REPUBLIC OF INDONESIA

THE ACADEMIC DEVELOPMENT OF THE GRADUATE PROGRAM AT THE FACULTY OF AGRICULTURAL ENGINEERING AND TECHNOLOGY, INSTITUT PERTANIAN BOGOR

DETAILED DESIGN REPORT ON MODEL INFRASTRUCTURE IMPROVEMENT WORKS

APRIL, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

Aiming at the enrichment of graduate level education, especially in the agricultural research field, the Government of the Republic of Indonesia has decided to make consistent efforts to realize academic development of the graduate program at the Institute Pertanian Bogor which is a key university of higher agricultural education in Indonesia.

In line with the said education policy, the Government of the Republic of Indonesia has requested to the government of Japan the project type technical cooperation for the Academic Development of the Graduate Program at the Faculty of Agricultural Engineering and Technology, Institute Pertanian Bogor.

In response to the request, the Record of Discussion (R/D) for the project was signed between both Governments of Japan and the Republic of Indonesia on December 24, 1987. The technical cooperation, therefore, started from April 1, 1988 for five(5) years.

It, however, was found that the existing experiment field was insufficient to conduct effective experiment and training programs and was necessary to improve the those infrastructures.

The Detailed Design Survey Team organized by Japan International Cooperation Agency was dispatched to the Republic of Indonesia to conduct the necessary field surveys for the detailed design of the facilities as the model infrastructure improvement works.

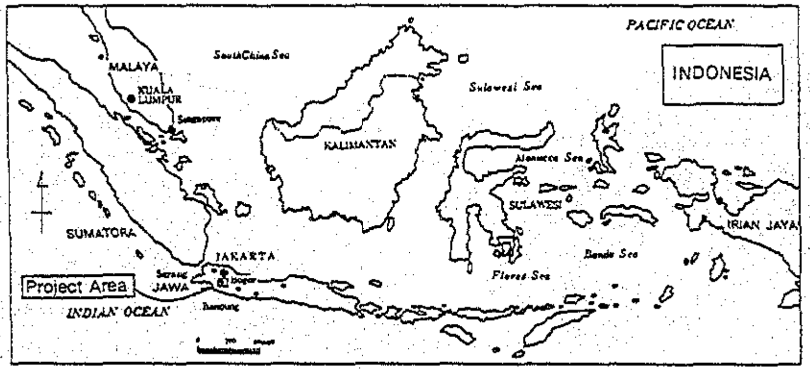
This reports presents the results of the field survey and the subsequent investigations in Japan.

We hope that this report will serve as a guideline for the construction of these facilities.

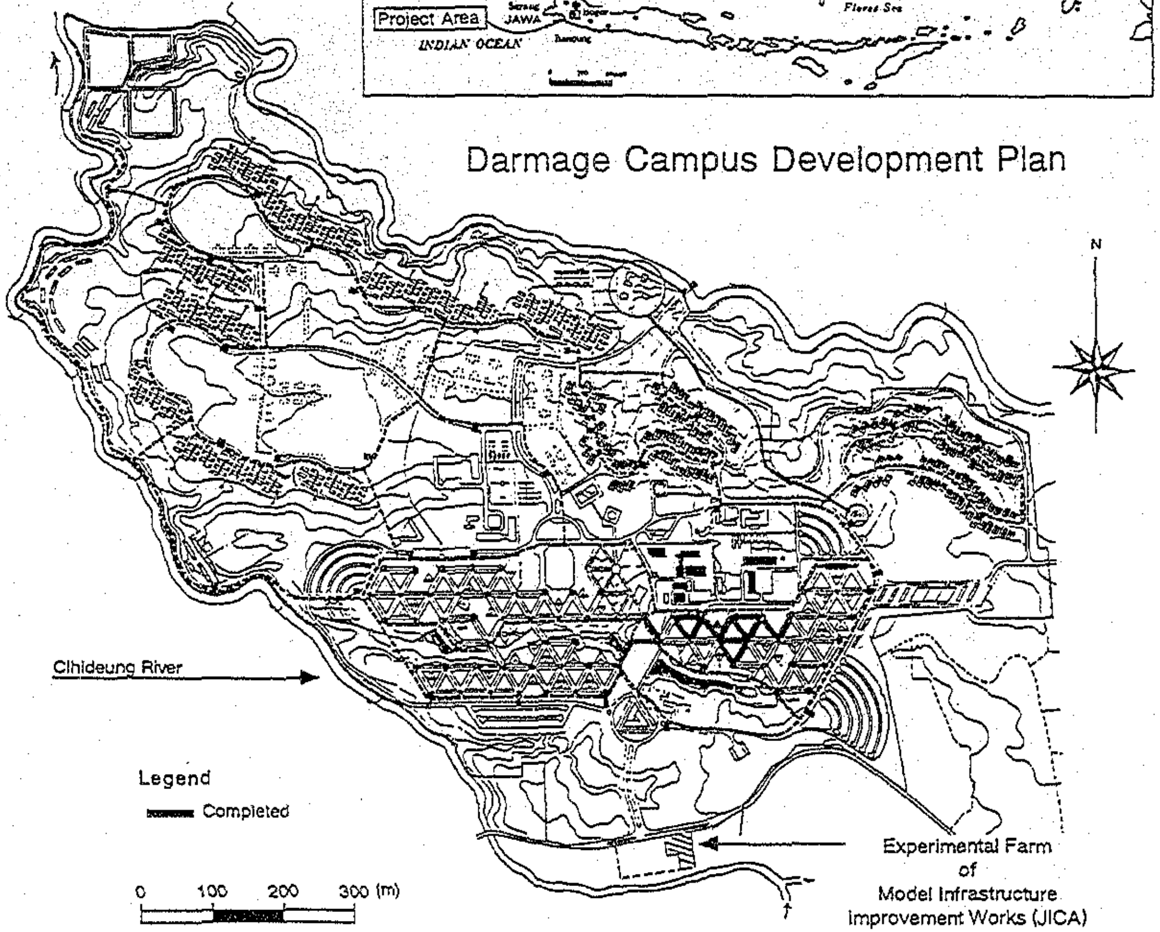
Lastly, I wish to take this opportunity to express my heartfelt gratitude to all officials concerned for all their valuable cooperation and assistance extended to the team throughout the survey.

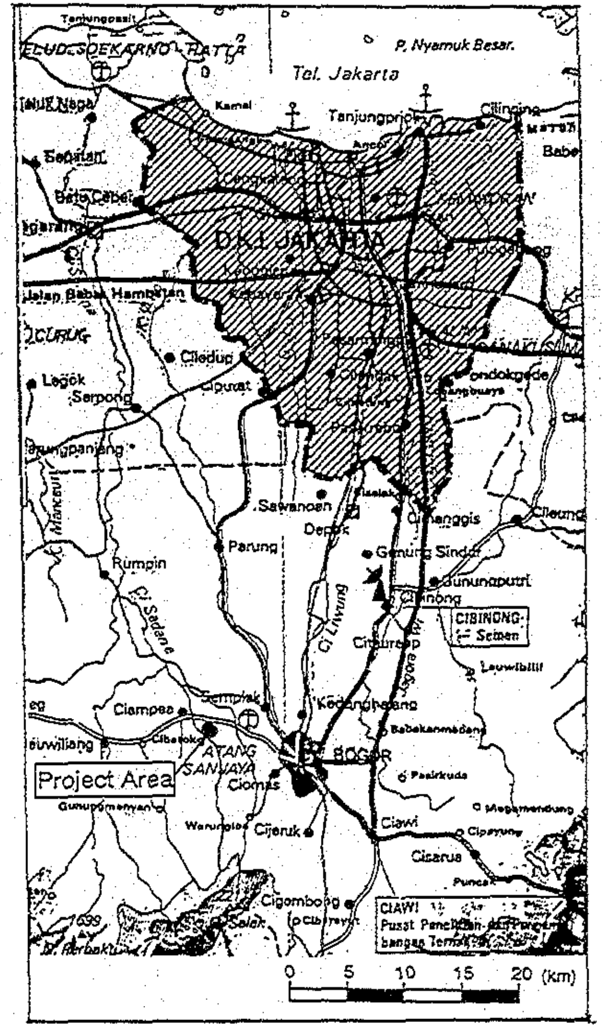
April, 1990

Yoshinobu Sakino
Director
Agricultural Development
Cooperation Department
Japan International Cooperation Agency



Darmage Campus Development Plan

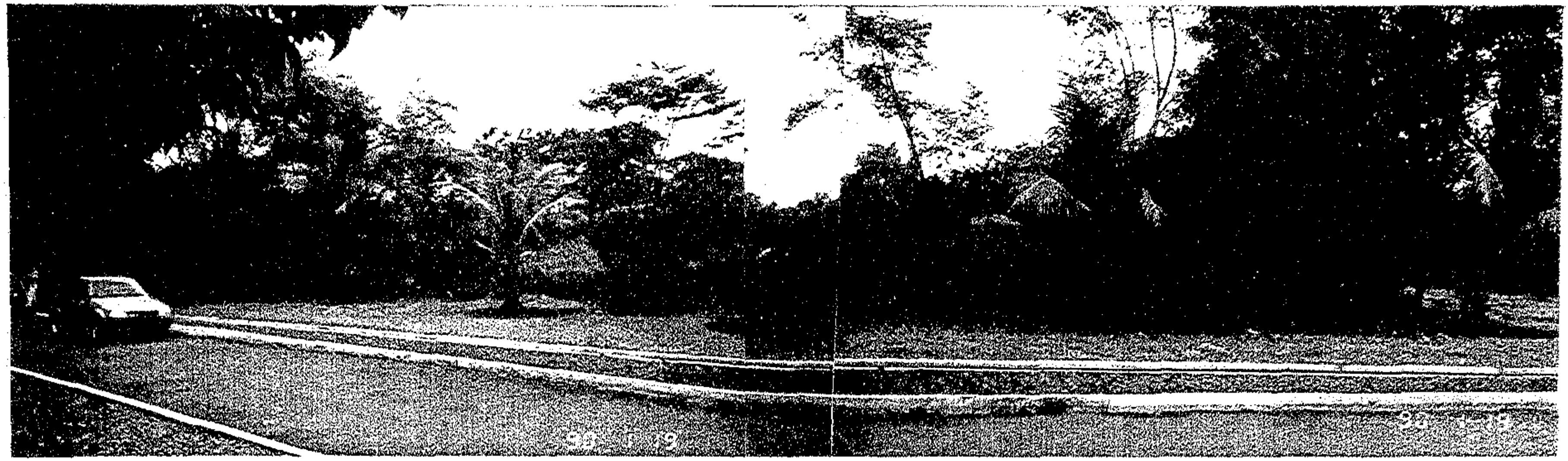




LOCATION MAPS
on
Model Infrastructure Improvement Works
for
Academic Development of the Graduate
Program at the Faculty of Agriculture and
Technology, Institut Pertanian Bogol
Republic of Indonesia

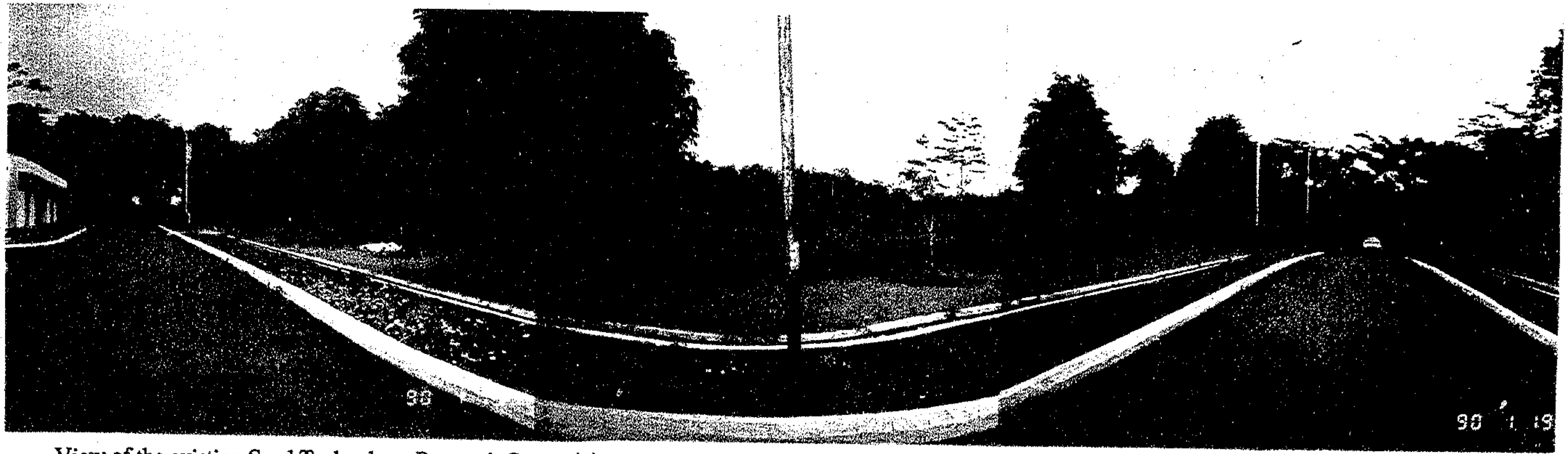
Entrance from
Jalan Raya Darmaga

Right (west) Side : Seed Technology Recerth Center
Left (east) Side : proposed project area

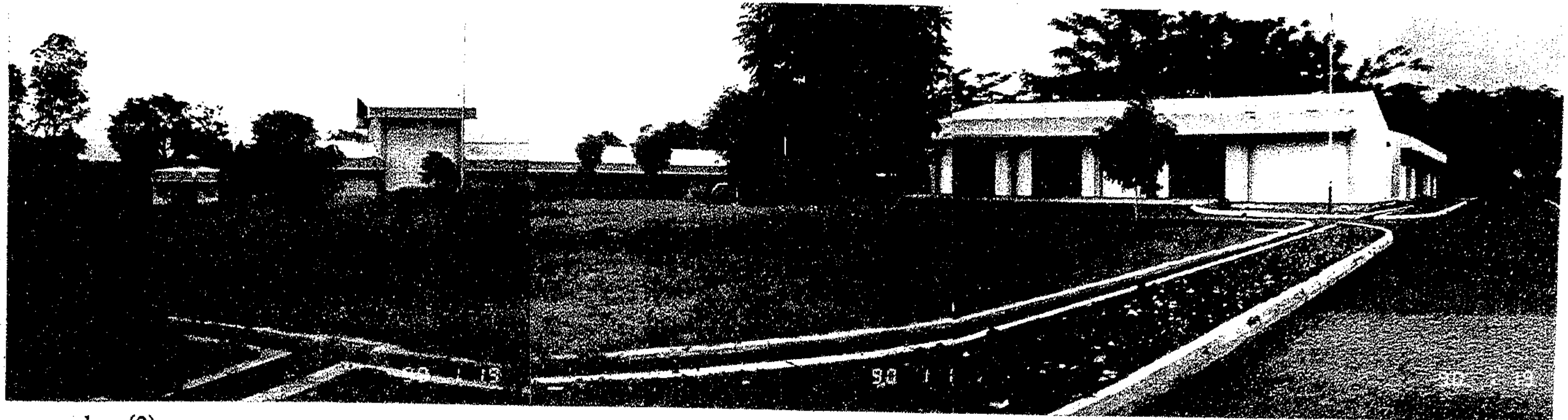


View of the proposed Project area from the entrance road

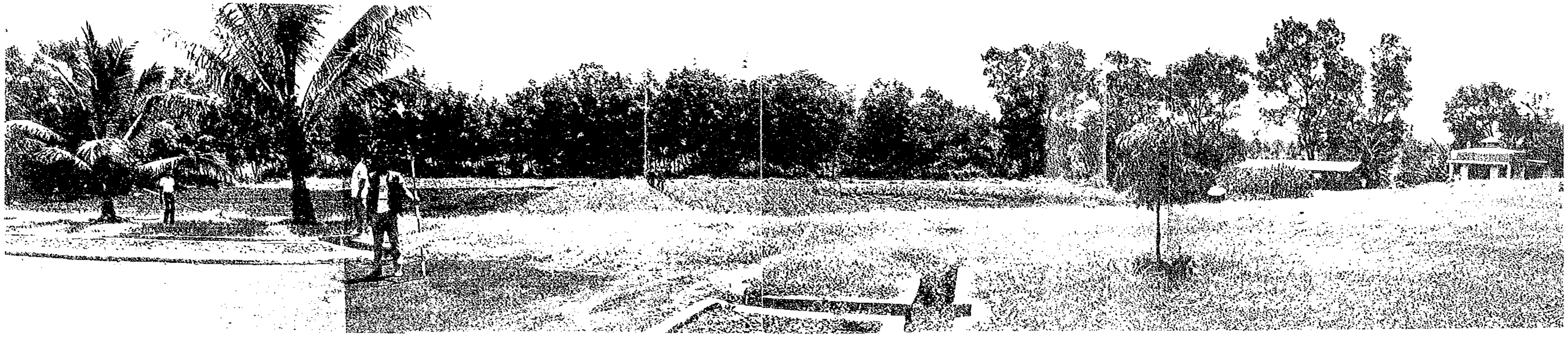
Proposed Irrigation Test Fields
Left : upland, Right : paddy field



View of the existing Seed Technology Research Center (1)



- do - (2)



Left Side : Proposed Site of Irrigation Test Fields and Link Road
Right Side : Energy Development Center Area

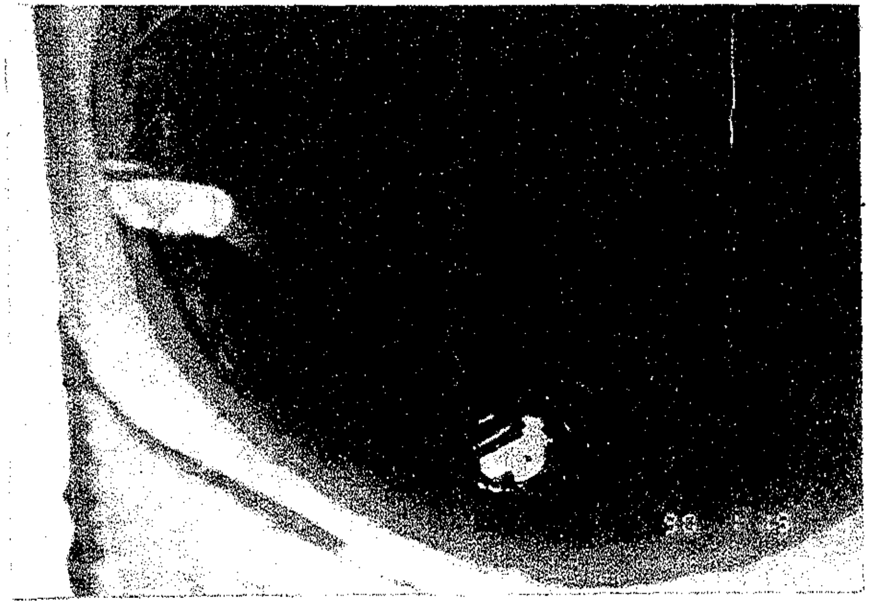
Proposed Tractor Test Field Site

Proposed Tractor Test Road Site

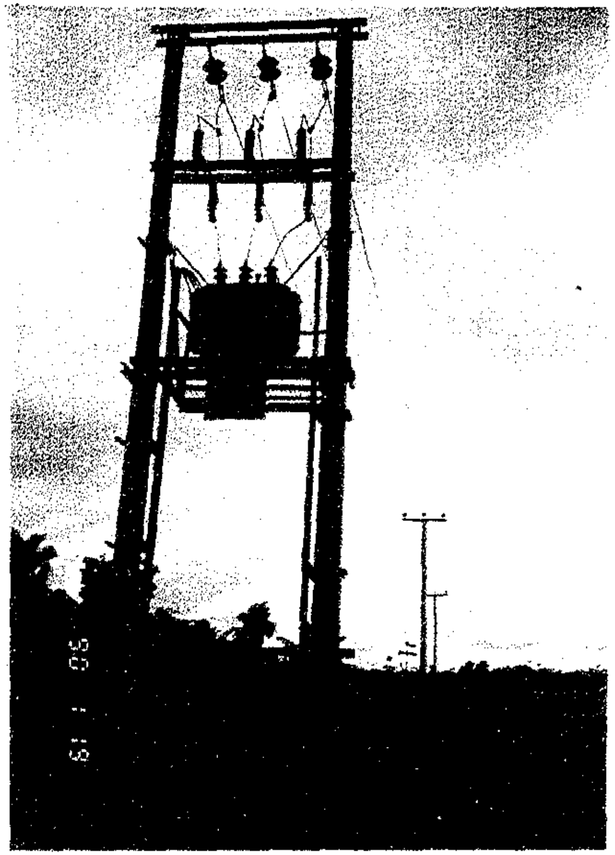
Upstream View of Section 2 from the Left Bank of the Cihideung River (nearby proposed Pump Station)

Upstream View of Section 2 from the Right Bank of the Cihideung River
Proposed Pump Station Site

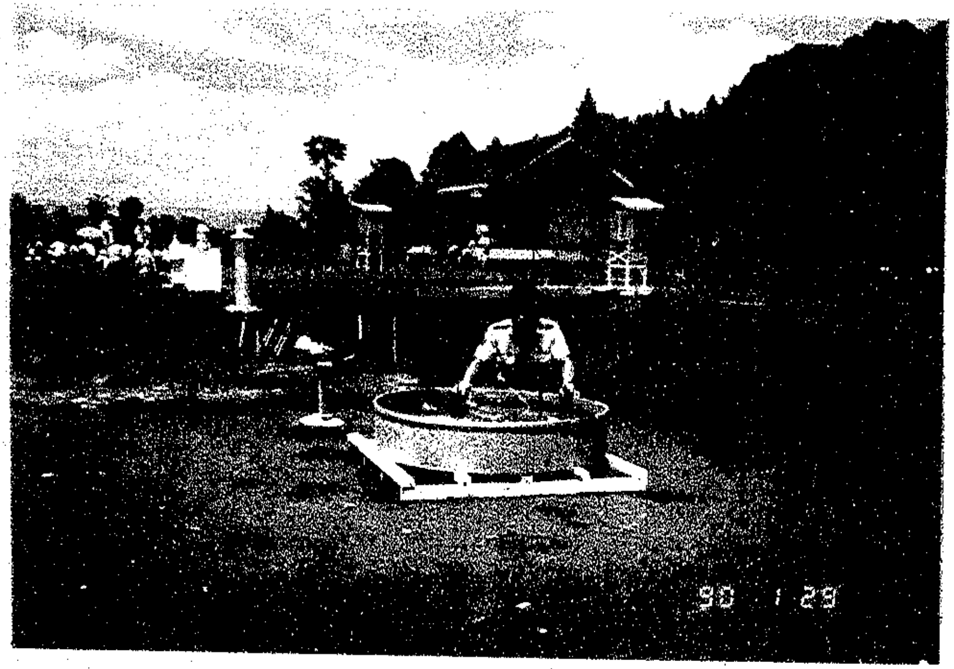
Test pit for Soil Analysis

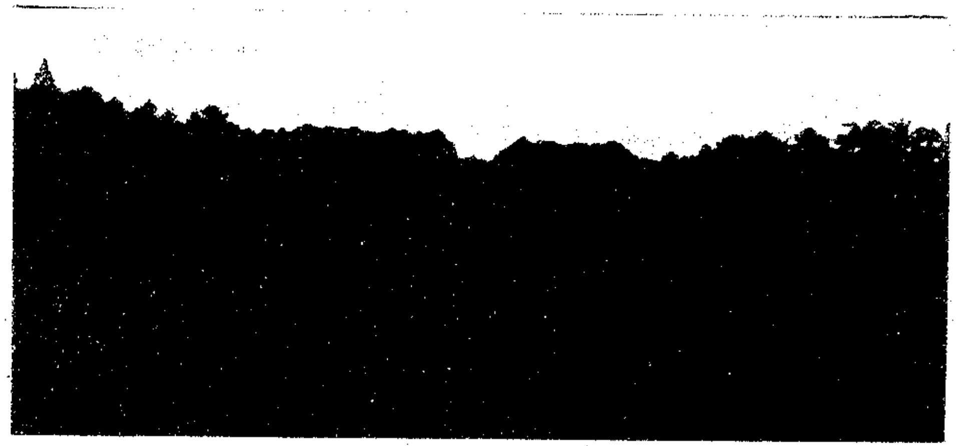


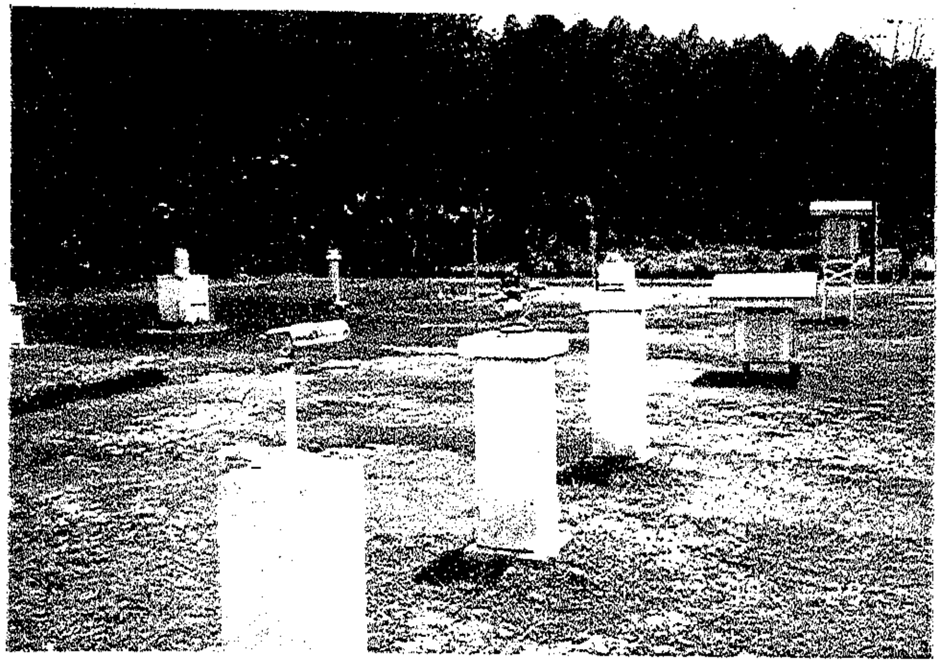
Irrigation Well digged
at the Seed Technology
Research Center
(Depth : more than 15m)



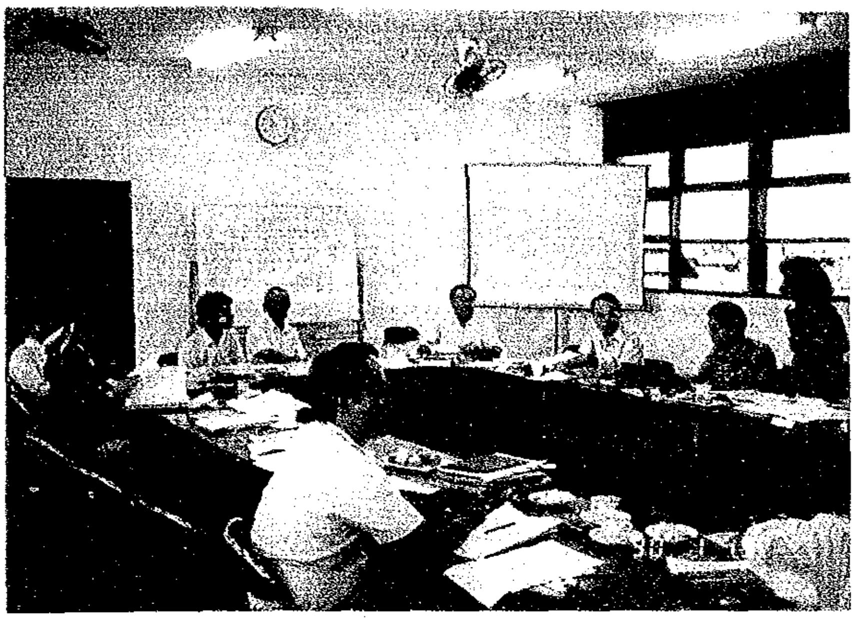
Transformer installed
in the Seed Technology Research Center







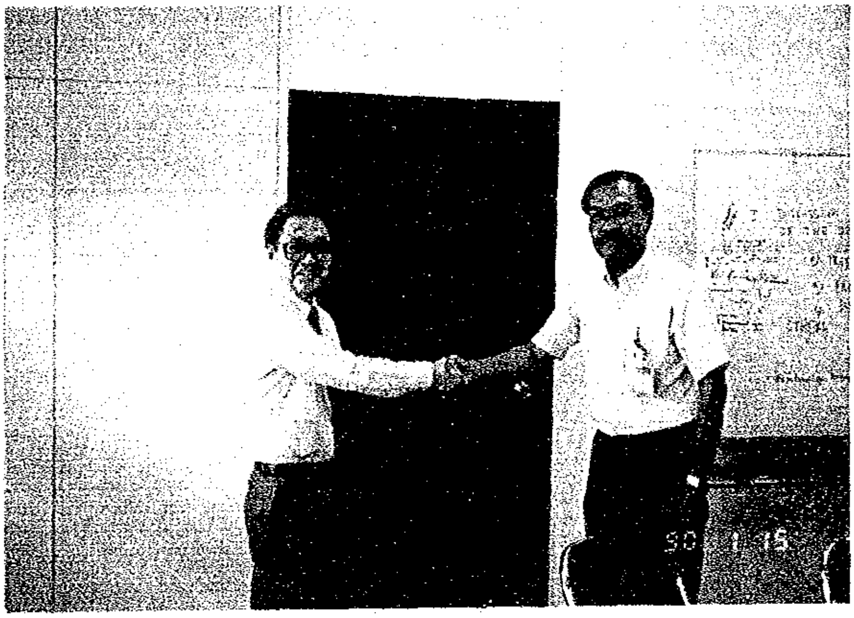
Climatological Station Darmaga Bogor, BMG



Discussion meeting
on Basic Plan
of the MIIP

- Dr. Kamaruddin Abdullah
  Executive Secretary of
  IPB-JICA project

- Dr. Ir. Soedodo Hardjoanridjcjo
  MSC MIIP. IPB
  Mr. Yanuar Jarwadi
  Assistant Coordinator of
  the MIIP. IPB

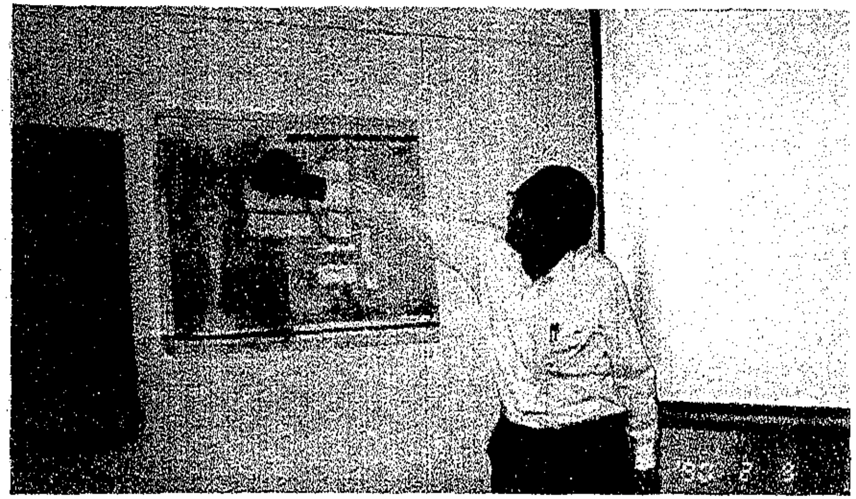


After Agreement of
the Basic Plan,
Dr. Kamaruddin Abdullah
and Dr. Hiroyasu Shimura
are shaking hands

Reporting to Prof
Dr. Sukadji
Ranuwihardjo

Darmaga Campus, IPB

Discussion Meeting on
Progress Report on February 9, 1990



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CHAPTER 1. OBJECTIVES OF THE SURVEY

1.1 Present Condition of the Republic of Indonesia

The Republic of Indonesia is situated on a latitude of 6° 08' N. to a latitude of 11° 15' S. and on a longitude of 94° 45' to 141° 05' E., and made up of a total of 13,667 islands. Its territorial size is approximately 1.9 million km^2. As administrative units, there are 27 provinces and the 3 special wards, Jakarta, Ache and Yogyakarta which are the first grade autonomies. Prefectures and cities are the second grade autonomies.

The total population reached 164 million as of 1985. About 26% of the population lived in cities and the remaining 74% in the countryside areas. It is estimated that the population will increase at total 182.65 million in 1990 and 216 million in 2000. The increase ratio of the population was 2.15% during the period from 1980 to 1985.

The official language in the country is Indonesian. Muslims account for 88.2% of the total population, and others are Christians 8.8%, Hindu 2.1% and Buddhists 1%.

It is said that there are roughly more than 300 tribes and about 250 languages. The Chinese population is estimated to account for some 3% of the total.

Most areas in Indonesia have a tropical climate and belong to the equator rain belt. In most areas, the rainy season usually begins in October and ends in March while the dry season begins in April and ends in September, but those periods can differ slightly depending on the year. There is not a great change in temperature throughout the year. It is about 27°C in the coastal areas and around 22°C in the higher elevations. The western states have a high amount of annual rainfall, while the eastern states have little. The average humidity is 75-85%.

The Indonesian currency unit is the Rupiah (Rp). The government has employed a managed floating system based on a basket system since 1978. The Rupiah-US dollar rate is at Rp 1,974-1,979 to $1 as of February 1990.

The fifth Suharto administration is stable and expected to last long, because the ruling party, Golkar overwhelmingly won in the general election in April 1987, backed strongly by pancasila democracy (5 principles for national foundation).

The recent Indonesian economy faces serious problems including eliminating oil dependency, expanding non-oil exports, reforming the tax system and activating the private sector, and it really needs a change in industrial structure. An urgent question is how to straighten out the economic structure marked by an inadequate infrastructure, high distribution costs, high interest rates and low productive efficiency.

The rapid industrialization and modernization have been developing. Workers in the agricultural sector account for 55% of the working population, those in the manufacturing sector 8%, in the trade sector 15% and in the service sector as low as 16%. The crucial problem is how to increase employment opportunities for the potential unemployed. In 1986, the total potential working population was 70.2 million, the number of those holding jobs 68.3 million, and out of work 1.9 million respectively.

The nominal gross domestic product (GDP) in 1987 reached Rp 114.5185 trillion and the real GDP hit Rp 86.3071 trillion. Its real GDP growth rate declined from 6.4% in 1984 to 2.3% in 1985. However, it steadily increased, recording 3.2% in 1986 and 3.6% in 1987. It is expected that the rate will be about 5% in 1988 and at least 5% in 1989. Primary sectors related to agriculture, forestry and fisheries account for 23.4%, mining 16%, manufacturing 14% and commerce 16% of the total GDP in 1987.

Major items of the Fifth Five-Year Program (April 1989-March 1994) are as follows:

(1) This program is the final stage of the first Twenty-Five Year Program, acting as a springboard for the second long-term program;

(2) The goals of this program are to improve the living standard, spread the wealth more evenly and improve substantially social welfare, and establish a firm foundation for the next stage of development;

(3) The creation of employment opportunities is one of the most urgent questions. It is expected that the working population will rise by 11.9 million to 86.4 million over the next five years;

(4) The average economic growth rate is forecasted to be 5%;

(5) The following sector-wise rate of economic growth is expected: 3.6% for agriculture (rice production accounts for 3.2% of this figure); 8.5% for industry; and 10% for non-oil and gas;

(6) The growth of the non-oil and gas sector will be achieved by promoting an industrial structure change, which will be well balanced between the agricultural and industrial sectors, and the export of non-oil and gas products. Thus, the required number of new jobs will be created;

(7) It is planned that the GNP share of the industrial sector will be increased from 14.4% to 16.9%, that of the agricultural sector will be decreased from 23.2% to 21.6% and the oil and gas sector from 19.8% to 16.3%;

(8) Labor intensification and the worker migration programs will be executed. To create the employment opportunities, cooperative associations and existing small and medium-sized private corporations will be developed;

(9) The funds to execute this program will be raised by non-oil and gas product export expansion, an increase in budgetary revenues such as the tax revenues, and an income increase due to the private investment promotion;

(10) The export of non-oil and gas products, mainly of industrial products will be increased more than 15% annually, and the export value will be doubled in five years;

(11) The budgetary revenues from non-oil and gas products will rise by 23.5% annually. The budgetary revenues from income, value-added, real estate and import taxes will be expanded;

(12) Approximately Rp 239 trillion investment is necessary for five years, and Rp 107 trillion (45%) will be spent from the national development budget. Individuals and firms are expected to invest the remaining Rp 132 trillion (55%);

(13) About Rp 11 trillion are scheduled to be expended on agricultural development in this program (for production increase of edible grains and cattle) and around Rp 6 trillion will be spent for irrigation. Approximately Rp 10 trillion will be appropriated for the energy sector such as expanding the electrical network, while Rp 12 trillion for construction and maintenance of roads. Rp 10.7 trillion will be spent for local development by a Presidential directive;

(14) About Rp 15.7 trillion are appropriated for the education sector and Rp 2.7 trillion for the health sector; and

(15) Stability of higher oil price will be maintained, because oil and gas have been playing an important role in the light of the national revenues and the acquisition of foreign currencies.

Problems foreseen in the future in the Indonesian economy are: (1) how to maintain the export expansion of various non-oil and gas products; (2) how to maintain self-sufficiency in rice and to encourage diversification of agriculture; (3) how to develop alternative sources of energy to replace of oil; and (4) how to create and increase employment opportunities in various fields.

The agricultural sector is very significant, because 74% of the total population live in agricultural districts and 55% of those holding jobs are engaged in the sector which economically, politically and socially supports the people of Indonesia. Therefore, the basic goals of the government agricultural policies are: (1) to achieve expanded production of food and self-sufficiency; (2) to increase farm income; (3) to increase the value of foreign currency acquisition; and (4) to create employment opportunities.

With regard to the program of rice output increase, Indonesia achieved self-sufficiency in 1986. However, the change of highly productive agricultural land into residential land or for other uses due to the expansion of the population and industrialization in Java has become a factor which seriously impedes the drive for self-sufficiency.

The following statistics show the agricultural production in 1987 (kilotons):

Rice (27,453), Corn (5,093), Casaba (14,479),
Sweet potato (1,905), Soybean (1,151),
Peanut (524), Salt water fish (2,029),

Freshwater fish (638), Meat (927), Eggs (495)
Milk (227), Gum (1,132), Palm oil (1,411),
Palm kernel (2,002), Copra (274), Coffee (357),
Tea (157), Clove (57), Pepper (49), Tobacco (115),
Sugar (2,128), Raw cotton (23)

Increase rates of consumer price index experienced in 17 cities in Indonesia were 6.3 % in all items, 7.2 % in food, 6.6 % in housing and 4.6 % in clothing for period October 1988 - October 1989.

Increase rates of wholesales price index were 9.1 % in agriculture, 5.2 % in mining, 5.7 % in manufacturing, 9.8 % in import, 5.5 % in export and 8.6 % in all sectors for period July 1988 - July 1989.

Inflation rates in the major cities in Java were 6.0 % in Jakarta, 5.3 % in Bandung, 7.0 % in Surabaya, 6.2 % in Yogyakarta and 6.1 % in Semarang in the fiscal year 1988/89.

1.2 Background of the Detailed Design Survey

In order to enrich education at graduate schools and increase the number of degree holders in the filed of agriculture study, the Indonesian government has been pushing forward the improvement project in the graduate school of Institut Pertanian Bogor (IPB) which has been considered to be the most important base for higher education in agriculture. As a part of this project, the construction of facilities for the graduate school at the Faculty of Agricultural Engineering and Technology was completed by Japanese financial cooperation (a total budget cost of ¥2.34 billion) as a grant in March 1976. The Indonesian government then requested the Project Type Japan's Technical Cooperation for a research and education at the graduate school, because it was recognized that improving teaching staff and strengthening education at the graduate school as well as constructing and improving facilities are necessary to enrich education at the graduate school in the Faculty of Agricultural Engineering and Technology, IPB.

Accepting this request, the preliminary survey mission was sent to Indonesia in June 1977. Consultation on the project execution was conducted in December 1977. Both governments of Indonesia and Japan agreed that Japan shall: (1) help to improve teaching staff at IPB through the cooperative studies; (2) give instruction and advice to the graduate students to obtain a degree; and (3) give instruction and advice on the matter of study exchanges with organizations concerned. On December 24, 1977, both governments signed the Record of Discussions (R/D) for the Project for the Academic Development of the Graduate Program at the Faculty of Agricultural Engineering and Technology, Institut Pertanian Bogor (IPB). Based on this R/D, the cooperative activities for this project were initiated on April 1, 1977. At present, experts dispatched by JICA on a long and short time bases have worked and offered assistance in Indonesia. This project is to be completed on March 31, 1993.

Relatively large field facilities are essential for experiment and practical application exercises to promote researches and education of agricultural engineering. However, there is not enough field space to carry out the experiments and practical application exercises at IPB. At the Indonesian government's request, both governments confirmed that Japan would assist the project as stated in the Record of Discussions.

Under these circumstances, the Detailed Design Survey (the Survey)Team of JICA was sent to Indonesia from January 7 to February 15.

1.3 Outline of the Model Infrastructure Improvement Works for the Academic Development of the Graduate Program at the Faculty of Agricultural Engineering and Technology, Institut Pertanian Bogor (IPB)

1.3.1 Background of the Project

The Detailed Design Survey Team (the Team) of Japan International Cooperation Agency (JICA) has discussed with the IPB and experts dispatched from JICA on the above improvement works several times after arrival in Indonesia. The IPB aims to improve these experimental fields under this project to demonstrate the agricultural practice system and its related research laboratory in the Agricultural Engineering Department. Specifically, IPB will use them as: (1) a demonstration farm for agricultural engineering and technology; (2) a research laboratory for graduate students at IPB; (3) educational facilities for students; (4) facilities for training; and (5) facilities for seminars.

The Team explained to the IPB that the Model Infrastructure Improvement Works undertaken by JICA will become a basis for execution of future cooperative researches and experts activities including training and practical application exercises of their counterparts. In addition, the Team fully explained that the project is to improve facilities for urgent and minimum requirements due to the budgetary limitation. The Team and IPB agreed on a basic plan as a result of examining the scale and contents of the requested facilities and discussing the implementation priorities for improvements in relation to cooperative research themes. The leader of the Team handed in a letter outlining the above facts finding to the Director General, Directorate General of Higher Education, Ministry of Education and Culture. The following four subjects have been selected as future cooperative research themes to be executed utilizing experimental field facilities improved by the project:

Group A. Optimum Utilization of Agricultural Machinery of Farm for Crop Production.

A1 The influence of mechanical tillage on soil physical and dynamic properties for increasing crop production.

A2 A study on the relationship between soil moisture and tractor capacity in dryland farming.

Group C. Labour Science and Farm Work Science.

C1 Measurement of human energy efficiency during the operation of agricultural machine and tools.

C2 Dynamic anthropometry research for designing purpose of simple tools.

Group G. Efficient Use of Irrigation in Indonesia.

G1 Modeling food crop response to irrigation and simulation for increasing production.

G2 Microcomputer controlled open channel flow monitoring system.

G3 Hydrological evaluation of water resources and its utilization to irrigation.

Group H. Evaluation of Optimum Physical Condition on Farm for Corp Production.

H1 The effect of compaction in paddy field on the optimum condition for secondary crop condition.

The size of the experimental fields to be examined in planning and designing of improvement works was set to approximately 2.5 ha, and the implementation priority of facilities to be improved in the experimental fields were defined as follows:

Priority	Contents of Improvement Works
1st	link roads
2nd	irrigation and drainage system
3rd	soil conservation test fields
4th	irrigation test fields consist of measurement plot, paddy fields, and upland fields
5th	tractor test fields
6th	tractor test roads, and
7th	workshop and workstation

Upon the completion of the field survey, the Team examined the tentative layout of the basic plan based on a newly drawn-up geographical map, and explained the modified layout to IPB and JICA's experts. It was reached to agree within parties concerned that the Team should examine the detailed plan on later after coming back to Japan and come up with the final plan of the project.

The Team reported the results of the field survey in Indonesia on February 23, 1990 to JICA and obtained an approval to formulate the Model Infrastructure Improvement Works in accordance with the above implementation priorities.

1.3.2 Formulation of the Model Infrastructure Improvement Works

According to the priorities stipulated above and with the considerations of the basic facilities of which widely contribute to be the future cooperative studies, the improvement works to be executed by JICA were determined as follows;

(1) Land levelling of entire fields for the agricultural machinery and engineering experiment

The land levelling is finished as following elevations;

Plot of tractor test road, tractor test field and workstation/workshop ----------------------------------	EL.	224.2 m
Plot of paddy field -------------------------------------	EL.	222.7 m
Plot of measurement plot/upland farm -----------------	EL.	223.0 m

While, the soil conservation test fields are made smooth surface with definite slope.

(2) Link road

The link road is asphalted and farm road is of a gravel pavement.

(3) Drainage facilities

The drainage system is provided to collect the rainfall effectively into the farm pond so as to utilize the rain water from the upper area of the field as much as possible. The spilled out water from the farm pond is released out to the existing drainage channel along the national road. The rain water from the slanted zone is drained out to the Cihideung River.

(4) Irrigation facilities

The irrigation water is pumped up into the irrigation canal from the farm pond, mainly. The irrigation water for the double cropping test of paddy in the rainy season and for another upland crop test in the dry season is secured by using this farm pond water.

In case to carry out the paddy crop test in the dry season and upland crop test, a pump irrigation system taking the water from the Cihideung River is necessary as a supplemental water supply. A pump having the discharge capacity of some 3 lit/sec is useful. Accordingly, only the pumping equipment is procured in this project.

According to the results of soil mechanical tests, an application of a concrete structure and a stone pitching protection at the farm pond were canceled except a stone pitching at the inlet and concrete steps for the pump base, despite of the original plan which was considered to be provide a stone pitching protection on full slope facing of the farm pond.

(5) Soil conservation test fields

Five slanted test plots are provided as follows;

Gentle slope plots	25 m long and 20 m wide x 3 plots
Steep slope plots	22 m long and 10 m wide x 2 plots

(6) Irrigation test field

The paddy field is of 100 m long and 30 m wide, divided into 4 sub-plots with a inlet for the irrigation water and a outlet for the drain water for each one.

The upland field plots are of 30 m long at the minimum and 40 m wide, and of 50 m long and 30 m wide.

The measurement plot is limited to carry out land levelling work only. The large scale concrete structure is omitted due to the limited budget. It is possible that a small size steel lysimeter (1 m x 1 m x 1 m) is applicable for temporary experiments.

(7) Tractor test field

The land levelling of the plot is made 80 m long and 35 m wide.

(8) Tractor test roads

The roads for a tractor passing test are provided with 150 m long and 3 m wide consisted of 3 different road facings as concrete and gravel pavement, and roller compacted surface.

(9) Workshop and workstation

The land levelling, an access road and the drainage system are executed for those facilities. Those building construction is excluded in the project due to the limited budget.

1.4 Objectives of the Survey

Confirming and taking into consideration the contents of Indonesian government request, an agricultural machinery and agricultural engineering experimental field is to be formulated based on investigation and survey of the fields and designed as the project for the Model Infrastructure Improvement Works.

1.5 Survey Area and Project Site

An area to be investigated is Bogor Darmaga Campus of IPB situated about 60 km south east from Jakarta. The project site is in Leuwikopo, as suggested by the IPB, which is an area between a road running at the front of main gate of the Darmaga Campus and the Cihideung River, with an area of approximately 2.5 ha, a part of IPB gardening field for practical application exercises adjacent to the Seed Technology Center in an easterly direction.

CHAPTER 2. PRESENT CONDITION

2.1 Location

Bogor is located approximately 60 km south from Jakarta. The Darmaga Campus of IPB can be reached by the national road which goes to Serang, west of Bogor, passing through Jalan Raya Gunung Batu, Jalan Raya Sindang Barang and Jalan Raya Darmaga. The campus is located about 10 km from Bogor, on a latitude of 6° 34' S. and on a longitude of 106° 43' E., and at an elevation of around 200 m.

2.2 Topography

The area to be investigated is a gentle hilly region. The southern border faces the Cihideung River, the northern border is a national road and the western border is the site of the Seed Technology Center in IPB where palms, coffee and other trees are planted now as an experimental field for the Polytechnical Agriculture Course, IBP.

2.3 Climate

There is the Climatological Station Darmaga Bogor under the control of the Meteorological Agency (Badan Meteorologi Dan Geofisika: BMG) located at about 2 km from the project site. Since it is a first grade climatological station and differs only 20 m to 30 m in elevation from that of the site, the climate data from here can be used as the site data.

The average temperature does not fluctuate substantially throughout the year. It changes moderately, peaking in May and October at 25.8°C and 25.9°C, and hitting a low in January and July at 24.8°C and 25.2°C. The highest temperature is at 34.4°C in October and the lowest at 17.2°C in July.

The annual average relative humidity ranges from 82% (in June, July and August) to 90% (in January).

The average annual rainfall is 3,738 mm and the average annual days of rainfall is 227. There are 8 months from October through to May when the average monthly rainfall exceeds 300 mm. Even from June through to September, the monthly rainfall exceeds 200 mm.

From December through to March, there is less than a 50% radiation of sunshine from 8:00 a.m. to 4:00 p.m. and particularly in January it hits a minimum 29% of sunshine radiation. The radiation of sunshine from April through to November ranges from 53% to 81%. Particularly in August, it has a high of 81%.

The monthly average evaporation ranges 2.5 mm/day in January to 3.9 mm/day in October. The annual average evaporation is 3.3 mm/day.

The wind speed ranges from 1.5 km/hr in July to 2.1 km/hr in December.

2.4 Hydrology

The catchment area of the Cihideung River running along the southern border of the project site is 35 km^2. The riverhead can be traced in the Mt. Gunung Salak whose elevation is 2,211 m. The length of river channel is 18 km and the mean width of the basin is 1.9 km. There are 3 intake weirs for irrigation, namely Cihideung, Cianyar and Cisunar which are located at about 4 km, 5.9 km and 7.3 km upstream from the project site, respectively. They have the catchment area of 16 km^2, 15 km^2 and 13 km^2, and the command area of 284 ha, 80 ha and 101 ha, respectively. There exists another Cihideung Supplemental Weir at 100 m downstream from the site to supply irrigation water to 64 ha command area with 13 km^2 catchment area.

The river water is primarily used for irrigation excluding the flood. Particularly in the dry season, most of the river water is used for irrigation. Therefore, water sources for irrigation at the site are limited with overflowed water from the Cihideung Intake Weir, the effluent water from the residual catchment area, and the recirculating water from other irrigation areas. Although this water is small amount, it is taken from the Cihideung Supplemental Weir and used for the downstream irrigation area. Therefore, to acquire water rights for a new water-intake source to secure water for the project site, it is necessary to propose to the Governor of the West Java Province through the Office of Water Resources, Bogor Branch, West Java Provincial Public Works and obtain his approval.

2.5 Soil

The soil in the project site is red and reddish-brown litosol, decomposed of tuff.

According to the test-pit digging, the soil up to 1 m depth is characterized by fine and homogeneous material without gravel and sand. There is no problem for this soil as for the experimental fields because it is used for paddy and upland farming at present, and the project site is now used as a gardening field.

2.6 Soil Mechanics and Geology

The soil of the project site was produced by the Salak volcano and forms an alluvial fan in which silt, sand, gravel and cobble weathered from the quarternary volcanic rock have reaccumulated. The outcrops of tuffaceous breccia can be seen in the riverbed of the Cihideung River near the downstream from the site.

The sandy pumiceous tuff classified as Qvst is distributed from the left bank of the Cihideung River adjacent to the site to the western area. The soil of the catchment area at about 1.5 km upstream from the site and at an elevation of around 200 m to 800 m is made up of the extremely weathered lahar, tuffaceous breccia, lapili and basaltic andesite, which are classified as Qvsb. The rocks of the area from the upstream of this area to the Mt. Salak consist of andesite including lava flow, basalt and pyroxene.

According to the soil mechanical test sampled from IPB's test pit, the project site soil is classified as VH (clayey soil) of the Japanese standard soil classification. Judging from the results of the soil mechanical analysis, the liquid limit test and the plastic limit test as well as the fact that the particle size distribution curve is moderate, the embankment slope must not be steep. In addition, the soil quality is assumed to be lowered when the soil is disturbed.

2.7 Irrigation Facilities

As stated in the section "Hydrology", there are the Cihideung irrigation facilities to take the water from the Cihideung River. In the village of Cihideung Udik at about 4 km upstream from the site, there is an intake weir that is operated throughout the year. The irrigation area is 284 ha. The intake weir is a Vlughter-type cover dam with a weir width of 20 m. The capacity of intake canal is approximately 640 lit/sec. The length of the main canal is about 5.6 km and that of the branch canal is around 3 km.

It is reported that the maximum river flow rate at the site is 120 m^3/sec., the minimum is 0.25 m^3/sec., and its average is roughly 3 m^3/sec. This weir was constructed by the *Puraja Muda Karana* in 1968.

The supplemental weir covers 64 ha command area and the amount of intake water is about 200 lit/sec, reportedly.

Therefore, obtaining water rights in advance is needed in order to pump up the water from the Cihideung River for this project to avoid future conflicts with the existing irrigation systems.

CHAPTER 3. PLANNING

3.1 Layout Planning for Facilities

A layout planning for facilities is drawn up taking into account: (1) convenient use of requested facilities which are to be constructed and improved in the project site; (2) economical construction works; and (3) harmonization between the existing Seed Technology Center and the Energy Development Research Center to be constructed in the future.

Judging from the shape of the project site, the ground heights and the areal restrictions caused by the existing facilities, the agricultural machinery experimental field and tractor test roads are positioned on both sides of link road so as to make direct access from the national road, the workshop is located near above both facilities and agricultural machinery facilities are placed in the east part of the area, referring to the topographical map drawn up in the project site.

Meanwhile, as for the agriculture and civil engineering experimental field, the upland and paddy fields are positioned on the eastern side of the entrance road running in front of the existing Seed Technology Center. Then, the study has undertaken from where the source of irrigation water is to be taken into the area.

If the existing farm pond in the Darmaga Campus of IPB, that is described in the request paper, is selected as a water source, a pumping station having the capacity of about 10 m lifting up the water and an about 400 m long pipeline system are necessary. Since this pipeline system will cross the national road, substantial construction cost is required.

In this project, the natural rainfall on the fields is to be utilized as the main water source. The rainfall will be collected and transported into the farm pond which has an adequate capacity and it will be constructed at the suitable place in the project site. In Bogor, there is a lot of rainfall throughout the year. The pond is filled repeatedly in several times in a year except in the dry season. The water is to be supplied through a canal network to each field, and a pump will be installed beside this pond. With this system, the water circulation from the pond to fields, vice versa, can be effective. Moreover, the execution of sprinkler irrigation tests for the upland farm is possible in the future.

Although the Cihideung River running along the southern border of the project site is a very attractive water source, there is the Cihideung Irrigation System of 284 ha upstream. The Irrigation Intake Weir was constructed in 1965 and the most river flow is used in the dry season. Furthermore, the supplemental intake weir was constructed at about 100 m downstream from the site to make up for the water shortage in the above irrigation area of 64 ha out of 284 ha. It is assumed that the required water of 10 lit/sec. for the dry season, which was estimated when the investigation was carried out in Indonesia, can be obtained from the leakage water through the upstream intake weir and the effluent through the residual catchment area. The Ministry of Public Works suggested that the application must be submitted to the Governor of the West Java Province by the IPB President after the completion of the basic design. Therefore, the Cihideung River was selected as a water source in the dry season for this project. The pumping station will be located at an appropriate site of the river, having a capacity of about 15 m lifting up the water, and the pipeline system will be provided to supply the water to the farm pond.

With regard to the measurement plot (lysimeter) for the study on water balance, the large-sized and reinforced concrete box type lysimeter was selected and positioned near the link road at the south of the farm pond.

The workstation for the experiment and practical application exercises on irrigation and the study on soil conservation is placed on the western side of the workshop or the south of the road. In this arrangement, the distance between the experiment facilities and the laboratory becomes short.

Two kinds of the soil conservation test fields are allocated. The gentle slope plot is positioned at the south slope of the workstation and the workshop. The steep slope plot is placed on the south slope of the tractor test roads. These are located at both sides of the link road which lead to the pump station aside of the Cihideung River from the national road entrance.

3.2 Road Planning

For link roads, the entrance gate will be constructed at the eastern border of the national road so that agricultural machinery is easily accessible to the fields. From this entrance, one straight road extending to the Cihideung River and another road, crossing above road at right angle, connecting to the northern border of the workstation, workshop, the southern border of the lysimeter and that of the experimental field for irrigation (for paddy) are scheduled to be constructed. These roads will be connected to the road of the existing Seed Technology Center. Thus, the trunk road will be formed T-shaped.

Taking into consideration of the frequency and intensity of rainfall, roads shall have appropriate drainage facilities. The same quality of asphalt pavement as the existing roads will be applied to mitigate the traffic disturbance caused by muddy roads. On the both sides of the roads, gravel roads will be constructed so as to allow people access to each experimental field easily during heavy rain. These sidewalks will be connected to those in the Seed Technology Center. As a whole, a rational road network will be established.

3.3 Irrigation Planning

Irrigation facilities include the farm pond, the Cihideung pumping station, the pipeline system and the irrigation canal.

Assuming that test crops are grown for a year which is introduced a triple cropping system with a total upland area of 0.55 ha, the water demand for the following crops is calculated by the FAO's pan evaporation method:

(1) corn as the first crop in the rainy season (133-day growing period);

(2) fruit, tomatoes, eggplant, melons or Guinea peppers as the second crops in the rainy season (133-day growing period); and

(3) soybeans as the third crop in the dry season (92-day growing period).

Meanwhile, the water demand for the paddy for cases (A) and (B) is determined by assuming that test crops are grown on paddy field and a lysimeter plot with a total area of 0.315 ha for the following cropping patterns;

(A) Three times paddy crops a year; and

(B) Double paddy crops a year, and a soybean crop in the dry season.

In the case of (A), it is assumed that an improved variety of paddy is grown for 135-140 days for the first crop in the rainy season and its irrigation term is 102 days after the transplantation; and an improved variety of paddy is grown for a relatively shorter period of 130-135 days for the second crop in the rainy season and for the third crop in the dry season. In the case of (B), an improved variety of paddy is grown for 135-140 days for the first and second crops in the rainy season and the irrigation term is 102 days after each transplantation; and soybeans are grown for 92 days in the dry season as a third crop. It is also assumed that 250 mm water is supplied for 10 days or 5 days as the paddling water for field preparation of transplanting, and amount of the percolation water is 2 mm/day.

The drought year and the abundant year were determined with a return period of 5-year, the former was in 1988 and the latter was in 1977. As for the number of consecutive days with dry weather for each year from 1977 to 1989 (excluding less than 5 mm/day), the maximum was 34 days in 1982 and the minimum was 9 days in 1985. It was recorded for 23 days in 1977 and for 17 days in 1988. The average number of days with dry weather for these 13 years was 18 days. The non-over probabilistic analysis on the rainfall for four months (from July through to October) during the dry season indicates that the rainfall of 609 mm recorded in 1988 is almost equivalent to the return periods of the 10-year rainfall, and 695 mm in 1977 to the 6-year rainfall. Therefore, the water balance was determined for 1988 and 1977 as the drought and the abundant year respectively.

The irrigation water demand for each period of 5 days was obtained by calculating the effective rainfall based on the record of daily rainfall in both years. It is assumed that the irrigation efficiency for upland farm is 60% and the efficiency of the irrigation canal is 95% taking into account the canal length and its structure.

The effective catchment area of the farm pond is 2.1 ha. Its capacity is assumed to be 1,000 m^3 considering the limitation of geography.

If there is a rainfall of less than 15 mm for a period of 5 days, the effective inflow into the farm pond is assumed to be 0 mm, and if there is a rainfall of more than 15 mm, the effective inflow is assumed to be 60% of the exceeding rainfall over than 15 mm.

The following table shows the results of water balance calculations in 1988 and 1977 (see tables in the Technical Data C4 of Appendix C):

Summary of the Water Balance Calculation Results
(annual values)

Base Year	Case A		Case B	
	1977	1988	1977	1988
1. Rainfall (mm)	4,338	3,189	4,338	3,189
2. Crop water requirements				
1. Upland crops (mm)	644	707	664	707
2. Paddy (mm)	1,456	1,853	950	1,275
3. Inflow to the farm pond				
1. Effective outflow of rainfall (mm)	2,065	1,390	2,065	1,390
2. Amount of water (m^3)	43,365	29,190	43,365	29,190
4. Irrigation water requirements				
1. Upland crop (m^3)	6,412	6,831	6,412	6,831
2. Paddy (m^3)	4,820	6,133	3,147	4,222
3. Total (m^3)	11,232	12,964	9,559	11,053
5. Shortage of water for irrigation (m^3)	1,421	2,395	415	1,187
6. Spilled water (m^3)	32,686	18,080	33,353	18,783
7. Pump operation time (hrs.)	133	224	38	112
8. Frequency of full charging of water to the pond	10	10	11	9
9. Terms of full water				
1. Number of pentad period	36	31	39	34
2. Percentage to one year (%)	50	43	54	47

According to the above data, the following conclusions are obtained:

(1) The capacity of the farm pond (1,000 m^3) is appropriate, although it has been decided by a geographical constraint.

(2) Therefore, the shortage of water must be supplied by the pumping up from the Cihideung River. It is assumed that a pump bore of 40 mm, a pumping capacity of 0.18 m^3/min (3 lit/sec or 10.8 m^3/hr) and an actual pumping head of about 12 m is installed and operated 10 hrs/day at the maximum.

In the experimental cropping plan for Case (A), the pump irrigation with the operational time of 224 hours is indispensable in the basic year of the drought, and 112 hours for Case (B).

(3) If the pumping station plan is abandoned due to a budgetary reason, the farm pond becomes the only water source for the time being. In this case, the experimental cropping plan must be slightly modified. For example, the starting time of the second cropping in the rainy season must be a little earlier. An improved variety of paddy should be adopted to be grown in a shorter growing period and these experiments must be completed by the end of June. Another measure is to make the cropping area decreased. In addition, the experiment should be limited in the dry season so it will not be affected by stress of water shortage.

(4) The required capacity of the pump estimated at 10 lit/sec during the field survey at the site can be reduced due to effectiveness of the farm pond function to the capacity of about 3 lit/sec.

Water is supplied to the irrigation canal, connecting each field with the farm pond, by using a pump with an actual lifting head of around 3 m as the distribution system of irrigation water.

3.4 Drainage Planning

The spillway of the farm pond is the vital drainage facilities. A probability analysis was performed on the short-time rainfall intensity to determine the spillway capacity. (See the tables in the Technical Data C1 of Appendix C.) The spillway capacity is given by discharging of 30-minute rainfall intensity with the return period of 100-year.

The drainage criteria to determine the drainage capacity of lysimeter outlet weir is set to 5-minute rainfall intensity with the return period of 100-year.

In the study of the cross sectional size of the drainage canal, the 15-minute rainfall intensity with the return period of 10-year was used as a magnitude criteria, and planning and designing were performed with referring to the cross sectional size of the existing drainage canal as the empirically required size.

In order to decide the base elevation of the pumping station aside the Cihideung River, a probability flood analysis of the river was performed. The flood and the flood rating curve at the site under consideration of the pumping station were obtained by conducting the un-uniform flow calculation on the data of the river surveying. (See the Technical Data C2 of Appendix C and attached Drawings for the results.)

As the results, the base height of the pumping station was determined as EL. 215 m to keep the structure safe against the 100-year flood water level.

3.5 Land Levelling Planning in the Field

The project site is now used as an experimental and practical application exercise field for Polytechnical Agriculture Course, IPB. The number of coconut trees planted exceeds roughly 150, and tree grafting tests are carried out with coffee and/or other trees. These fields have already been decided as the experimental fields for the Faculty of Agricultural Engineering and Technology as a result of the internal discussions with the IPB. All experiments and collection of data concerning to this area must be completed before the commencement of construction works. All trees such as coconut, coffee, and other trees shall be removed and cleared out unless otherwise admitted as necessary from the viewpoint of scenery, as confirmed in the Team Leader's Letter.

The designed elevations of the site are set to the land level to minimize the amount of earth works by analyzing the ground height and the area using the surveyed topographic map.

The land elevations after levelling are as follows;

1.	Tractor test roads	EL.	224.2 m
2.	Tractor test field	EL.	224.2 m
3.	Paddy fields	EL.	222.7 m
4.	Upland fields and measurement plot	EL.	223.0 m
5.	Workshop and workstation, and	EL.	224.2 m

6. High water level of farm pond EL. 222.4 m

3.6 Power Supply Plan

A power supply is required for operation of the pumping stations, the workshop and the workstation.

The required power is supplied through a distribution panel appurtenant to the transformer installed at the Seed Technology Center. Since these works are performed by the Bogor Branch Office of PLN, the costs are not included in the project budget.

3.7 Construction Works in the Charge of Indonesian Side

Among the components of the experimental fields for the project, all construction works except components that are employed by the Model Infrastructure Improvement Works by the Government of Japan shall be borne by Indonesian Side.

3.8 Maintenance Plan

All maintenance of the facilities shall be carried out by the IPB. The coordinator of this project has been appointed as the person in charge of operation for the time being. The maintenance expenses are estimated to be Rp 25 million annually.

CHAPTER 4. DETAILED DESIGN

4.1 General

Based on the previous chapter, detailed design are carried out on the following work items in this chapter:

Land levelling :	2.5 ha
Link road :	main road 454 m, farm road 100 m
Irrigation and drainage facilities :	farm pond 1 nos, irrigation canal 96 m, drainage canal 1,571 m
Soil conservation test field :	20 m x 25 m x 3 plots, 10 m x 22 m x 2 plots
Irrigation test field :	paddy field 3,000 m^2, upland 2,700 m^2
Tractor test field :	upland 3,010 m^2 (including tractor turning space)
Tractor test road :	150 m x 3 lines

4.2 Land Levelling

Whole area of the test field (2.5 ha) is designed to be reshaped. The amount of earth works of land levelling is considered to be as small as possible within each block area of the facilities. As for the irrigation test field (upland) and the tractor test field (upland), present top soils are firstly collected in stock areas and spreaded after land levelling in order to conserve soil productivity.

4.3 Link Road

Link roads are designed aiming at easy access among each facility in the test field. Link roads are designed like a character of T in a plan. Farm road is also designed to approach for agricultural machinery to paddy field and upland of the irrigation test field.

Proposed roads are summarized as below:

	Line	Width	Sub Base	Pavement
Main Road	Entrance of Test Field - Cihideung River	8 m (Effective width : 5 m)	Gravel 15 cm	Asphalt 5 cm
	Entrance Road of Seed Technology Center - Tractor Test Field	7 m (Effective width : 4 m)	Gravel 15 cm	Asphalt 5 cm
Farm Road	Entrance Road of Seed Technology Center - Irrigation Test Field	4 m (Effective width : 3 m)	Soil compaction	Gravel 15 cm

Each road is designed to be higher than the levelled land by embankment for easy transportation under rainfall conditions, and designed to be sloped at 5 % in cross section for easy drainage. The maximum vertical slope of the roads is designed at 8 %.

4.4 Irrigation and Drainage Facilities

Farm pond, irrigation canal and pump stations are designed as irrigation facilities and drainage canals as drainage facilities.

(1) Farm Pond

1) Farm Pond

Capacity of the farm pond is proposed as 1,000 m^3. Bed elevation of the drainage canal, which supplies water to the farm pond, is deigned lower at 0.60 m than the levelled land (EL. 223.00 m). Therefore, full water level of the farm pond is designed at EL. 222.40 m, so that flow water in the drainage canals can be drained into the farm pond. The side slope of the farm pond is designed at 1 : 1.5 in order to ensure stability of the slope. Inlet portion of the farm pond around the drainage canal and the portion around the spillway are protected by stone masonry.

2) Spillway

The spillway has a function to drain excess water when water level is over the capacity of the farm pond, which corresponds to the full water level.

a Design discharge

Design discharge of the spillway is estimated by using following formula considering rainfall intensity of 30 minutes rainfall duration with 100-year return period:

$Q = R_{30}^{100} \times A,$

Where; Q : design discharge,

R_{30}^{100} : rainfall intensity of 30 minutes rainfall duration with 100-year return period ($R_{30}^{100} = 147.8$ mm/hr),

A : catchment area ($A = 2.41$ ha).

$Q = 147.8$ (mm/hr) x 2.41 (ha)
$= 1.00$ (m^3/sec)

b. Crest

The crest portion of the spillway is designed to have a drop, concrete box which connects the crest portion with the guide channel of the spillway, so that critical section can be brought about. The crest length of the spillway is calculated from the following formula:

$Q = C\,L\,H^{3/2},$

Where; Q : design discharge ($Q = 1.00$ m^3/sec),
C : coefficient of discharge ($C = 1.7$),
L : crest length,
H : total head above crest ($H = 0.50$ m).

The crest length is determined at 2.0 m including an allowance to required crest length which is calculated from above formula. Having this crest length, design flood water level is estimated at EL. 223.34 m.

$1.00 = 1.7 \times L \times (0.50)^{3/2}$

$L = 1.7 \fallingdotseq 2.0$ (m)

c. Guide channel

Hydraulic calculation is performed based on the following Manning's formula:

$$Q = A\,V = (B \times d) \times (\frac{1}{n} R^{2/3}\, i^{1/2}),$$

Where; Q : design discharge ($Q = 1.00\ m^3/sec$),
A : flow area (m^2),
V : velocity (m/sec),
B : bed width (m) (B = 1.0 m),
d : water depth (m),
n : coefficient of roughness
(n = 0.015 (concrete)),
R : hydraulic mean depth (m),
i : bed slope (i = 1 : 200).

The result of the calculation based on the design figures is as follows:

$$1.00 = (1.0 \times d) \times \{\frac{1}{0.015} \times (\frac{1.0xd}{1.0+2d})^{2/3} \times (\frac{1}{200})^{1/2}\}$$

$$d \fallingdotseq 0.53\ (m)$$

The height of side wall is determined at 1.0 m including a freeboard (Fb) calculated from the following formula:

$$Fb = 0.05\,d + \frac{1}{2g} \times (\frac{q}{Bd})^2 + 0.10$$
$$= 0.05 \times 0.53 + \frac{1}{19.6} \times (\frac{1.00}{1.0x0.53})^2 + 0.10$$
$$= 0.31\ (m)$$

(2) Irrigation canal

Irrigation canal is designed to have enough capacity on the deign gross duty of water.

1) Design gross duty of water

Design gross duty of water is estimated as peak water requirement form the irrigation test field and the tractor test field as follows:

$$Q = q_1 \times A_1 + q_2 \times A_2,$$

Where; Q : design gross duty of water,
A_1 : commanded paddy field area (paddy field of irrigation test field 3,000 m^2, measurement plot 150 m^2),

A_2 : commanded upland area (upland of irrigation test field 2,700 m^2, tractor test field 2,800 m^2),

q_1 : water requirement for preparation of paddy fields as peak water requirement from paddy fields (250 mm/day),

q_2 : evapotranspiration of crops (3.9 mm/day, September) as peak water requirement from uplands, considering conveyance loss and application loss;

$$3.9 \times \frac{1}{0.95} \times \frac{1}{0.60} = 6.8 \text{ (mm/day)}.$$

Design gross duty of water is estimated at 0.010 m^3/sec by using above design figures as follows:

$$Q = 250 \text{ (mm/day)} \times (3,000 + 150) \text{ (m}^2\text{)} + 6.8 \text{ (mm/day)} \times 5,500 \text{ (m}^2\text{)}$$
$$= 824.9 \text{ (m}^3\text{/day)}$$
$$= 0.010 \text{ (m}^3\text{/sec)}$$

2) Design capacity

According to the design gross duty of water calculated in the previous section, design capacity (Qd) of the irrigation canal, under the condition of irrigation duration of 10 hours a day during peak period, is estimated at 0.024 m^3/sec based on the following formula:

$$Qd = 0.010 \text{ (m}^3\text{/sec)} \times \frac{24}{10}$$
$$= 0.024 \text{ (m}^3\text{/sec)}$$

3) Hydraulic calculation

The irrigation canal is designed on the basis of hydraulic calculation by following Manning's formula:

$$Q = A\,V = (B \times d) \times \left(\frac{1}{n} R^{2/3}\, i^{1/2}\right),$$

Where; Q : design discharge (Q = 0.024 m^3/sec),
A : flow area,
V : velocity,
B : base width (B = 0.30 m),
d : water depth,
n : coefficient of roughness (n = 0.015),
R : hydraulic mean depth,

i : bed slope (i = 1 : 1,000).

Water depth (d) is estimated at 0.19 m by using these figures in the Manning's formula as follows:

$$0.023 = (0.30 \times d) \times \frac{1}{0.015} \times (\frac{0.30d}{0.30+2d})^{2/3} \times (\frac{1}{1000})^{1/2}$$

$$d = 0.19 \text{ (m)}$$

A free board (Fb) is calculated from following formula, then height of side wall is determined at 0.30 m:

$$Fb = 0.05\,d + \frac{1}{2g}(\frac{Q}{A})^2 + 0.10$$
$$= 0.05 \times 0.19 + \frac{1}{19.6} \times (\frac{0.024}{0.30 \times 0.19})^2 + 0.10$$
$$= 0.11 \text{ (m)}$$

(3) Drainage canal

Proposed four (4) systems of drainage canal are summarized as follows:

System	Catchment Area	Area (ha)
1.	North area of tractor test field and tractor test road.	0.4
2.	Upland in irrigation test field.	0.7
3.	Paddy field in irrigation test field, south area of tractor test field and tractor test road.	1.3
4.	Soil conservation test field and building area.	0.1

Gutters of the T-shaped link roads and drainage canals connecting to the farm pond is designed as half-concrete pipe, referenced with existing drainage canals, in order to prevent farm pond from sedimentation. Drainage canals within factor test road area and gutters of the link roads between work station, workshop and soil conservation test field are designed as open ditch.

1) Design discharge

Design discharge is estimated based on rainfall intensity of 15 minutes rainfall duration with 10-year return period as follows:

$Q = R_{15}^{10} \times A$,

Where; Q : design discharge,

R_{15}^{10} : rainfall intensity of 15 minutes rainfall duration with 10-year return period (R_{15}^{10} = 183.5 mm/hr),

A : catchment area.

Design discharge is calculated at 0.51 m^3/sec/ha from the above formula.

2) Hydraulic calculation

The drainage canals are designed on the basis of hydraulic calculation using following Manning's formula:

$$Q = A\,V = (B \times d) \times (\frac{1}{n} R^{2/3} i^{1/2}),$$

Where; Q : design discharge,

A : catchment area,

V : velocity,

B : bed width,

d : water depth,

n : coefficient of roughness,

R : hydraulic mean depth,

i : bed slope.

3) Canal size of half-concrete pipe

Canal size of half-concrete pipe in the drainage canal system No. 3, whose catchment area is 1.3 ha, is examined here. In this examination, inundation in paddy fields is considered to be allowed. Design discharge is calculated as follows:

$$Q = 0.51\ (m^3/sec/ha) \times 1.0\ (ha) \times 0.6$$
$$= 0.31\ (m^3/sec)$$

Flow area (A) is studied as follows, with the assumption that the diameter of half-concrete pipe is 0.50 m:

$$A = \frac{1}{2} \times \frac{(0.50)^2\pi}{4} + 0.50(d - 0.25)$$
$$= 0.50\ d - 0.027$$

Water depth (d) is calculated at 0.48 m by calculation using above figures as follows:

$$0.31 = (0.50\,d - 0.027) \times \frac{1}{0.015} \times \left\{\frac{0.50d-0.027}{\frac{0.50\pi}{2}+2(d-0.25)}\right\}^{2/3} \times \left(\frac{1}{200}\right)^{1/2}$$

$d = 0.48$ (m)

Height of side wall is determined at 0.60 m considering freeboard of about 0.10 m.

4) Canal size of open ditch

Canal size of open ditch is determined based on the design discharge of 0.51 m^3/sec/ha and catchment area of 2,000 m^2 as follows:

$Q = 0.51 \times 0.2 = 0.102$ (m^3/sec)

The bases in calculation on cross section of open ditch are 0.5 m in bed width, 1 : 1 in side slope, 0.030 in coefficient of roughness and 1 / 500 (= 0.002) in vertical slope. The results of calculation are as follows:

$H = 0.3$ (m), $A = 0.24$ (m^2), $P = 1.348$ (m), $R = 0.178$ (m),
$V = 0.47$ (m/sec), $Q = 0.113$ (m^3/sec).

As a result, the size of open ditch is decided at 0.5 m in bed width, 0.3 m in water depth and 0.5 m in height.

(4) Pump station

Two (2) pump stations are set up in the area. The purposes of pump stations and salient features of pumps are as follows:

1) Pump station at farm pond

As the farm pond is planned to be located in the lower portion of the area, pumping system is required for taking up irrigation water from the farm pond to the irrigation canal. That is the purpose of this pump station. The salient features of the pump is as follows:

Design capacity :	0.41 m^3/min,
Total pump head :	5 m,
Pump type :	Horizontal single suction single stage volute pump,
Diameter of pipe :	ø 50 mm,
Motive power :	Motor, 0.75 kW (50 Hz).

The pump is set up in the outdoors, and fixed on the base concrete by anker bolts. A portable hose is used as a suction pipe.

2) Pump station at the Cihideung river

The pump station at the Cihideung river has the purpose of pumping up stable river water from the Cihideung river into the farm pond during the shortage of storage water in the farm pond. The salient features of the pump is as follows:

Design capacity :	0.18 m^3/min,
Total pump head :	20 m,
Pump type :	Horizontal single suction multi stage volute pump,
Diameter of pipe :	ø 50 mm,
Motive power :	Motor, 2.2 kW (50 Hz).

The pump is set up in the outdoors, and fixed on the base concrete by anker volts. Water is couveyed through portable hose from the pump station to the farm pond.

4.5 Soil Conservation Test Field

The objectives of the soil conservation test fields are to make experiments on soil erosion and soil conservation under the conditions of rainfall on a sloping ground. These test fields are summarized as follows.

Degree of slope : 3 %	20 m x 25 m x 1 plot,
Degree of slope : 6 %	20 m x 25 m x 1 plot,
Degree of slope : 9 %	20 m x 25 m x 1 plot,
Degree of slope : more than 9 %	10 m x 22 m x 2 plots.

Each field is surrounded by concrete wall not to enter surface water from the outside. On the other hand, concrete boxes (width 1.0 m, height 0.5 m) with crest device are set up for measurement of the discharged soil and water running down through a sloping ground. Access roads for tractors are designed at the north side of the soil conservation test fields of 20 m x 25 m size plots.

4.6 Irrigation Test Field

Paddy field (3,000 m^2, 30 m x 100 m) and upland (2,700 m^2, 30 m x 90 m) are designed as the irrigation test field. The elevation of the paddy field is designed at 222.70 m after land levelling. The paddy field has irrigation canal on the north side and drainage canal on the south side. The paddy field is divided into four (4) plots, and ridges are made on the border. Upland is located on the north of the paddy field. The ridges of the upland are higher at 30 cm than the levelled field.

4.7 Tractor Test Field

Upland as the tractor test field is designed with an area of 2,800 m^2 (35 m x 80 m). The turning spaces for agricultural machinery are prepared with 3 m width on each short side of the field.

4.8 Tractor Test Road

Nebraska Tractor Test on different road surface conditions is planned in this tractor test road. Therefore, in this design, three (3) kinds of road surface, such as concrete, gravel and earth, are designed as follows:

Length:	150 m x 3 lines, (Access portions and/or tractor turning spaces are designed at the both end of the test roads),
Width:	total width 4 m, effective width 3 m,
Pavement :	- Concrete pavement 1 line, (thickness of concrete 12 cm, sub base gravel 20 cm), - Gravel pavement 1 line, (thickness of gravel 15 cm),
Cross slope :	5 % toward each side,
Vertical slope:	flat.

CHAPTER 5. COST ESTIMATE

5.1 Project Components

This Model Infrastructure Improvement Works are consist of following project components:

(1)	Land levelling	2.5 ha
(2)	Link road	
	Main road (asphalt pavement)	effective width 5 m, length 180 m
		effective width 4 m, length 274 m
	Farm road (gravel pavement)	effective width 3 m, length 100 m
(3)	Irrigation and drainage system	
	Farm pond	1 No. 60 m by 24 m size, with 2 set pumps 1,000 m^3 storage capacity
	Irrigation canal	96 m long
	Drainage canal	1,571 m long
(4)	Soil conservation test field	
		3 plots (3, 6, and 9 % gradings) width 20 m, lenth 25 m
		2 plots (more than 9 % grading) width 10 m, length 22m
(5)	Irrigation test field	
	Paddy field	0.3 ha
	Upland	0.27 ha
(6)	Tractor test field	
	Upland	0.3 ha
(7)	Tractor test road	
	Concrete paved	effective width 3 m, length 150 m
	Gravel paved	effective width 3 m, length 150 m
	Earth	effective width 3 m, length 150 m

5.2 Project Cost

The project cost is given in the following page. The costs were estimated based on privaling prices at the time on February, 1990. The foreign exchange rate was used at 0.08 Japanese Yen per 1 Indonesian Rupiah. The breakdown of construction cost, labor wages, material prices and rates of construction works are shown in Appendix C.

Project Cost

(Unit: Rp.)

A.	CONSTRUCTION COST			270,836,000
	1.	Direct Cost		216,669,000
		1-1	Land Levelling	26,005,000
		1-2	Link Road	35,894,000
		1-3	Irrigation and Drainage System	111,250,000
			1-3-1 Farm Pond	32,445,000
			1-3-2 Irrigation Canal	6,610,000
			1-3-3 Drainage Canal	72,195,000
		1-4	Soil Conservation Test Field	25,731,000
		1-5	Irrigation Test Field	3,958,000
			1-5-1 Paddy Field	2,420,000
			1-5-2 Upland	1,538,000
		1-6	Tractor Test Field	487,000
		1-7	Tractor Test Road	13,344,000
	2.	Indirect Cost (25% of 1. Direct Cost)		54,167,000
B.	CONTINGENCY (10% of A)			27,084,000
C.	MISCELLANEOUS (4.9% of A+B)			14,580,000
	GRAND TOTAL			Rp. 312,500,000
	(equivalent to Japanese yen currency)			¥ 25,000,000

Note: Rp. 1.0 = ¥ 0.08, as of February 1990

CHAPTER 6. PROJECT IMPLEMENTATION PLANNING

6.1 Construction planning

(1) Basic conception

The number of workable days were assumed as 21 days per month taking into consideration of an actual field work to be carried out during the dry season. A swelling factor in the earth volume calculation for earth works is applyed as 1 : 1 in comparison with natural soil volume and compacted embankment one. Because balances of those materials are negligible due to the small scale work.

(2) Major construction equipment and materials

The construction equipment to be used are considered light and small prevailing models due to the small scale work and the utilization of heavy equipment by the contractor is uncertain, as follows:

Dump track (8 t)	transportation for materials
Bulldozer (11 t)	earth excavation and spreading
Backhoe shovel (0.35 m)	earth excavation
Vibrating roller (3 t)	compaction

Construction materials such as cement, lumber, stone and concrete products made in the factory are procured in the project area.

(3) Construction method

The construction of temporary works of the field office, the labor camp are executed together with the field survey for the construction including setting out the control points in advance of the commencement of the major works.

Then, the land levelling will be started. Any organic material shall not remain onto any road sub-base.

Consecutive works such as construction of road, farm pond, irrigation and drainage canals etc. will be carried out after that.