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 DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT  
 DIRECTORATE OF RIVERS AND SWAMPS

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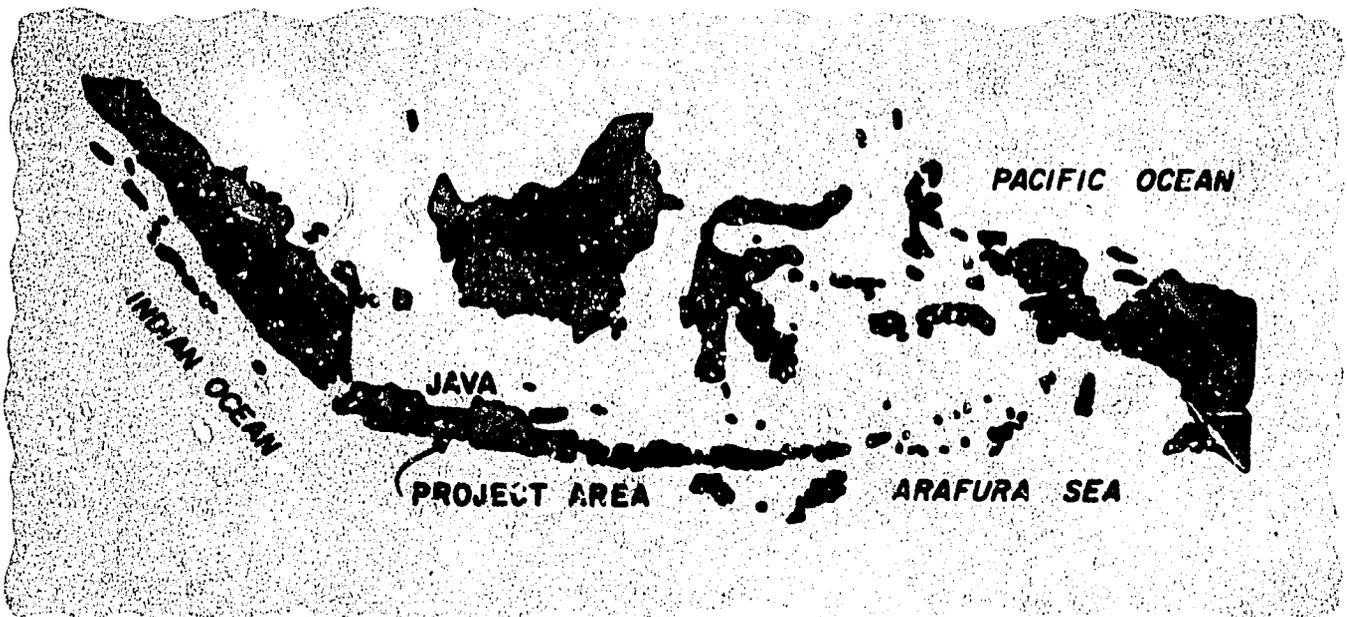
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# THE CITANDUY RIVER BASIN DEVELOPMENT PROJECT

## MASTER PLAN

EXECUTIVE SUMMARY  
 CONCLUSIONS AND RECOMMENDATIONS



SUBMITTED BY:

ENGINEERING CONSULTANTS, INC.  
 DENVER, COLORADO, U.S.A.      BANJAR, INDONESIA

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MINISTRY OF PUBLIC WORKS AND ELECTRIC POWER  
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DEVELOPMENT PROJECT

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BANJAR, INDONESIA

MAY 1975



ENGINEERING CONSULTANTS, INC.

May 1, 1975

Director General of  
Water Resources Development  
Ministry of Public Works  
and Electric Power  
Jalan Pattimura 20/7  
Kebayoran Baru, Jakarta  
Republic of Indonesia

ATTN: Director of River and  
Swampy Area Development

Our File: 1138/20  
DG 830/75

Subject: Citanduy Project Master Plan

Dear Sir:

We are pleased to submit our report, "Master Plan, The Citanduy River Basin Development Project". This report has been prepared for you under the terms of the Contract between the Directorate General of Water Resources Development and Engineering Consultants, Inc. and signed on July 23, 1973.

This report consists of two parts: Executive Summary and Main Report. While it represents the joint efforts of the Consultant's team, we also wish to acknowledge that many other people have contributed both directly and indirectly to the success of this report. A full acknowledgment follows this letter of transmittal. If we have inadvertently neglected to mention a participant, it is an error of omission rather than commission.

It has been a pleasure to prepare this report. It is particularly gratifying to note the benefits which the proposed development plan will bring to the inhabitants of the area and to the Nation as well.

Very truly yours,

ENGINEERING CONSULTANTS, INC.

Glen Rockwell  
President

Gifford E. Rogers  
Resident Manager

## ACKNOWLEDGMENTS

The preparation and publication of a feasibility study of a level compatible with the standards of international development agencies requires a closely knit, smoothly functioning organization which is composed of not only the technicians who actually prepare the report, but also those who support these activities and, perhaps most importantly, those whose vision and foresight brought an idea to reality. Such a task is an arduous one even when time is not a limiting factor. With the imposition of a very tight time schedule, the task becomes monumental.

Without the vision and guidance of the officials of the Ministry of Public Works and Electric Power of the Government of the Republic of Indonesia, the Citanduy River Basin Development Project never would have come into existence. For this action of far-reaching consequences, the Consultant wishes to acknowledge the leadership of the following officials:

Ir. Sutami	-	Minister of Public Works and Electric Power
Ir. Suyono Sosrodarsono	-	Director General of Water Resources Development
Ir. Y. Sudaryoko	-	Director of River and Swampy Area Development and Chairman Steering Committee
Ir. Sarbini Ronodibroto	-	Secretary, Directorate of River and Swampy Areas Development and Secretary Steering Committee
Ir. Soebandi Wirosoemarto	-	Project Manager, Citanduy Basin Development Project
Ir. Sriyono	-	Deputy Project Manager Citanduy Basin Development Project

Once launched, a project of the magnitude of this study requires periodic examination and technical orientation. Since the study involved many different technical specialties and its final form would be significantly affected by the plans and activities of many other governmental organizations, it was fitting that periodic guidance should be supplied through a Steering Committee. The Consultant wishes to acknowledge the guidance and understanding demonstrated by the individual members of the Steering Committees:

1. Ir. Y. Sudaryoko  
Director of River & Swampy, DGWRD,  
Ministry of the Public Work - Head of the Committee
2. Ir. Sudarso Rawijo  
(or official appointed by him)  
Director of Agricultural Technique  
Directorate General of Agriculture,  
Ministry of Agriculture - Member

- |     |  |   |                      |
|-----|--|---|----------------------|
| 3.  | Ir. Mardjono<br>Head of Directorate of 'Prasarana<br>Desa', Dir. Gen. of Rural Development<br>Ministry of Internal Affairs                                 | - | Member               |
| 4.  | Ir. Oesman Djoyoadinoto<br>(or official appointed by him)  | - | Member               |
| 5.  | Drs. Sarwohadi<br>Staff, Bureau of Agriculture and<br>Plantation. BAPPENAS.  | - | Member               |
| 6.  | Ir. I. Gede Oka<br>Head of 'Dinas Pengembangan'<br>Reboisasi & Rehabilitasi, Dir. Gen.<br>of Forestry, Ministry of Agriculture                             | - | Member               |
| 7.  | Ir. Mardjono Notodihardjo<br>Head of 'Dinas Perancang Pengembangan<br>Wilayah Sungai, 'Perancang' Directorate;<br>Dir. Gen. of Water Resources Development | - | Member               |
| 8.  | Ir. Muslim A./Ir. Sufrani Atmakusuma<br>PLN Official    PLN Official   | - | Member               |
| 9.  | Mr. C. Woody<br>Chief Engineer, USAID, Jakarta   | - | Member               |
| 10. | Ir. Sarbini Ronodibroto<br>Secretary to the River and Swampy<br>Director DGWRD, Ministry of the<br>Public Work   | - | Secretary and Member |

As stated previously, the preparation of this report was a team effort, of which the Consultant's staff members formed an integral part. Those of the Consultant's staff who actively participated in the preparation of these studies include:

- |     |                        |   |  |
|-----|------------------------|---|--|
| 1.  | Cecil M. Langford      | - | Senior Vice President and<br>Project Sponsor |
| 2.  | Gifford E. Rogers      | - | Resident Manager                             |
| 3.  | Max K. Kuehl           | - | Chief Engineer                               |
| 4.  | Wallace J. Schoenleber | - | Civil Engineer                               |
| 5.  | Harry N. Cole          | - | Civil Engineer                               |
| 6.  | David E. Bogan         | - | Irrigation and Drainage Engineer             |
| 7.  | M. P. Saunders         | - | Planning Engineer                            |
| 8.  | Yin Au-Yeung           | - | Hydrologist                                  |
| 9.  | M. A. Stevens          | - | Flood Control Engineer                       |
| 10. | Donald P. Scott        | - | Geologist                                    |
| 11. | Paul Otter             | - | Planning Engineer                            |

12.	H. W. Burke	-	Foundation Specialist
13.	Robert E. Struthers	-	Economist
14.	Roydon T. Edwards	-	Agriculturist
15.	Herbert C. Fletcher	-	Land Management Specialist
16.	Ethan D. Churchill	-	Environmentalist
17.	Robert A. Gardner	-	Soil Scientist
18.	Elna H. Cole	-	Typist

Each of the previously named technicians was faced with such tasks as data collection, field investigations, office analyses, and report drafting. Without the capable and willing assistance of members of P. T. Indah Karya, who supplied all services for which the ministry was responsible, their chores would have been practically insurmountable. The Consultant wishes to gratefully acknowledge the invaluable assistance lent by officials and members of the Counterpart Team:

1.	Ir. A. Angudi	-	Back Up Service
2.	Prof. Ir. Ali Djojoadinoto	-	Back Up Service
3.	Prof. Ir. Urip Iman Sujono	-	Back Up Service
4.	Ir. Sahat T. P. Siagian	-	Counterpart Team Leader
5.	Ir. Yasin Umar K.	-	Civil Engineer Counterpart
6.	Ir. Amirudin	-	Planning Engineer Counterpart
7.	Ir. Imam Hidayat	-	Economist Counterpart
8.	Drs. Subagyo	-	Soil Scientist Counterpart
9.	Ir. Tossin Apandi	-	Agriculturist Counterpart
10.	Ir. Yusron Lubis	-	Hydrologist Counterpart
11.	Ir. Sriyono	-	River Specialist Counterpart
12.	Achmad Djojoadinoto	-	Irrigation and Drainage Counterpart
13.	Iling Sugandhy	-	Geologist Counterpart
14.	Ir. Parijan	-	Civil Engineer Counterpart
15.	Ir. Arwadi	-	Planning Engineer Counterpart
16.	Ir. Radhi Sinaro	-	Irrigation and Drainage Engineer Counterpart
17.	Ir. Sampujo	-	Hydrologist Counterpart
18.	Krebet Suryo'ndadari	-	Planning Engineer Counterpart

19.	Drs. Soekanto	-	Hydrologist Counterpart
20.	Ir. Siswoko	-	Chief Planning Engineer Counterpart
21.	P. Napitupulu	-	Irrigation Counterpart Assistant
22.	T. Maruly Nadapdap	-	Hydrologist Counterpart Assistant
23.	Drs. Sitanggang	-	Civil Engineer Counterpart Assistant
24.	Ir. Eddy Sumardi AS	-	Soil Scientist Counterpart Assistant
25.	Drs. Wildan Arifin	-	Economist Counterpart Assistant
26.	Rachmat Adiwijaya	-	Agriculturist Counterpart Assistant
27.	Amung Mansyur	-	Draftsman
28.	Zamzam	-	Draftsman
29.	Mahyudin	-	Draftsman
30.	Slamet Riyadi	-	Draftsman
31.	M. Hapit	-	Draftsman
32.	A. Lathief	-	Draftsman

If the preparation of any published report, the effort of all the technicians and their assistants would never see the light of day if they were not suitably typed, reproduced, collated, and bound into a report which can be easily read by all concerned. The Consultant wishes to acknowledge the dedicated service and assistance of the administrative staff who so competently supplied the finishing touches to this report:

1.	Miss Pauline Sulianti	-	Interpreter, Typist
2.	Mrs. Nungki S.W.	-	Secretary
3.	Miss Supiarti	-	Clerk
4.	Miss Sri Z. Oemar	-	Typist
5.	Miss Etjih Suhari	-	Typist
6.	Mr. Dasiran Tapawira	-	Reproduction machine Operator

In the course of the investigation, data were obtained from the following government agencies: Agriculture, Animal Husbandry, Forestry, Fisheries, Plantations, Ports Administration, Census, Road Construction, Railways Enterprise, Transmigration, Cooperatives, Health, Education, Manpower, BAPPEMKA, Geological Survey, LPMA, Jatiluhur Authority, West Java State Mining Agency, Interior, and Public Works.

## Executive Summary

### The Citanduy Project Area

The Citanduy River basin consists of 350,000 hectares. The Segara Anakan drains an area of 96,000 hectares. Together these two watersheds make up the Citanduy Project area of 446,000 hectares. For the first 60 kilometers of length above its mouth, the Citanduy forms the boundary between Central and West Java.

The drainage basin of the Citanduy consists of three main features. The most prominent feature is Volcano Sawal, which occupies approximately one tenth of the drainage basin. The second is the hill region which forms both the north and south borders of the Citanduy basin. The volcano and hill region are eroded by surface runoff. The third is the alluvial plain covering about 15 percent of the drainage area. The Citanduy receives runoff from four major tributary areas. The Cimuntur basin, the Cijolang basin and the Cikawung basin are located on the left side of the Citanduy River. The Ciseel basin is located along the lower two-thirds of the Citanduy River on the right side.

Segara Anakan is a brackish water lagoon which receives runoff from its own watershed and is also fed by the Citanduy at high tide when the west strait of the Segara Anakan cannot discharge seaward. Largely as a result of this, the lagoon is being filled with sediment deposits carried by the Citanduy. At the tidal zone, these deltaic deposits are mostly occupied by mangrove forest growth.

Nusa Kambangan is the east-west trending island that forms the southern margin of Segara Anakan and its environs. It extends eastward from the mouth of the Citanduy to the east strait at Cilacap, through which the Segara Anakan is also connected to the sea. The island is mountainous and rocky, and is used as a prison colony.

The climate is tropical and wet. The trade winds influence the rainfall patterns, bringing a wet season from November through April. The mean annual rainfall in the project area is 3,000 millimeters.

The area is intensively farmed. About one-fourth of the area is devoted to lowland rice, which is the principal crop. Cropping extends the year round, but is less successful during the dry season. Wherever possible the valleys and hillsides are formed into rice paddies.

Irrigation has long been practiced in the basin. Most of the potential irrigable areas have already been developed. There are 25,087 hectares under technical and semi-technical irrigation systems, and another 33,583 hectares under rural (simple) irrigation systems.

All except the very most remote and rough upland areas are heavily populated. The average population density is 600 persons per square kilometer. Population growth is 2.25 percent per year. As a result of overpopulation, all farming and other economic activities carried on in the area are extremely labor-intensive. The heavier population concentrations occur in the valley areas which are the better adapted to intensive land use.

Life in this agrarian setting is quite simple. Modern technology, transportation and communications do not greatly influence the existence of large numbers of the population. Farmers, who comprise 80 percent of all the people, largely

subsist on what they produce. The market economy is relatively weak. Commercial activities are minimal. Average per capita income is about Rp. 20,000 (\$50), which is half the national average.

### Problems and Needs

Frequent flood disasters in the lower basin affect the lives, the property and income of a large proportion of the population of the Citanduy Project area. On a yearly basis, large volumes of flood waters are delivered to the alluvial plains as many as a dozen times. The distribution of rainfall throughout the year is such that the peak flood stage at Banjar, at the head of the flood plain, has occurred at least four times in the so-called dry season in the last 23 years.

The existing levee systems fail to provide the needed degree of protection. In the recent large floods of 1968 and 1973, more than 20,000 hectares were inundated and as many as 50,000 people displaced and made temporarily homeless. In the areas flooded, half the rice crop was damaged and 90 percent of the other crops were adversely affected. Along with these damages, losses accrue in all of the private and governmental activity sectors.

There is an urgent need to provide flood protection in the lower basin. River control by dams, levees or by a combination of both, together with improved land management in the upper watersheds, can bring about the desired degree of protection in the flood prone areas.

Irrigation systems are virtually all in need of rehabilitation and improvement. Inadequate maintenance, and in some cases faulty design, limits the delivery of irrigation water. Shortages are particularly crucial in the dry season. After rehabilitation is completed, improved systems of management will be needed to ensure proper operation and maintenance, water allocation and measurement and collection and utilization of O & M revenues. There are minor areas where irrigation service could be provided by extending existing systems or building new ones.

Drainage problems arise because of the extremely flat topography of the flood plain. There is no outlet for internal drainage water when the Citanduy and Ciseel rivers are at high stage. Existing drains are poorly maintained and consequently lack capacity. Flap gates and other structures are inoperative in many cases. In the lower Sidareja area the flat topography and surface flooding contributes to poor drainage at high tide. During the dry season salt water intrusion occurs in this area. This drainage and salinity problem will persist after construction of the Sidareja irrigation system, which is now in the design stage, unless relief is afforded through tidal control. No program for irrigation improvements or flood control works can be fully effective unless accompanied by an adequate surface drainage system.

Drinking water supplies are frequently polluted and inadequate. None of the major towns in the basin has an adequate water system, most of the towns have none at all and residents must rely on shallow, hand dug wells. Provision of good water supplies depends on reservoir storage and treatment plants or upon deep wells. Lack of potable water is a severe health hazard.

The basin has erosion problems in the hilly areas because of high rainfall, erosive soils, and clean-tillage farming practices on too-steep land. Runoff is accelerated, streams are turbid and aggradation occurs in the lower reaches of the river. The Segara Anakan is being shallowed by sediments carried by the Citanduy River to the point that it will be destroyed as a fish habitat in another 20 years. Revegetation of forests and pastures is necessary on cutover areas and on the steep farm lands where erosion is a problem. Forests and natural areas require a better system of management to maximize their conservation objectives as well as economic returns. Better systems of contour and residue mulch farming are needed.

Electric power supplies are limited and service is not available to most of the residents of the basin. The supply of power is not dependable because of an overloaded and outdated transmission system. Interconnection with other areas in a loop or grid transmission system would improve system reliability and balance the loads between regions. Additional generating capacity is needed to meet the load growth that is occurring.

At the farm level, a combination of factors contribute to lack of needed progress in increasing the food supply and the profitability of farming. Farms are too small, and too many people must try to make their living from the available land. While the introduction of new high-yield rice varieties is progressing, it is short of being complete for a number of causes. Drainage and flood mitigation are first requisites to bringing about the required changes in agriculture and irrigation. Additional programs to improve the effectiveness of agricultural extension services, marketing and storage facilities, and transportation will be required. Greater availability of improved seed varieties, fertilizer, pesticides and equipment must be given priority.

Fisheries are deteriorating and need to be sustained because this is one of the major sources of animal protein in the local diet. The Segara Anakan supports 4,000 families of fishermen at present, but is declining in productivity. Fish ponds require better management practices. River fishery is poor because of the extremely turbid waters.

Land use planning and management needs to be redirected and enforced to get better use out of the land and water resources of the river basin. A multiple use concept would be productive if applied to forests and rubber plantations. Agency funding should be coordinated so that programs can be adequately financed once they are started. Too many ambitious projects cannot be adequately funded at one time. Water management policy and regulations ought to be modernized and clarified. Competition among water uses will soon become a problem requiring proper adjudication and management. Water users need better guidance and supervision in use of irrigation water supplies. This requires an appropriate system of incentives, rules and penalties to make the organization and practices successful.

Of less direct interest in water resource development, but not to be forgotten, are desirable targets involving development of transportation, education, public health and sanitation. Environmental considerations must be constantly kept in mind.

#### Proposed Development Plan

Lower Citanduy/Ciseel River System. A comprehensive management scheme for this area is proposed to mitigate flood damage and to rehabilitate and extend the existing irrigation and surface drainage facilities.

Thorough consideration was given to the formulation of the optimal system to protect the flood prone areas of the lower basin. Dams on the Citanduy, Ciseel and Cijolang rivers were analyzed in various combinations with and without levees. The least costly solution for 25-year protection is a protection system involving levees only. Levees along the Citanduy, Ciseel, Cijolang and Cikawang rivers would be redesigned and upgraded. The Ciseel River requires a cut-off at mile 18 and diversion into the Citanduy for best protection of adjacent lands and construction economics.

Irrigation systems involving 12,447 hectares of land would be rehabilitated and 3,800 hectares of irrigable land would be brought under new irrigation canals. All appurtenant drainage works would be upgraded and extended as necessary to more expeditiously evacuate surface runoff.

The subproject would have a capital investment cost of Rp. 6,268 million (\$15,140,000) and is economically justified with an internal rate of return of 15 percent.

Matenggeng Dam and Powerplant. The proposed dam would occupy a site on the Cijolang River about 10 kilometers above its confluence with the Citanduy. The dam would be an earth or rockfill structure rising 120 meters above the streambed and having a crest length of 650 meters. The design turbine head is 175 meters, obtained through a power outlet tunnel leading from an arm of the reservoir to a powerhouse downstream of the dam.

The powerplant would consist of four 25,000 kilowatt generating units, for a total installed capacity of 100,000 kilowatts. The plant factor would be 24 percent. The peaking power output would complement the high peak load demand in the national power system.

The cost of the dam and reservoir is about Rp. 33,030 million (\$79.8 million). An analysis of the comparative cost of generating peaking power shows the plant would be competitive with the most likely alternative source of power. Its investment is economically justified at an internal rate of return of 12.6 percent at maximum development. The internal rate of return could be increased to 13.4 percent with a somewhat smaller development.

Reclamation of the Segara Anakan and its Environs. The subproject plan is to convert the lagoon to a fresh water lake and control the water surface at about mean sea level by constructing cut-off dikes and tide gates at its outlets to the ocean. The surrounding swamp lands, freed from the influence of the salt water and the high water due to tides, would be reclaimed for rice farming. Only a small part of the area is being farmed at present, and this has only limited production under the prevailing adverse salinity and poor drainage conditions. The potentially productive area expected to be reclaimed would total 21,000 hectares, and could provide settlement opportunities for a large number of low-income families. Unless the influence of the salt water is eliminated through tidal action control, the lands will never be productive.

The Citanduy River would be rerouted directly to the Indian Ocean to eliminate the sedimentation that is now taking place and to minimize the number of tide gates. Tide gates would be constructed at the west and east outlets to the lagoon. The operation of the gates would be automatic, in that they are designed to be closed when the tide on the ocean side is higher than the level of the fresh water in the lake. When the tide recedes, the higher water in the lake will flow out through the gates.

Clearing of about 16,000 hectares of mangroves and swamp growth is necessary. Filling of low areas would be accomplished by hydraulic dredge. Irrigation and drainage systems would be provided, using the lake as a water supply reservoir. The soils of the project are naturally fertile and will provide a highly productive medium for paddy rice culture. Problems of potential acid-sulphate conditions have been investigated. With proper management of the water level of the lake, no problems with acid-sulphate condition would occur.

An additional aspect of reclamation includes the improvement and prolongation of fishery production. The fresh water lake can be managed to provide a highly productive fish habitat.

The fresh water lake could be utilized as a source for potable water for the city of Cilacap. The cost of the proposed Jeruklegi Reservoir would be saved by utilizing the new fresh water lake.

The subproject plan provides for settler assistance during the development period to ensure that the farmers get a proper start. The cost of fish restocking and management is also included.

The total cost of the Segara Anakan subproject would be Rp. 11,035 million (\$26,655,000). The internal rate of return is 18 percent.

The Upper Citanduy/Ciseel River System. In the West Java side of the Upper Citanduy/Ciseel watershed it is proposed to rehabilitate the irrigation and drainage facilities of ten irrigation systems. The combined service area under these systems is 5,926 hectares.

These systems have most of the same problems which characterize the irrigation systems in the lower basin area. The canals and structures require a thorough program of upgrading, cleaning and rehabilitation. The fact that these systems are in the upper watershed where the topography is more severe has made it especially difficult to do a proper job of maintenance. With properly designed and constructed weirs, canals, drains and other structures the systems can be brought to full productivity.

Along with the rehabilitation program, the new management approach employed by the Citanduy River Authority will perpetuate a high degree of readiness in the systems and will improve the allocation and distribution of the available water supplies.

The cost of rehabilitation would be Rp. 558 million (\$1,350,000). The internal rate of return is 22 percent, indicating a high degree of economic justification.

Rehabilitation of Irrigation and Drainage in the Central Java Areas. There are 5,647 hectares of land under eight technical and semi-technical systems that are proposed to be rehabilitated. The principal problems consist of deteriorated structures, canals that are silted-up, and inadequate drainage ditches.

With the improvements brought about through the rehabilitation plan, the lands would have a dependable water supply for two crops per year. Water distribution would be improved. Operation and maintenance programs would be more effective. The management system under the Citanduy Authority would ensure that the irrigation, and drainage works would be maintained in good condition.

The cost of the rehabilitation would be Rp. 393 million (\$949,275). The internal rate of return is 27 percent.

Construction of the Sidareja Irrigation System. The Sidareja Irrigation System is presently under construction. The planned service area is reported to be 7,119 ha. However, 2,200 ha of the planned service area lies within the proposed reclamation boundary of the Segara Anakan subproject. The 2,200 ha area is predominantly cultivated areas of former tidal marsh (CTM) and cultivated areas of former tidal swamp (CTS) which must be reclaimed before they can be irrigated. Present plans envision reclamation of this area by means of flood discharges diverted from the Citanduy River at the Nusawuluh weir. This would be a very gradual natural reclamation process.

The water balance analysis indicates that there will be enough water available in the Citanduy River to irrigate the entire Sidareja area for two rice crops per year. Therefore, the construction of the irrigation system should be continued. The successful development of the Sidareja area however, depends upon control of tidal fluctuations in the Segara Anakan caused by the Indian Ocean, and improvement of surface drainage. Therefore, the design of the Sidareja irrigation system should be inter-related with the development of the Segara Anakan reclamation area.

Furthermore, the 2,200 ha portion of the presently proposed Sidareja service area can be better reclaimed and irrigated by the methods proposed for the Segara Anakan subproject. The Citanduy River Project organization should give consideration to excluding this area from their present design and to extend the system in the vicinity of the town of Sidareja which was excluded from their design.

Construction of the Cihaur Irrigation System. The Cihaur system would have a service area of 2,100 hectares. The successful development of this unit would depend on the tidal control afforded by the Segara Anakan subproject to solve the problems of drainage and salt water intrusion in the lower reach. The diversion requirement would be provided through the Manganti diversion structure which is being constructed now for irrigation of the Sidareja area. The diversion from Manganti would be carried to the Cibeureum River through the proposed Sidareja canal system. A check dam and pumping station located on the Cibeureum River would be constructed to divert and lift the water about 3 meters to the service area. The area served by this lift would be 1,255 hectares. A second pump lift of about 5 meters would serve the rest of the area.

The water supply would be sufficient to produce two rice crops per year. At the present time, the area is extremely handicapped by the poor drainage and salinity conditions characteristic of all the lands bordering on the Segara Anakan.

The cost of this proposed irrigation unit would be Rp. 582 million (\$1,406,000). The internal rate of return is 14 percent.

Upstream Watershed Management Improvement Program. The objectives of this program would be to strengthen the capacity for watershed planning, managing and developing critical land areas within the Citanduy River systems. Detailed watershed management plans for at least four subwatersheds are required for demonstration of good conservation methods and practices.

The program would develop and promulgate conservation principles and practices leading to soil and water conservation, reforestation and greater involvement of the people in conservation activities. Village improvement associations would be organized.

The program involves preparation of soil, land use and cadastral maps of the pertinent areas; development and application of proper land use practices; economic and social studies related to watershed management; and the execution of conservation plans in agriculture, horticulture and forestry.

The program cost for the first 5 years is estimated to be Rp. 844 million (\$2 million).

The Proposed Management System. It is envisaged that the management of the entire Citanduy River Basin Development project will be concentrated under one central Authority. This Authority would be composed of several subproject branches, each one in charge of the affairs of its corresponding subproject. Direct supervision and management would be centered in the Minister for Public Works and Electric Power.

The existing organization of Public Works would be maintained and its function of operation and maintenance of primary and secondary irrigation systems would be continued.

Once the authority is established under the Ministry, a central committee of several ministries involved would have to be established to coordinate their services. Together the various ministers (or their representatives) would provide the

Minister of Public Works and Electric Power with information upon which to formulate policy and directives to the Board of Directors of the watershed authority.

The board of directors would be appointed by the Minister of Public Works and Electric Power. They would carry out the policies and directives into direct action through the General Manager. Agency coordination at field level is the responsibility of the board of directors so that assistance at that level is under the direction of the General Manager through his lines of administration.

The General Manager would have a staff commensurate with the number of programs in operation at any particular time. At the present moment it is envisaged that his three principal assistants would be the Managers for the Upstream Development, Segara Anakan subproject, and Lower Citanduy/Ciseel Subproject.

### Schedule for Development

An immediate start on design and preconstruction activities for the Lower Citanduy/Ciseel Subproject would enable construction to start in 1976. The entire program for flood control and irrigation and drainage rehabilitation would be completed in 1981.

Commencement of design and preconstruction activities for the Segara Anakan should also start in 1975. The program of construction would be largely completed by the end of 1982, and settlement of the project could be well along by that time. The settler assistance programs would continue through 1987.

The upstream watershed management program would be started in 1976 and run for five years to accomplish the goals set forth in our management plan.

Design and preconstruction activities are proposed to be started in 1981 for Matenggeng Dam and Powerplant, and for the irrigation and drainage programs in the Upper Citanduy/Ciseel and Central Java areas. Construction of Matenggeng and the rehabilitation projects would be completed in 1986. The Cihaur irrigation system would be completed in 1989.

### Conclusions and Recommendations

The development possibilities of the Citanduy Basin have been studied in a comprehensive manner. The results of these studies have been compiled in a set of twelve appendices which cover all the technical, socio-economic, and environmental aspects associated with the optimal development of the land, water and human resources of the basin.

As a result of these comprehensive studies, it has been possible to identify the viable development subprojects and prepare a Master Plan for their efficient implementation in an order of priority designed to suit the best interests of the inhabitants of the basin, and at the same time seeking compatibility with overall development plans of the Nation.

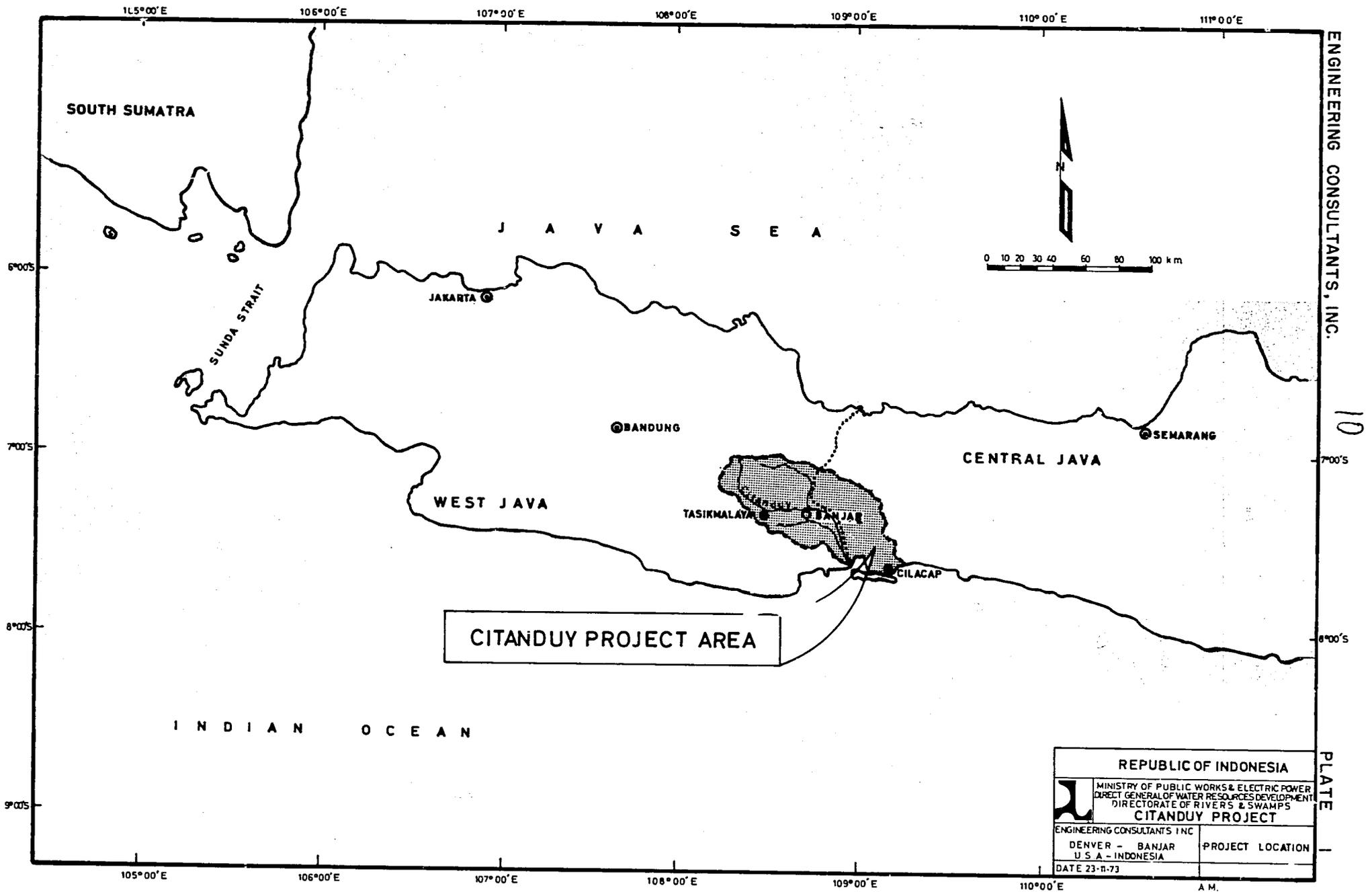
During the performance of these studies and the preparation of the Master Plan, certain conclusions were reached. On the basis of these conclusions, the Consultant was able to formulate definite recommendations for the planned development of the Citanduy River Basin.

## Conclusions

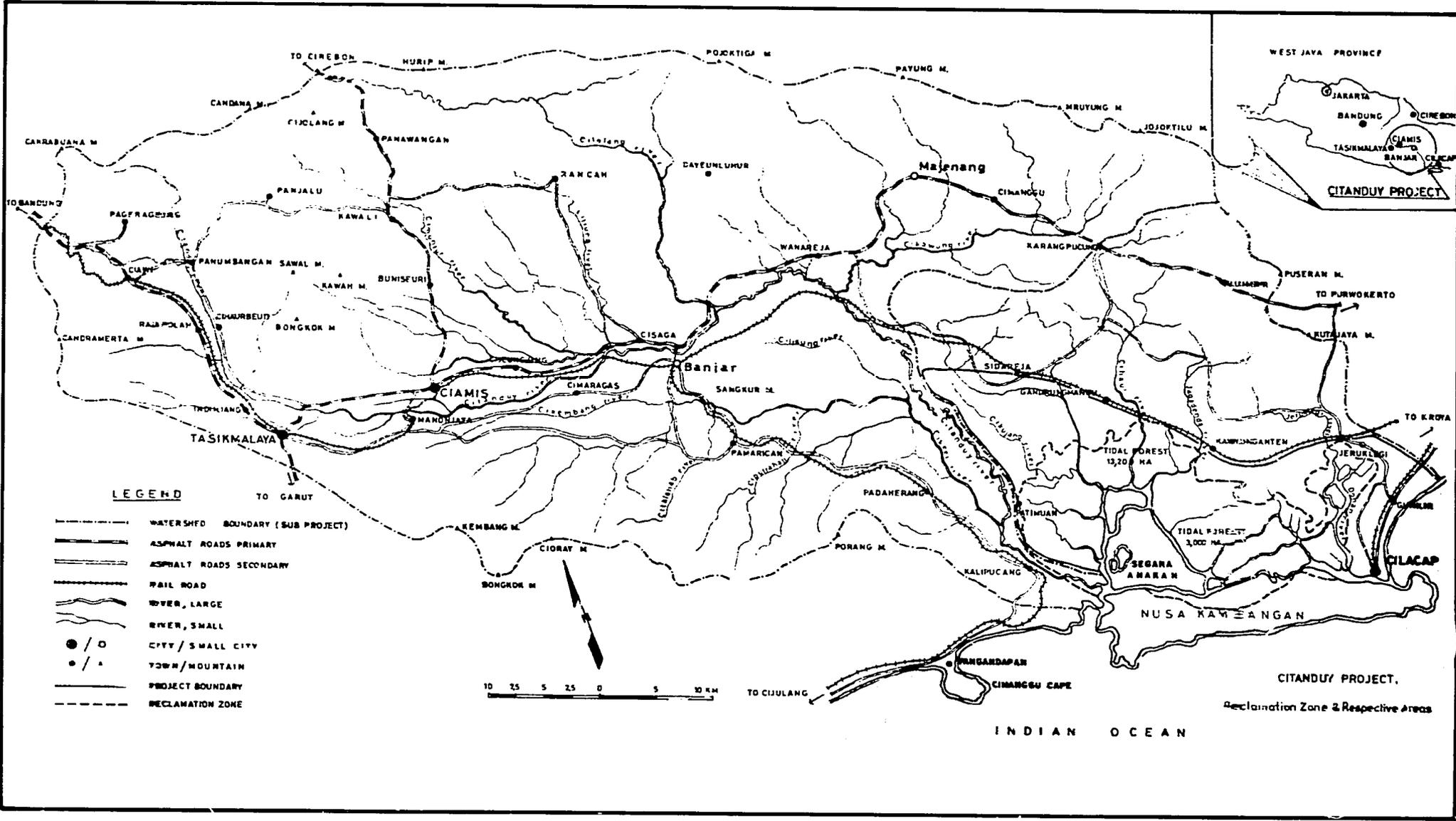
1. Increased food production is a major need in Indonesia on the local as well as on the national level. This can be accomplished either by bringing new lands under irrigation, or by improving production on lands already in agricultural production, or by some combination of these. For the project area, increased food production means principally irrigated rice production, supplemented by fresh water fishing and limited amounts of upland crops.
2. The geographical configuration and physical characteristics of the Citanduy Basin permit it to be divided into four distinct areas, all interdependent, but each also capable of standing alone as a viable subproject for development. These are the Upper Citanduy/Ciseel River system, the Lower Citanduy/Ciseel River system, the Segara Anakan and its environs, and the balance of the Segara Anakan watershed in Central Java.
3. Many problems are common to all subproject areas, but each also has its own peculiar problems. However, the essential element in the solution of both the common and individual problems is proper water and land management.
4. It is apparent that the most urgent problem to be solved is that of mitigation of damages and human suffering wrought annually by the flooding of the Citanduy/Ciseel River system. Once this is under optimum control both the farmer and the associated business man will be encouraged to invest more time, effort, and money in the improvement of his present economic and social condition. Therefore, the development of a comprehensive water management scheme for the Lower Citanduy/Ciseel River system should receive top priority in the development plans for the basin.
5. Additional lands must be dedicated to irrigated agriculture if Indonesia is to be able to produce enough food to feed its growing population. The reclamation of the Segara Anakan and its environs would not only make 21,000 ha of new land available for irrigated rice production, it would also improve the drainage, and hence the production, of several thousand hectares surrounding and above the proposed subproject area. For this reason, the reclamation of the Segara Anakan and its environs has been assigned second priority in the basin development plan.
6. Rapid runoff and the associated problems of erosion and sedimentation are also pressing problems, especially in the upper watersheds. A program of multiple land-use planning including reforestation is desirable. Therefore, a comprehensive water management scheme for the Upper Citanduy/Ciseel River system has been assigned third priority in the overall development plan. The rehabilitation of existing technical and semi-technical irrigation systems is included.
7. In the balance of the Segara Anakan watershed area, irrigation and drainage rehabilitation and improvement is of high priority. However, these operations cannot be optimized until after the drainage and salinity problems associated with the Segara Anakan as it now exists are resolved. Hence, this is the fourth priority development project.
8. A centralized project development authority is recommended as the best means of obtaining efficient project management and assuring a coordinated and dependable program of operation and maintenance.
9. To a great extent, the level of success obtained by this project, and its component subprojects, will be directly proportional to the level of active participation by the project inhabitants.
10. The entire project area suffers from a chronic shortage of electric power. The construction of the Matenggeng multi-purpose dam would alleviate this shortage.
11. The net environmental impact of the project will be beneficial. The beneficial impact on the human element will be particularly significant.

## Recommendations

1. Design and preconstruction activities for both the first and second priority projects should be undertaken immediately.
2. Construction on the Lower Citanduy/Ciseel River system water management scheme should be undertaken as quickly as plans and specifications can be prepared.
3. Construction of the Segara Anakan reclamation project should be undertaken within three or four years of the start of the first priority project.
4. Demonstration farms on the upper watersheds should be started immediately.
5. Irrigation and drainage work in the third and fourth priority subprojects should not be undertaken until the first and second priority subprojects are well advanced.
6. Designs and specifications for Matenggeng Dam should be prepared soon even though the construction of the facility may be delayed for several years.

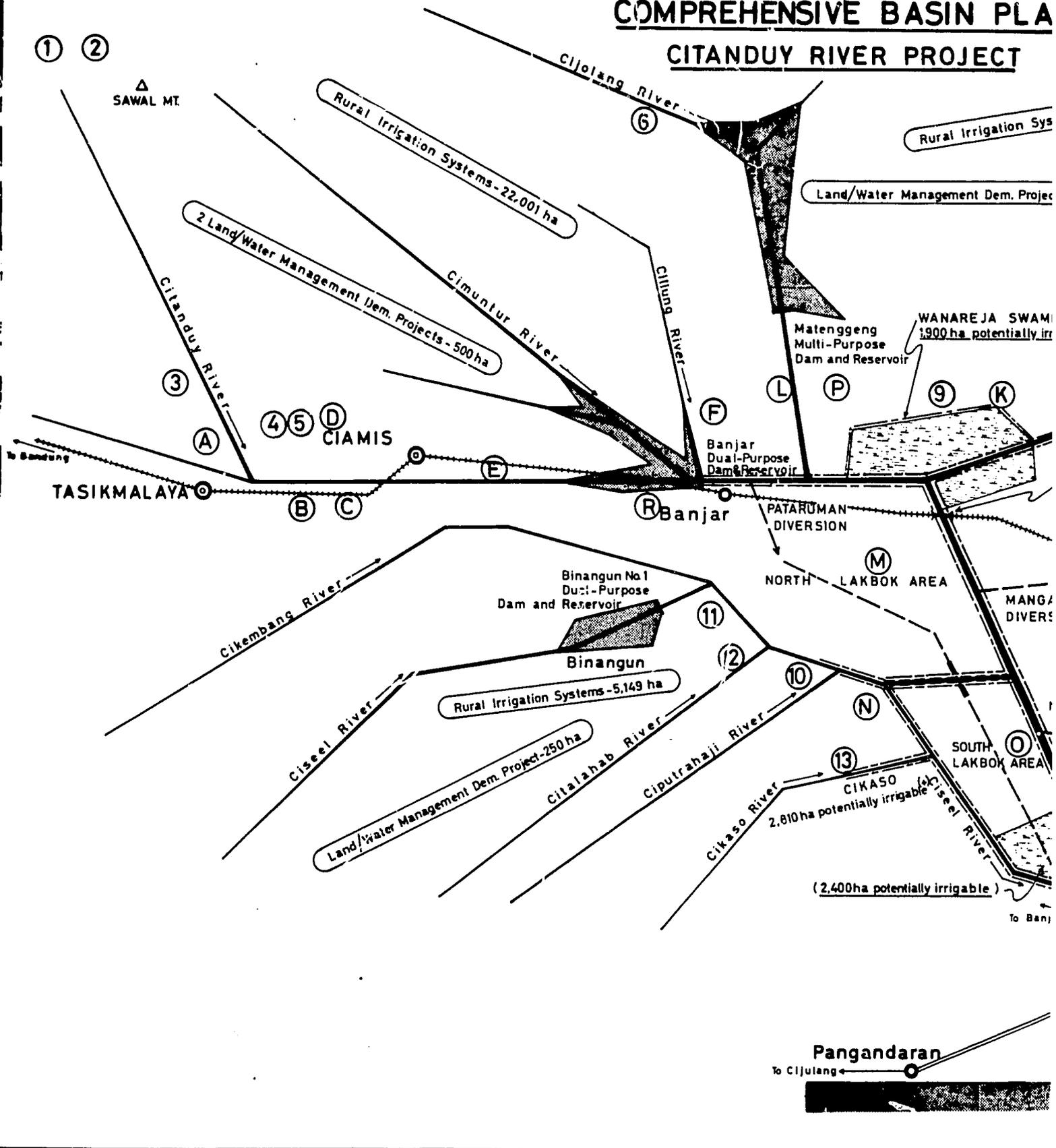


A.M.



CITANDUY PROJECT.  
Reclamation Zone & Respective Areas

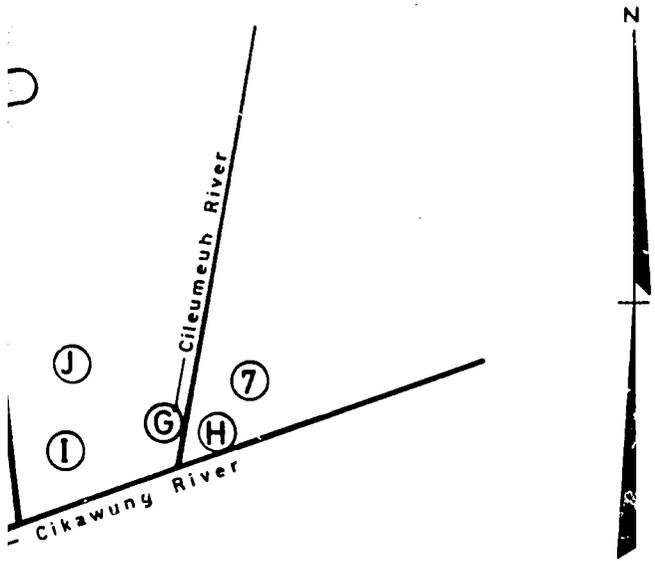
# COMPREHENSIVE BASIN PLAN CITANDUY RIVER PROJECT



Pangandaran

To Cijulang





BRIDGE No.1452

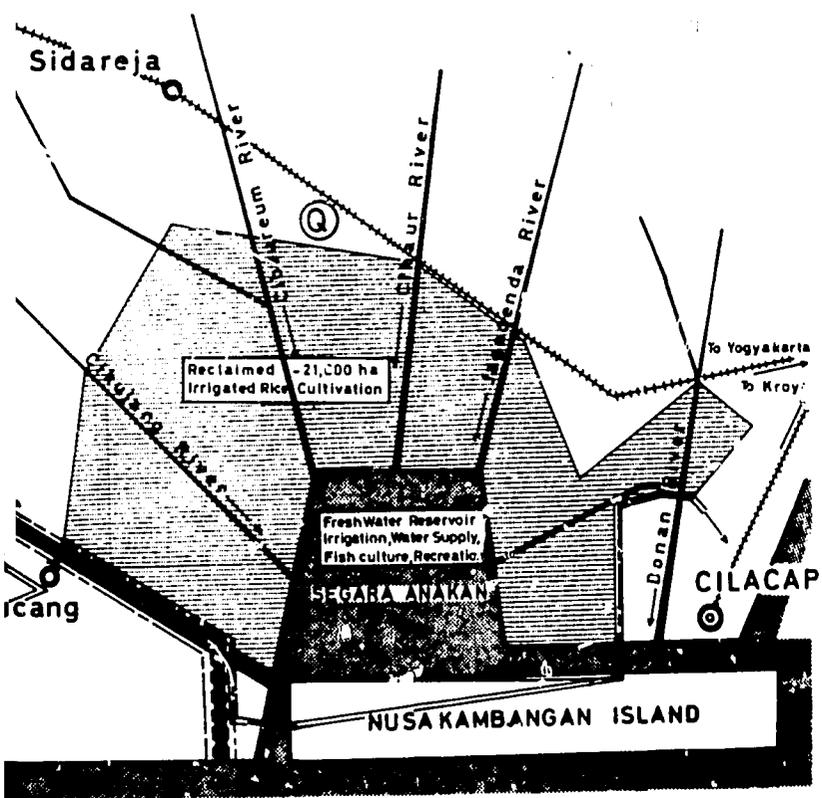
No.	Name	Classification	Area(ha)
<b>Existing</b>			
1*	Cipatani	Semi-Technical	500
2*	Cikayaharja	" "	1,200
3	Cigede	" "	869
4	Cigayam	" "	382
5	Ciloganti	" "	2,20
6	Jagabaya	" "	600
7	Cilempuyang	" "	400
8	Pahonjean	" "	300
9	Wanareja	" "	400
10	GunungPutriII	" "	750
11	GunungPutriI	" "	750
12	Citalahab	" "	630
13	Cikaso	" "	590
Sub-total			7,551
<b>Planned</b>			
A	Indihang	Technical	500
B	Cimuluh	" "	1,950
C	Cikalang	" "	110
D	Cimarongmang	" "	189
E	Cipalih	" "	730
F	Wangundireja	" "	576
G	Clopadang	" "	237
H	Cileumeuh	" "	1,549
I	Cijalu	" "	1,449
J	Sidangasari	" "	561
K	Wanareja	" "	751
L	Rawa Onom	" "	1,028
M	North Lakbok	" "	7,033
N	Ciputrahaji	" "	1,706
Sub-total			18,159
Total Rehabilitation Projects			25,710
Less (1) and (2)(*)			7,400
Total Budgeted Rehabilitation			24,020
<b>Now Being Designed</b>			
R	Banjar Plains	Technical	889
S	Sidareja	" "	7,119
Total Now Being Designed			8,008
Total Rural Irrigation Systems			33,583
<b>Potentially Irrigable Projects</b>			
Wanareja			1,900
Cikaso			2,810
South Lakbok			2,400
Total Potentially Irrigable Project			7,110
Total All Irrigation Citanduy Project			101,321

**NOTES**

- Neither Binangun No. 1 nor Banjar Dual - Purpose Dams and Reservoirs are included in the Master Plan for the development of the Citanduy River Basin. They are shown only because they are the most desirable of all the remaining proposed dam sites other than Matenggeng Dam. Neither has been studied at the feasibility level.
- (\*) Wanareja irrigation will not be possible until swamp no longer required for retention basin. Extreme South Lakbok irrigation will not be possible until pump drainage is feasible. Cikaso irrigation will not be possible until dependable source of water is developed-probably Binangun No. 1 Dual-Purpose Dam.

**ANNUAL PROJECT BENEFITS**

	Millions of Rupiah
FLOOD CONTROL	1,064
IRRIGATION AND DRAINAGE	5,176
HYDROELECTRIC POWER	4,260
CILACAP PUBLIC WATER SUPPLY	433
FRESH WATER FISHERY	122
4 WATERSHED DEMONSTRATION PROJECTS (Intangible)	



Indian Ocean