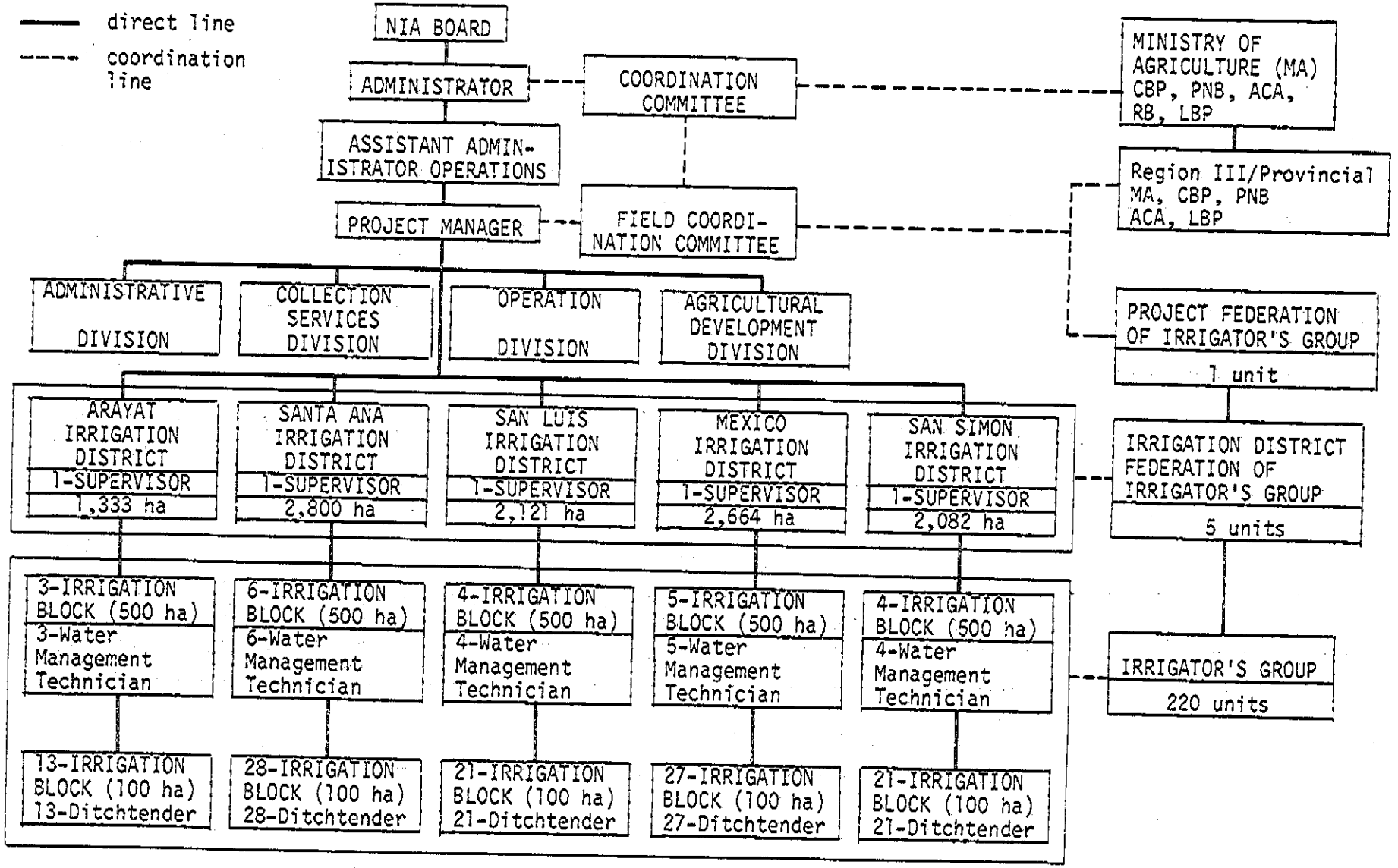
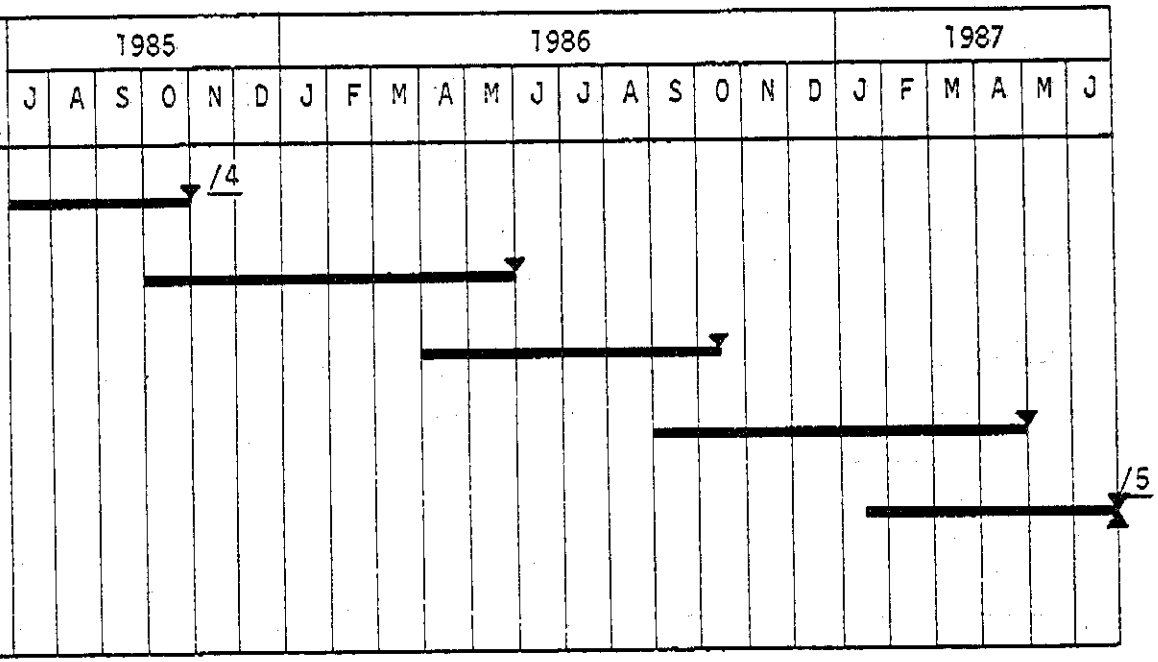


Fig. 5.2.3 SCHEDULE OF FARMER'S ORGANIZATION SETUP /1

Name of Irrigation District	Command Area (ha)	No. of Farm Households (No.) /2	No. of IG (No.) /3
Arayat	1,333	557	27
Santa Ana	2,800	1,170	56
San Luis	2,121	887	43
Mexico	2,664	1,114	53
San Simon	2,082	872	41
Total	11,000	4,600	220



/1: Parcellary map necessary for setup of irrigator's group will be conducted for the entire irrigation service area (11,000 ha) during period of April, 1984 to June, 1985. Design of farm ditch and farm drain will be done in parallel with irrigator's group setup for each irrigation district

/2: Estimated number of farm households in Irrigation District

/3: Estimated number of irrigator's group in Irrigation District

/4: Establishment of irrigation district federation of irrigator's groups

/5: Establishment of project federation of irrigator's groups