No. 1

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
WESTERN BARRIOS IMPOUNDING IRRIGATION
IN
THE REPUBLIC OF THE PHILIPPINES

MAY 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

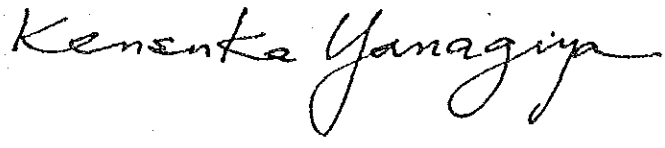
In response to a request of the Government of the Republic of the Philippines, the Government of Japan has decided to conduct a Basic Design Study on the Project for the Western Barrios Impounding Irrigation and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Philippines a survey team headed by Mr. Yoshiro Okamoto, Senior Engineer, Design Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries, from January 19 to February 26, 1989.

The team exchanged views with the officials concerned of the Government of the Philippines and conducted field surveys in Manila and Tarlac Province. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss a draft report and the present report has been prepared.

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

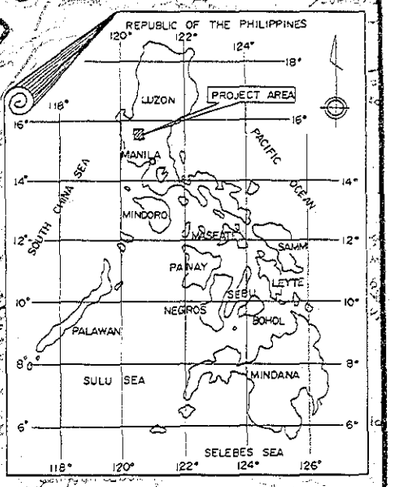
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

May, 1989

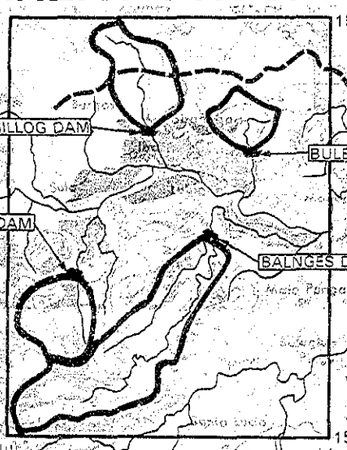


Kensuke Yanagiya
President
Japan International Cooperation Agency

LOCATION MAP



TARLAC PROVINCE

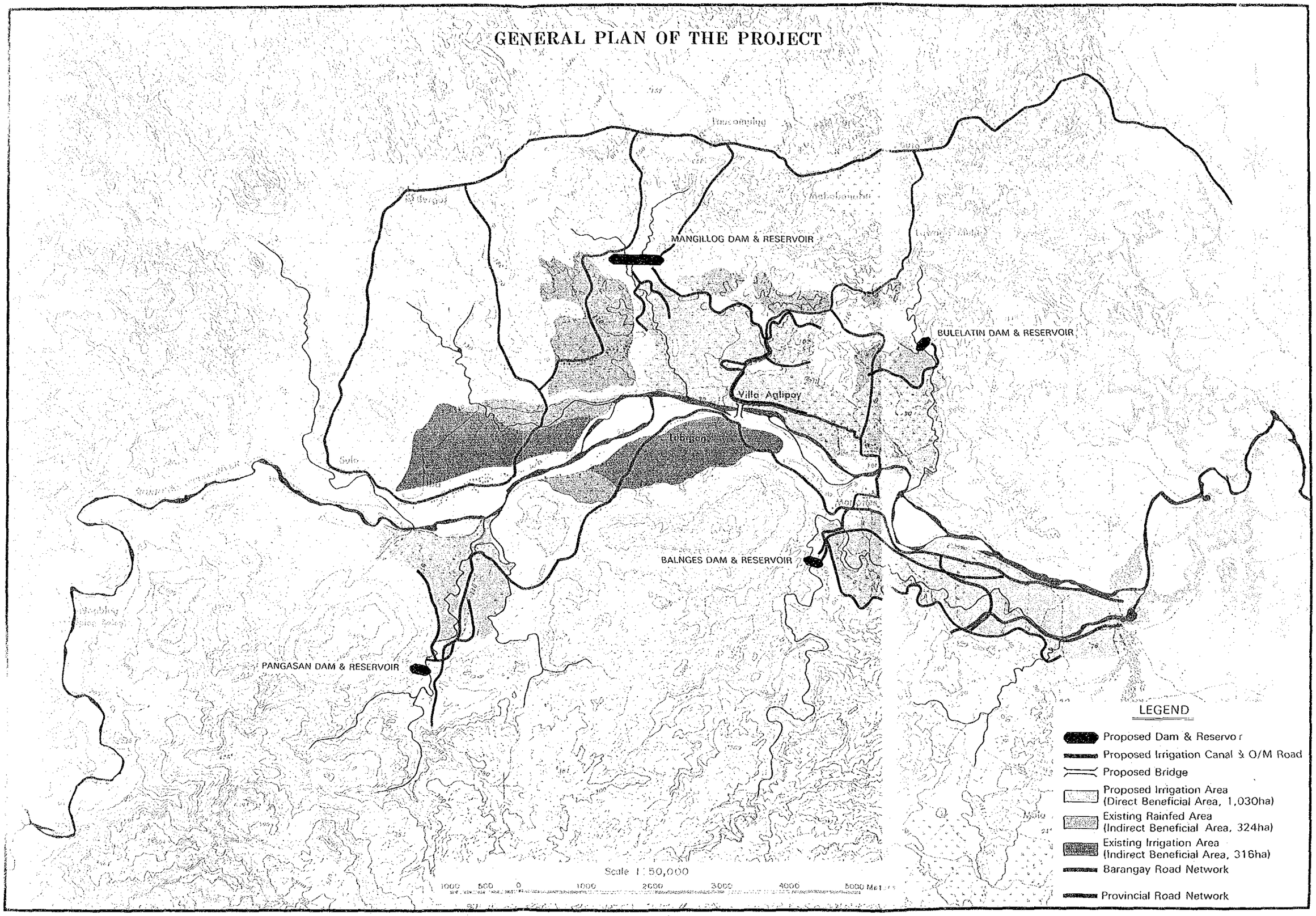


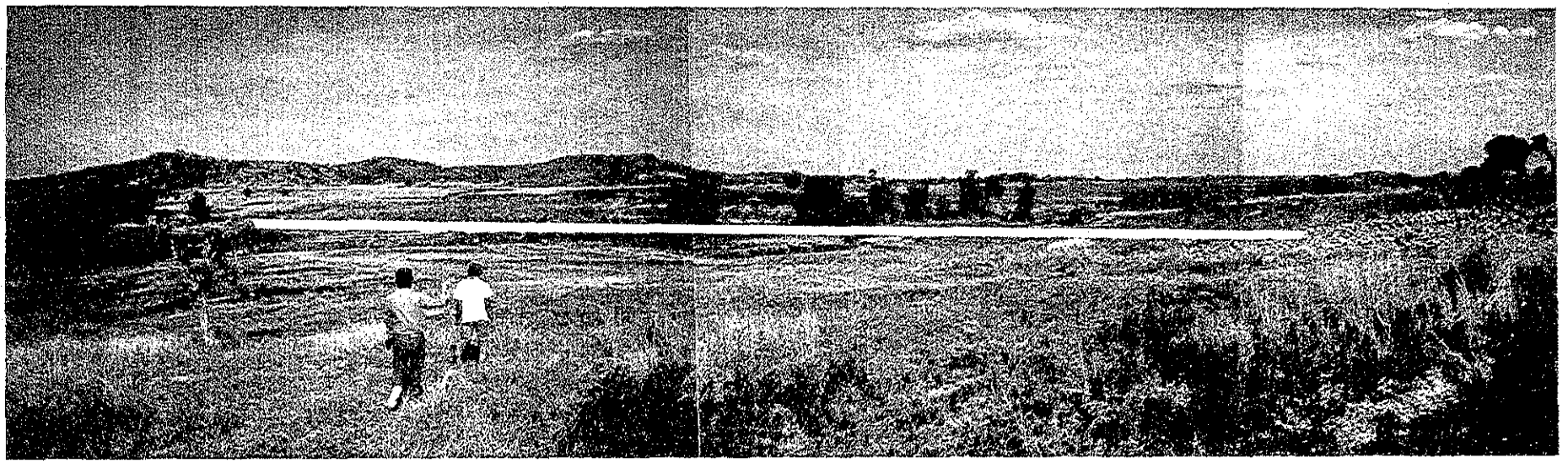
NIA OFFICE CONCEPTION

LEGEND

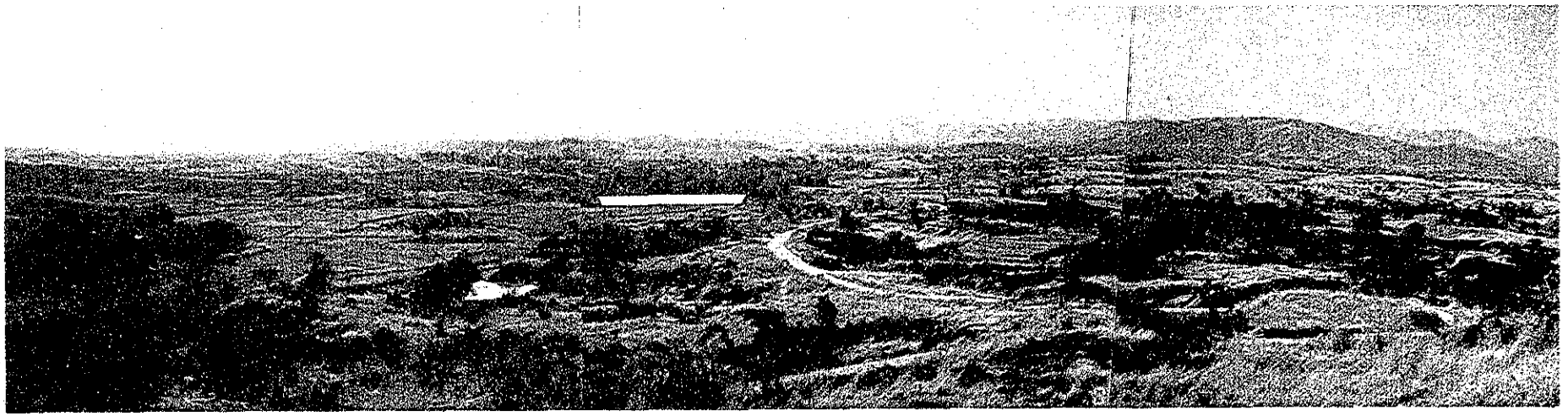
- Boundary of Province
- Boundary of Watershed
- Irrigation Beneficial Area (1,030ha)
- Indirect Beneficial Area (640ha)
- National Road
- Provincial Road

GENERAL PLAN OF THE PROJECT

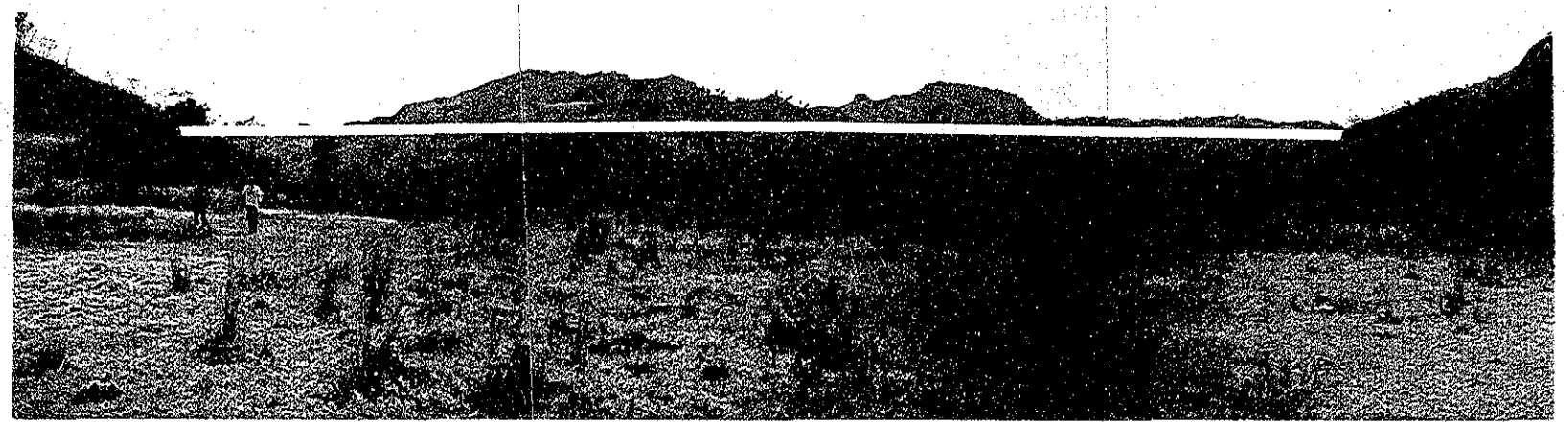




Proposed Mangillog Dam Site

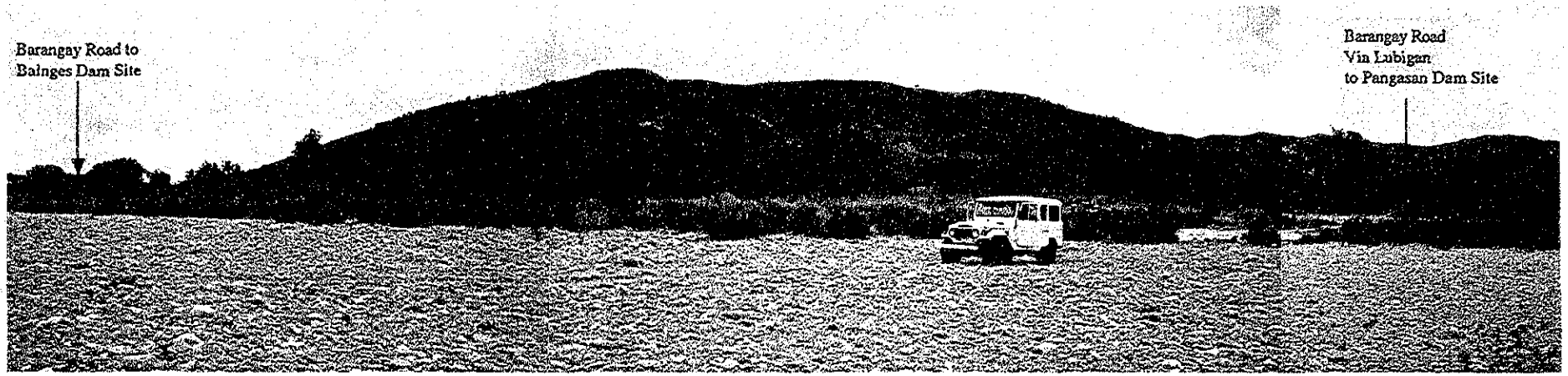


Proposed Bulelatin Dam Site

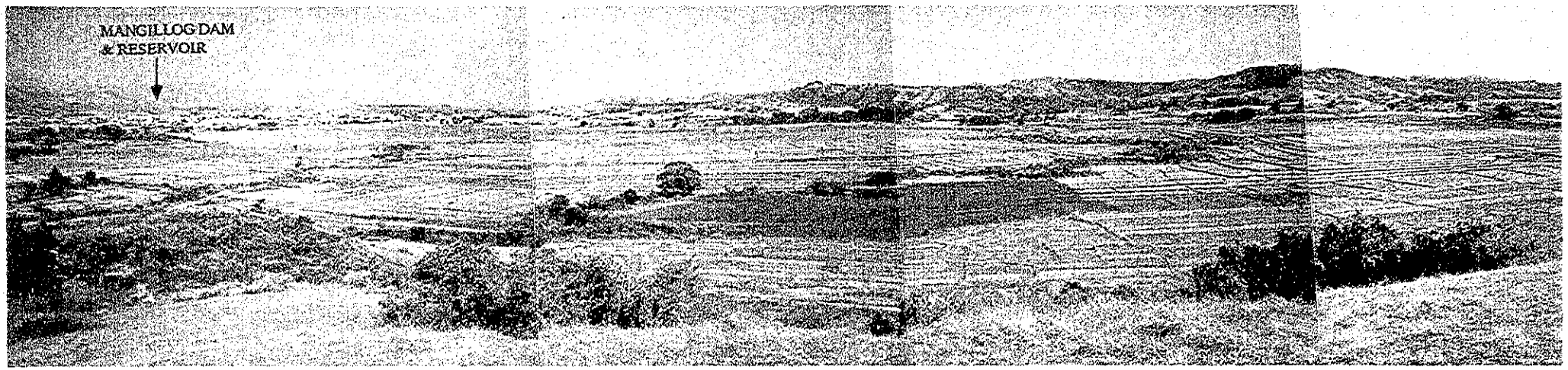


Proposed Pangasan Dam Site

Proposed Balnges Dam Site



Proposed Bridge Site of the Bulsa River



Proposed Irrigation Area of Mangillog Reservoir

Summary

The Government of the Republic of the Philippines established the Medium-Term National Development Plan (1987 - 1992) in November, 1986, making sincere efforts to achieve the immediate economic recovery and contributing economic growth in the future.

The goals of this plan aim for the (a) alleviation of poverty, (b) generation of employment opportunity, (c) promotion of social equity and (d) attainment of a sustained economic growth.

High priorities among the development targets are given to the agriculture and rural development for improvement of poor farming income through enhancement of agricultural productivity and increase of the employment opportunity in the rural area.

Efforts are being made for implementation of a large number of small scale and labor intensified agricultural infrastructure improvement and development projects, particularly for irrigation facilities, rural roads, etc., directing to eradicate rural poverty in the country.

In line with the said national development plan, the Regional Development Council of Central Luzon (Region III) decided the Medium-Term Central Luzon Region Development Plan (1987 - 1992) to cover the whole Central Region in which imbalance is remarkable between the urban area under rapid industrialization and the rural area left undeveloped.

According to this plan, the development strategy for Central Luzon is to rectify urban-rural disparities or imbalances in the incomes, public services and facilities and development of both spatial and sectoral aspects, so that well-balanced development of the agriculture and industry of this region can be achieved.

Also it indicates that the agricultural development plan shall involve diversification and intensification of the agriculture, improvement of the marketing system of agricultural products, and expansion of high-yield variety, in addition to improvement and expansion of the irrigation facilities.

Tarlac Province in the center of Luzon, comparing to neighbors fertile crop zone of Pampanga and Nueva Ecija Provinces, is reconciled to low level of agricultural productivity due to lack of or insufficient investment in irrigation facilities.

In particular, the Western Barrios area along the Bulsa River, located in the west of Tarlac Municipality, Tarlac Province, has long been left behind any large scale development projects and been compelled to engage in the poor unstable rainfed agriculture.

But this area has high potentiality to raise agricultural production if the irrigation facilities are constructed. Expecting much substantial development effect owing to the construction of small reservoir irrigation systems, the National Irrigation Administration (NIA) has established an irrigation development plan of the Western Barrios area and carried out the feasibility study on the Western Barrios Impounding Irrigation Project, Tarlac, Tarlac, in April, 1988.

On confirming the project's feasibility and the urgent need of its implementation, the Government of the Philippines requested to grant the financial cooperation on this project in the Annual Consultation with the Government of Japan in June, 1988.

In response to this request, the Government of Japan has decided to execute the Basic Design Study on the Project for Western Barrios Impounding Irrigation and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent a Study Team for 39 days from January 19 to February 26, 1989 for the purpose of basic study including necessary surveying and data collection to confirm viability of the Project as a Grant Aid Program of Japan.

Through field surveys, discussions and exchanging views with the Philippine officials concerned, the Study Team grasped the local situation and basic lines of the Project.

This Project aims at lifting up the level of the present low agricultural productivity and contributing to promotion and prosperity of regional economy through the development of irrigation agriculture with reservoirs and their related gravity irrigation systems in the existing unstable rainfed cropping area along the Bulsa River in the west of Tarlac Municipality, Tarlac Province. Another aim is to indicate a preceeding example of reservoir irrigation system to the Small Water Impounding Management Project (SWIM) which is going on under the supervision of the Department of the Public Works and Highway all over the country.

The objective area of the Project has been left behind the large scale agricultural and irrigation projects (i.e. the Balog-Balog Multipurpose Project and the Pampanga Delta Development Project) with the reason of its geographic and topographic conditions, and been compelled to engage in the single cropping of the rainfed paddy. Thus, farmers of this area conceive a desire to provide the irrigation systems for the area.

It has been confirmed that the whole beneficial area by the Project is 1,670 ha including 1,030 ha of the net irrigation area.

The main constraint on the agricultural production is the lack of the stable water source for crop cultivation. It is, therefore, strongly desired to develop new water sources. The most effective and economical method of water sources development for the Project Area is the full utilization of the surface water for double cropping in one year through the new construction of reservoirs and related irrigation systems.

Construction of reservoirs has no critical problems from both technical and economical points of view.

With such constructions, it is expected that the agricultural production of the Project Area makes rapid increase, thus the level of the farmers income would be substantially improved.

Since the Project Area is located at about 120 km north of Manila, the Capital of the Philippines, and accessible through the national road, the demonstration effects of the reservoir irrigation systems as a preceeding project of SWIM can be easily expanded in the country.

Side by side with the field surveys by the Study Team, land acquisition negotiation for the dams and reservoirs of this Project has been undertaken by the Government of the Philippines and is progressing substantially with the positive support of the local farmers. There is good hope that the thing will succeed.

Upon completion of the field surveys, the Study Team has performed analysis on the collected data as well as reviewing the F/S report by the NIA and prepared the Basic Design Study Report (draft final) on this Project in May 1989.

The Project component to be undertaken by the Government of Japan has been determined as enumerated hereunder on the basis of the request from the Government of the Philippines and careful reviews by the Study Team on their necessity, technical feasibility, and economic viability.

1) Dams & reservoirs construction

Name	Dam Height (m)	Dam Crest Length (m)	Gross Storage Capacity (MCM)
Mangillog	19.3	704.5	3.21
Bulelatin	10.3	215.0	0.73
Pangasan	17.3	195.0	1.14
Balnges	24.2	208.0	1.82
Total			6.90

2) Irrigation systems construction

Name	Total Canal Length (km)	Irrigation Area (ha)
Mangillog main irrigation system	10.32	360
Bulelatin main irrigation system	1.58	120
Pangasan main irrigation system	3.13	200
Balnges main irrigation system	8.80	350
Total	23.83	1,030

3) Bridge construction

Bulsa river bridge : length: 225 m, effective width: 3.6 m

For the construction of these facilities, the construction plan of earth work of dams has been decided on the basis of effective utilization of heavy machinery. While manpower is mainly adopted for the construction of the irrigation canals. Since the construction works for each dam and irrigation canal works can be proceeded synchronously and all of the works will be completed within 12 months.

JICA sent the Study Team to the Philippines for explanation and discussion on the Basic Design Study Report (draft final) on the Project for 6 days from May 15 to 20, 1989. After series of discussions, the basic design on the above mentioned facilities proposed in the draft final report has been agreed in principle toward the realization of the Project.

The benefits resulting from the implementation of the Project are summarized as follows:

1) Owing to the stable irrigation water supply through irrigation systems from the reservoirs, the paddy production of 1,030 ha in the wet season will highly increase and become annually stable by taking off low level of unstable rainfed paddy production ;

2) Storage of rain water in the reservoirs at the end of the wet season ensures to cultivate around 840 ha of the dry season corn which will give high returns. Diversified crop production in the dry season, therefore, will largely increase. Also, created agricultural employment opportunity in the rural area during the dry season contributes to the settlement of farmers and the stability in their livelihood in the rural society ;

3) The reservoirs will play the role of an important example as precedence to the nation-wide SWIM Project and considerably contribute to the promotion of the SWIM Program implementation ;

4) The construction of the Bulsa River bridge solves the isolation problem of rural barangays extended in the southern part along the Bulsa River in the wet season. It is expected that it contributes in the promotion of wide communication among the barangay members throughout the year and provide the foundations of the equitable development of the rural areas concerned ;

5) Improvement of road networks such as the operation and maintenance road along the irrigation canals and access roads will contribute to encouragement of an intensive farming practice and in expansion of transportation for the agricultural input materials and the agricultural products.

This Project is expected to offer the above mentioned substantial benefits, wide effects and impacts, and its operation and maintenance plan is prospected to be adequate and feasible. In this context, it is recommended that the Project is viable and worth execution under a Grant Aid Program of Japan.

The approximate amount of Project cost to be borne by the Philippines under a Grant Aid Program of Japan includes about ₱ 4,500,000 for construction of terminal canal system, about ₱ 7,500,000 for land acquisition and about ₱ 3,000,000 for head office and project office expenses. It is reported that the Department of Budget and Management has prepared the budget for land acquisition. On the other hand, the budget for construction of terminal canal system and for head office and project office expenses will be prepared by the NIA after receipt of the Basic Design Study Report.

The executing agency of this Project is the NIA. In the NIA, the Western Barrios Impounding Irrigation Project Office (WBIIPO) shall be organized under the supervision of the assistant administrator for Project Development and Implementation. At the same time, the Steering Committee and the Technical Committee which were organized at start of Basic Design Study are further strengthened to support the WBIIPO and to ensure smooth implementation of the Project.

After completion of this Project, the NIA is responsible to carry out the operation and maintenance of the dams, reservoirs and related irrigation systems. During the period, the NIA will undertake training and guidance for the O&M to the Tarlac Provincial Government staffs as well as to farmers irrigators' organization which will be organized at the implementation stage of the Project.

Upon the progress of skillfulness of the Tarlac Provincial staffs, the O&M works on the main facilities i.e. dams, reservoirs will be gradually transferred to the Tarlac Provincial Government from the NIA on the judgement by the NIA. The O&M works on the irrigation systems also will be transferred from the NIA to the farmers irrigators' organization upon the achievement of systematization of the organization on the basis of the judgement by the NIA. The operation and maintenance of the reservoir irrigation systems shall be made principally by the farmers irrigators' organization with technical support and coordination from the Tarlac Provincial Government and the NIA.

The annual operation and maintenance expenses for the dams and irrigation systems (including dredging, weeding, etc.) are estimated to run up to ₱ 250,000. Such expenses will be accommodated from the collected fund as the irrigation fee from members of the farmers irrigators' organization. It is estimated that the annual irrigation fee is ₱ 350 per one farming household (1.5 ha in average) which is less than 5% of the farm income prospected at full development stage of the Project. Therefore its payment will be acceptable by the beneficial farm households.

After completion of the Project, the following is recommended for realization of the effective operation and maintenance:

1) Terminal irrigation system should be constructed for dams and irrigation facilities to fulfill their function firmly as early as possible.
2) The NIA, the Government of Tarlac Province and Tarlac Municipality should establish the coordination body among themselves. The coordination body

should organize the farmers irrigators' organization for beneficial farmers to operate and maintain dams and irrigation facilities and manage water use.

3) The NIA, the Government of Tarlac Province and Tarlac Municipality should guide the farmers irrigators' organization on the operation and management of the irrigation systems and the regulation of water use.

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ABBREVIATIONS

BBMP	:	Balog-Balog Multipurpose Project
cavan	:	50 kg paddy
CIS	:	Communal Irrigation System
cm	:	centimeter
cm^2	:	square centimeter
DBM	:	Department of Budget and Management
DCIECP	:	Diversified Crops Irrigation Engineering Center Project
EL	:	elevation above mean sea level
ha	:	hectare
JICA	:	Japan International Cooperation Agency
kg	:	kilogram
km	:	kilometer
km^2	:	square kilometer
lit	:	liter
m	:	meter
MCM	:	million cubic meter
mm	:	millimeter
m^3	:	cubic meter
m^2	:	square meter
NEDA	:	National Economic Development Authority
NIA	:	National Irrigation Administration
NPC	:	National Power Corporation
sec	:	second
SWIM	:	Small Water Impounding Management Project
ton	:	metric ton
WBIIP	:	Western Barrios Impounding Irrigation Project

CHAPTER 1 INTRODUCTION

The Government of the Republic of the Philippines established the Medium-Term National Development Plan (1987 - 1992) in November, 1986, making sincere efforts to achieve the immediate economic recovery and contributing economic growth in the future.

The goals of this plan aim for the (a) alleviation of poverty, (b) generation of employment opportunity, (c) promotion of equity and social justice and (d) attainment of a sustained economic growth.

High priorities among the development targets are given to the agriculture and rural development for improvement of poor farming income through enhancement of agricultural productivity and increase of the employment opportunity in the rural area.

In line with the said national development plan, the Regional Development Council of Central Luzon (Region III) decided the Medium-Term Central Luzon Region Development Plan (1987 - 1992) to cover the whole Central Region in which imbalance is remarkable between the urban area under rapid industrialization and the rural area left undeveloped. According to this plan, the development strategy for Central Luzon is to rectify urban-rural disparities or imbalances in the incomes, public services and facilities and development of both spatial and sectoral aspects, so that well-balanced development of the agriculture and industry of this region can be achieved.

It also indicates that the agricultural development plan involves diversification and intensification of the agriculture, improvement of the distribution system of agricultural products, and expansion of high-yield variety, in addition to improvement and expansion of the irrigation facilities.

In line with the Medium-Term National Development Plan and the Medium-Term Central Luzon Region Development Plan, the National Irrigation Administration (NIA) established a reservoir irrigation development plan and finalized the development project for the Western Barrios area along the Bulsa River in the west of Tarlac Municipality, Tarlac Province in April, 1988. Although the area is located in the vicinity of the fertile granary of Pampanga and Nueva Ecija Provinces in the center of Luzon, its agricultural productivity is still stagnant at a low level of a rainfed agriculture because of insufficient provision of irrigation facilities.

On confirming its technical feasibility of the project and the urgent need of its implementation, the Government of the Philippines requested to grant the financial cooperation on this project in the Annual Consultation with the Government of Japan in June, 1988.

The request is for the purpose of irrigation and rural development for 1,670 ha of the Western Barrios area and includes the following project components :

1)	Dam and reservoir	4 places
2)	Irrigation canals	15 kms
3)	Rural facilities	14 places (involving assembly hall, storage, etc.)
4)	Others	Road, bridge, agricultural machine

In response to this request, the Government of Japan recognized that a reservoir irrigation development is the most important study subject for this area and has a high priority among the above requested components and decided the characteristic of the Project to be a reservoir irrigation development excluding social facilities and agricultural machine, and to conduct the Basic Design Study on the Project.

The Japan International Cooperation Agency (JICA) sent a study team headed by Mr. Yoshiro Okamoto; Senior Engineer, Agricultural Structure Improvement Bureau, Design Department, Ministry of Agriculture, Forestry and Fishery to justify the Project as a Grant Aid Program of Japan for 39 days from January 19 to February 26, 1989.

After a series of study and analysis on the collected data and the field survey results, the draft final report was prepared in April, 1989.

JICA sent the Study Team to the Philippines for explanation and discussion on the draft final report on the Project for 6 days from May 15 to 20, 1989. After a series of discussions with the Philippine officials, the basic design proposed in the draft final report has been agreed in principle.

This final report has been prepared with refinement and amendment of the draft final report and printed in Japan. (The members of the team, field survey schedule, member list of the Philippine officials concerned, and minutes of meeting are attached in Appendix.)

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Outline of the Agriculture

The agriculture of the Philippines is about one third of the Gross National Product, and the agricultural products including processed products reaches about 60% of the total export amount. Principal crops include rice and corn for foods and coconuts and sugarcane for the export.

On the other hand, of the total population of 52.09 million of the Philippines as of 1983, the agricultural population is 22.72 million (about 48%) and the agricultural labor force occupies about 50% of the total labor force. In this way, agriculture is an essential sector in the Philippines.

As for the family income and expenditures in the year of 1985, the average for the country's total number of families of 9,847 thousand in 1985 was ₱ 31,052 of family income, ₱ 26,865 of family expenditures.

The average amount of the total rural family number of 6,121 thousand was ₱ 21,875 of family income, ₱ 19,397 of family expenditures, while the average for the total number of urban families of 3,762 thousand was ₱ 46,127 of family income and ₱ 39,134 of family expenditures. Thus, the rural families have a living standard half or less than that of the urban families.

In the Philippines, the poverty line is defined in terms of a monthly income required to satisfy almost 100 percent of the nutritional requirements and basic needs of a family of six. In value terms, the poverty line is estimated at ₱ 2,382 for nationwide families, ₱ 3,282 for the National Capital Region (NCR), and ₱ 2,285 for the outside of NCR, or ₱ 2,912 for the urban area, ₱ 2,066 for the rural area, respectively.

According to the statistics of 1985, however, about 60% of the total households is below the poverty line, of which about 70% is concentrated in the rural areas. In this context, development of the agriculture and rural areas is considered important also for relief from the poverty.

The 1983 statistics shows that the total area of cultivated land is 11.25 million ha (about 38% of the land), of which 7.85 million ha are for single cropping while 3.4 million ha for perennial cropping. The land ownership pattern includes about 40% of tenant farmers, and the national average farm size is about 3.6 ha.

For the production amount, rice has achieved 2.5 tons/ha due to introduction of the high-yield variety while corn production, though important as foods and forage, is as low as about 1 ton/ha. About 300 thousand tons of corn (10% of the consumption) are imported annually.

At present, farmers tend to rely on rice cropping because it offers the most stable income source and the self-sufficiency of rice production was achieved roughly in 1970s. In future, improvement of the farmer's income will be made through self-sufficiency of forage crops, production increase for export crops, and other promotion of diversified cropping.

2.2 Medium-Term National Development Plan (1987 - 1992)

With the ultimate aim of the development focused on (1) alleviation of poverty, (2) creation of the employment opportunity, (3) promotion of the equity and social justice, and (4) the attainment of sustainable economic growth, the Government of the Philippines has put the top priority on agriculture and rural development. For short-term, the Government has preferred the development strategy to concentrate on the small-scale labor-intensive infrastructure projects such as feeder (farm) roads, communal irrigation systems, school buildings and rural water supply basically for the rural farm areas with stress placed on stabilization and improvement of the rural incomes. Also, other labor-intensive development projects such as reforestation, seed production and distribution of planting materials are emphasized.

In the medium-term, an employment-oriented, rural-based development strategy will be implemented to directly address the goal of poverty alleviation and equitable distribution of benefits.

Another aim of this plan is to reduce the poverty families to 45.4% of the total number of households. Particularly, in the rural areas, reduction from 63.7% in 1985 to 48.1% in 1992 is planned.

This plan intends to achieve the annual mean growth rate of 6.9% for GDP; 5.8% for agriculture, forestry, and fishery; 7.6% for manufacture, 4.8% for mining and quarrying 16.5% for construction; 8.4% for electricity, gas, and waterworks; and 6.6% for services.

2.3 Central Luzon Region Development Plan (1987 - 1992)

Central Luzon Region will maintain to be a major agricultural area and the primary sector will thus play the principal role in achieving growth and development for the region. However, this region is located nearest to the National Capital Region, Manila and is experiencing concentrated industrialization and populational movement. Accordingly, despite the region has the largest plains in Luzon, the agriculture sector of this region is deteriorating and nearing the margin to absorb the labor force. In the future, the industry sector will play a role of pushing the regional growth. The development strategy for the region has been established on the basis of the consideration of the above features.

The basic strategy for the region consists of rectifying imbalanced distribution in the levels of development and income between rural and urban areas. In other words, the center in which the rural areas grows in tandem with the urban areas is established in several places of this region. This is expected to vitalize the economic activity of the region.

The measures to enhance the role of private sectors for development will be taken. Such measures include reforms of fiscal and price policies, zoning regulation, improvement of efficiency of communication, improvement and expansion of transportation and infrastructure will enhance efficiency of the market economy.

The growth and income-generating capabilities of agriculture shall be intensified through high-yielding crop varieties, multi-croppings, adequate production inputs, sufficient infrastructure support, cheap credit, and an efficient system of marketing and distribution of agricultural commodities. Commodity specialization shall be

undertaken on a selective basis in areas with known potentials for contributing to short and long-term agricultural growth.

The agricultural development strategy for the region includes the followings:

(1) Continuation of agricultural development through intensification and diversification in agricultural production. Agricultural commodity specialization by a selective area-wise basis. Application of advanced technology and expansion of the capacity of agriculture-related institutions (research institute, extension works, cooperative production, marketing financing) specifically for Nueva Ecija, Tarlac, and Pampanga Provinces for the purpose of increasing the agricultural production.

(2) Self-sufficiency of agricultural production met to marketability. Since the surplus market for agricultural production will be induced by increasing the degree of commercialization of agricultural products, industrial utilization of these products will also be promoted.

(3) Development of low cost and home-level processing technologies for agricultural products for the purpose of increasing the farm income.

(4) Improvement of marketing and distributing systems in the region to increase the share of the farmer's cooperative association.

(5) Promotion of dissemination of seeds of high-yield variety, fertilizer, agricultural chemicals and biotechnology.

(6) Stress on expansion of the irrigation facilities, improvement of soil and irrigation water management, and extension of post-crop treatment technology.

(7) Promotion of development of natural resources while considering conservation of resources for the preservation of the regional economy.

The following items are existing problems for the development of this district:

(1) Persistence of low-income and poverty in the rural areas,

(2) Fluctuation of the agricultural production from year to year,

(3) Slow-down of the industrial growth and the low-level of private investment,

(4) Worsening of the social condition and growing insurgency in the rural area,

(5) Damages to the effective utilization, maintenance and management of infrastructure caused by frequent floods,

(6) Deforestation and abuse of natural resources,

(7) Continued reliance on economic stimulus provided by the industries sensitive to tentative influences (such as the US military bases and export processing zone).

The final goal of the regional development is set as the following items:

(1) Uplifting of the general welfare of the population,

(2) Higher rural income,

(3) Greater economic self-reliance,

(4) Sustained increase in agricultural production and productivity,

(5) Accelerated industrial development,

(6) Self-sustained economy in areas dependent on impermanent influences,

(7) More efficient, effective and equitably distributed social services and facilities,

(8) Prevalence of positive social and moral value, and

(9) Enhanced environmental protection and optimum land use.

In line with the regional development plan, irrigation projects have been established by the NIA for the total beneficial areas of 16,433 ha in the Provinces of Nueva Ecija, Tarlac, Pampanga and Zambales. The contents of these irrigation projects are construction of irrigation facilities and establishment of CISs. The Western Barrios area is not included in these beneficial areas.

The NIA is also putting into effect the plan of constructing the Balog-Balog multi-purpose reservoir in the upper reaches of the Bulsa River to secure stable supply of irrigation water of about 40,000 ha to the eastern part of Tarlac Province. But the Western Barrios area is located at high elevation terrain and not included in the beneficial area by this plan, and thus left behind in irrigation development.

2.4 Outline of the Request

2.4.1 Circumstances of the Request

It is the earnest desire for the local farmer living in the Western Barrios area, Tarlac, Tarlac to establish irrigation reservoirs and irrigation systems necessary for a year round cropping and to improve infrastructure aiming at the alleviation of poverty, increase of farm income and uplifting the living standard of local populace.

The NIA submitted the prefeasibility report on the development plan of the above area to the Department of Budget and Management (DBM) in October, 1987. The DBM proposed to the National Economic Development Authority (NEDA) for funding in the implementation of the project. The NEDA, however, recommended to the NIA that a feasibility level study should be undertaken and the project be backed up with a more detailed data.

With the recommendation from the NEDA, the NIA, the DBM and the Tarlac Provincial Government discussed on the small water impounding irrigation project for rainfed areas in Sula, Villa Agripay, Moriones Barangays to construct dams and reservoirs across the tributaries of the Bulsa River for wet and dry season irrigation. As a result, the agreement among the above three agencies was concluded on February 28, 1988. According to the agreement, the following was decided :

(1) The DBM, as the coordinating and facilitating agency, shall perform other administrative functions as well as the release of funds for project preparation and implementation, and coordinate and monitor project status and accomplishments.

(2) The NIA, as implementing agency, shall undertake the feasibility study and implementation of the project, implement programs to strengthen the existing Irrigators' Association and organize additional Irrigators' Association in the new area of the project.

(3) The Government of Tarlac Province, as one of the implementing agencies, shall spearhead the delivery of support services for the agri-institutional development component and coordinate with the concerned government and private agencies in the province.

The NIA conducted the feasibility survey on the project in a short period and completed the feasibility study in April, 1988, and soon after submitted the Feasibility Study Report to the NEDA.

After the evaluation of the Feasibility Study Report on the Western Barrios Impounding Irrigation Project, the NEDA has judged that the project is one of the most important project along with the National and Regional Medium-Term Development Plan, and has a high priority for its urgent implementation, therefore, offered to the Japanese Government for possible financial assistance under the Grant Aid Program in the Annual Consultation between the Government of the Philippines and the Government of Japan in 1988.

2.4.2 Contents of the Request

The contents of the request from the Government of the Philippines are as follows:

1. Dams and Reservoirs, Appurtenant Structures : 4 places

		Dam Height (m)	Crest length (m)	Storage Volume (thousand m^3)
(a)	Mangillog	17.7	845	3,216
(b)	Bulelatin	8.8	210	725
(c)	Pangasan	18.0	210	1,027
(d)	Balnges	19.2	185	1,819

2. Irrigation Facilities : 4 systems
   (a) Mangillog area : 5.4 km long (Main Canal)

(b) Bulelatin area : 1.8 km long
(c) Pangasan area : 2.2 km long
(d) Balnges area : 5.6 km long

3. Institutional Development Facilities & Machine
   (a) Construction of four (4) Barangay Halls (10 m x 20 m each)
   (b) Construction of four (4) Grain Warehouses (15 m x 30 m each)
   (c) Supply and Installation of three (3) Mini-Hydro Generators at Dam Sites
   (d) Supply and Installation of three (3) Paddy Husks Generators in communities

4. Other Supporting Facilities
   (a) Construction of two (2) Temporary Bridges crossing Bulsa River
   (b) Construction of 2,700 meters long community Road
   (c) Supply of seventeen (17) numbers of Reaper
   (d) Supply of twelve (12) numbers of Thresher
   (e) Supply of twenty eight (28) numbers of Dryer
   (f) Supply of one (1) Rice Mill
   (g) Other equipment

Note: The beneficial area of the project is 1,670 ha in the Western Barrios area.

CHAPTER 3 OUTLINE OF THE PROJECT AREA

3.1 Location

The Project Area belongs to the administrative jurisdiction of Tarlac Municipality in the Province of Tarlac, and is located about 20 km west of the center of Tarlac Municipality.

An enveloped area which includes the Project beneficial area and the respective watersheds of four dams and reservoirs to be constructed at the Mangillog, Bulelatin, Pangasan and Balnges tributaries of the Bulsa River is situated between North Latitude 15° 22' and 15° 37' and East Longitude 120° 22' and 120° 30'. Its land elevation is lying between 70 m and 762 m above sea level.

The Project beneficial area is 1,670 ha of the rainfed paddy field with a gentle slope extending on the left and right banks of the above tributaries of the Bulsa River.

Access to the Project Area is through the linking barangay roads to the Lagawa-Burgos provincial road which is stretched west from the center of Tarlac Municipality with a left turning of National Highway No. 3 originated from Manila.

3.2 Administration and Population

Tarlac Province is located approximately at the center of Luzon and belongs to the Region III, Central Luzon. This province is surrounded by Pangasinan Province to the north, Nueva Ecija Province to the east, Pampanga Province to the south and Zambales Province to the west. The Provincial Government lies in Tarlac Municipality, about 125 km distance via National Highway No. 3 from Manila and about 127 km from Baguio City.

The land area of the Province is 3,053.4 km^2 and the population is 688,457 (1980) with the population density of 225 persons/km^2. Of the population, 14%

lives in the urban area while 85% in the rural area. There are 17 municipalities in Tarlac Province, which are further divided into about 508 barangays (the smallest unit of the administration).

Tarlac Municipality has the largest population (175,691 as of 1980) among the municipalities in the Province, with the land area of 936 km^2 and population density of 188 persons/km^2. A 16% of the population is in the urban area while 84% in the rural area. The future population is predicted as follows on the basis of the population census: (data: Socio Economic Profile, Tarlac 1986)

	Tarlac Province			Tarlac Municipality		
Year	Urban	Rural	Total	Urban	Rural	Total
1980	103,223	585,234	688,457	28,267	147,424	175,691
1990	165,343	662,335	827,678	50,644	167,249	217,893
2000	215,930	748,324	964,254	66,138	194,215	260,353
2010	267,813	803,217	1,071,030	82,030	212,999	295,029
2020	319,285	833,667	1,152,952	97,090	225,345	322,435
2030	371,623	848,261	1,219,884	113,005	231,762	344,767

The undeveloped area stretching in the western hilly zone of Tarlac Municipality is normally called the Western Barrios area, which includes 12 barangays (Burgos, Iba, Labney, Lawacamulag, Lubigan, Maamot, Mababanaba, Moriones, Pao, San Juan de Valdez, Sula, and Villa Aglipay). This area is located about 10 to 30 km west from the center of Tarlac Municipality.

The Western Barrios area has a land area of 333 km^2, and a population of 14,211 (1982). When a population growth rate of 1.27% in average of the rural area in Tarlac Municipality is applied, the population in 1990 is estimated to be 15,720.

The barangays covered by this Project are six, that is, Iba, Mababanaba, Moriones, Sula, Lubigan, and Villa Aglipay.

The future population of barangays covered by the Project may be predicted as follows by applying the above population growth rate:

Barangay	1982	1990	1995	2000
Iba	2,513	2,780	2,961	3,154
Mababanaba	2,064	2,283	2,432	2,590
Moriones	1,264	1,398	1,489	1,586
Sula	987	1,092	1,163	1,239
Lubigan	555	614	654	697
Villa Aglipay	2,459	2,720	2,897	3,086
Total	9,842	10,887	11,596	12,352

From the above, the population benefited by this Project is estimated to be 11,000.

3.3 Meteo-Hydrology

Climate of the Project Area is classified to be the first type of the Philippine Climate, which has the wet season from May to October dominated by southwestern monsoon and the dry season from November to April dominated by northeastern monsoon.

As is known from twenty-year data of the PAGASA Hacienda Luisita Station, San Miguel, Tarlac, the annual rainfall is 3,455 mm in the maximum (1972), 1,291 mm in the minimum (1973), and 1,857 mm in average. The six-month rainfall depth during the wet season is 3,094 mm in the maximum (1972), 1,143 mm in the minimum (1973), and 1,668 mm on the average. In this way, the rainfall is substantial in the wet season and decreases extremely in the dry season.

The mean annual temperature is 27.2°C and monthly mean temperature is highest at 29.1°C in May and lowest at 25.3°C in January. The mean annual evaporation is 1,780 mm and the monthly evaporation is largest at 215 mm in February and smallest at 102 mm in August. The mean annual relative humidity is 70% and the monthly relative humidity is highest at 82% in August and lowest at 57% in April. Typhoon is most frequent in June and November.

The discharge of the Bulsa River was observed at Villa Aglipay with 405 km^2 of catchment area from 1960 to 1973. According to the data, the mean annual discharge is 31.1 m^3/sec, the mean monthly discharge is highest in August at 130.3 m^3/sec, lowest in April at 4.5 m^3/sec. During four months from June to September, the mean monthly discharge is higher than mean annual discharge and is lower than 10 m^3/sec during five months from December to April.

3.4 Topography and Geology

The north and the west of Tarlac Province is an extending alluvial plain with sandy and silty soils, while the west and the northwest comprises the rolling and hilly elevated zone on the eastern outskirts of the Zambales Mountain Range.

The Bulsa River originates in the said western mountain range in which the highest is the Dome Peak of EL. 1,670 m, running down through the steep slope area and enters in the middle reaches of the gentle hilly area at Balog-Balog. It passes through around central portion of the Project Area from the west to the east and joins with the O'donnell River in the vicinity of the urban center of Tarlac Municipality, and changes its direction to the north and crosses the provincial border with the northeast of Camiling. Finally it joins with the Agno River and flows into the Lingayen Gulf.

The province involves also a basin of the Pampanga River to the southeast, in which it is partially submerged in flood season.

The Western Barrios area including the Project Area is characterized by the undulating or rolling topography where rainfed farming of rice and goat grazing are prevailing. The width of the Bulsa River in the Project Area is about 200 m to 280 m, and an average river gradient is 1/400 with rich deposits of sand and gravel.

The Project Area is formed by the Pre-Miocene rocks. The oldest ones are metavolcanic rocks and ultramafic complex which consists of gabbro and peridotite with other similar lithological units. Basalt or diabase flows are considered as a regional bedrock.

The ultramafic complex forms the core of the Zambales Mountain Range and outcrops to the west of the reservoir area. The main rock types of this complex are

peridotite with some other similar lithological units and gabbro which occupy a fairly wide section of the watershed of Mangillog.

The middle and lower Miocene or Oligocene sediments with some limestone are unconformable which cover the eastern border of the oldest igneous rocks. During the Miocene-Pliocene orogenic movements, big masses of diorite with intricated nets of dikes and leucratic apophysis intruded the pre-Miocene formations.

Diorite Complex is the most widely spread formation further upstream of the Project Area which underlies the Balog-Balog Multipurpose Dam and its reservoir area. This igneous plutonic complex is a rock series in which variable mineralogical composition and field relationship suggest different stages of intrusion.

Later, other clastic sediments represented by upper to lower Miocene conglomerates and claystones (Tarlac, Malinta and Moriones Formations) cover the outer border of the eastern Zambales. A thick sequence of Malinta, Moriones and Akskitero Formations covers the proposed damsites and reservoir areas.

Around the Zambales boundaries, the Pliocene to early Quaternary volcanic activities were very strong. The quaternary volcanic (andesite flow and pyroclastic) are distributed upstream of the Bulsa River. This rock is widely spread upstream of the Project Area and forms prominent peaks of almost vertical walls and is sometimes in fault contact with the intrusive diorite. Dacite and andesite plugs and dikes with pyroclastic sediments, siltstone and tuffaceous agglomerate are present in the Project Area (Bamban Formation) covering widely the oldest outcrops mainly at west and southwest of Tarlac.

The recent deposits include terrace deposits and alluvium. The terrace deposits form wide plains along the meanders of the Bulsa River. These deposits are silty or sandy gravel with boulders, covered by silty sand or silty clay which are normally cultivated. The alluvium consists of well graded and lithologically assorted sandy and gravel deposits which are abundant in boulders. Fines are practically absent.

3.5 Soil, Land Use and Land Resources

The soils of Tarlac Province consist of fine sandy loam, loam, and clay loam and is suitable for agriculture. Paddy cropping is mostly in the wet season and, where irrigation water is available, paddy, corn and sugarcane are planted throughout the

year. According to the land survey data of Tarlac Province, land use in the province are as follows:

1.	Public forestry	123,738 ha
2.	Crop cultivation land	104,768
3.	Fishpond	852
4.	Swamp	672
5.	Pasture	4,668
6.	Others	70,647
	Total	305,345 ha

On the other hand, the land resources as irrigation area of the Project have been identified as 1,167 ha in gross and 1,030 ha in net because of topographical constraints.

	Irrigation Area (ha)	
Name of Reservoir	Gross	Net
Mangillog	400	360
Bulelatin	137	120
Pangasan	230	200
Belongs	400	350
Total	1,167	1,030

3.6 Agriculture

Tarlac Province is supported basically by agriculture. Major foods are produced and commercial crops are cultivated. Stock raising and poultry farming are also active. Rice production is made on 39,760 ha of irrigated land and 33,100 ha of rainfed land, a total of 72,880 ha. The total rice production is 1,362,900 cavans (1 cavan = 50 kg). The number of farming household is 62,071. Rice cultivation in Tarlac Municipality is as follows (1984):

Irrigation farming land	9,700 ha	582,410 cavans of paddy
Rainfed farming land	3,680 ha	168,360 cavans of paddy
Total	13,380 ha	740,770 cavans (37,038 tons)
No. of Rice farming households	22,883	

Production of other foods includes 3,495 ha for rootcrops such as onions, camote, garlic and peanuts, 2,018 ha for fruits and vegetables, 3,404 ha for beans and greens, 2,290 ha for corns. The amount of corn production is 2,111 tons. Commercial products include sugarcane (12,600 ha), with the amount of production at 819,000 piculs (1 picul = 60 kg).

The communal irrigation systems which are being handled by the NIA are located in 45 barangays and total registered area is 7,341 ha in Tarlac Municipality. There exist 2 communal irrigation systems near the Project Area. One is the Iba-Sula irrigation system (250 ha), the other is the Lubigan irrigation system (175 ha). In both double cropping is partly practised. In Tarlac Municipality, there are 60 registered deep well pumps and 360 shallow well pumps which are being used by a total of 87 barangays.

All of the planned net irrigation area (1,030 ha) of the Project is cropped with rainfed paddy during the wet season and not-cultivated during the dry season. Accordingly, the present crop intensity is about 100%. Average yield of paddy is 2 tons/ha, and it remains at considerably low level in comparison with 2.67 tons/ha of the nation-wide average (1986).

As for rainfed farming, transplanting is made from June to September and harvesting from October to middle December, and agricultural labor is, of 72 man•day per 1 ha, 40% family labor and 60% employed labor. Agricultural labor

is mostly required for transplanting and harvesting, which occupies 67% of the whole required labor force.

A 1.5 ha farm was chosen as a representative farm size in the Project Area. Distribution of farm size in the area is summarized in the table bellow :

(Unit : %)

Farm Size (ha)	FO	L	CLT	L/CLT	Total
- 0.5	0.7	1.3	0.7	-	2.6
0.51 - 1.0	5.5	12.8	2.4	-	20.7
1.1 - 2.0	8.4	24.0	6.8	0.2	39.5
2.1 - 3.0	6.4	9.5	5.1	0.7	21.6
3.1 - 4.0	2.2	2.0	2.2	1.3	7.7
4.1 - 5.0	1.8	0.7	0.4	0.7	3.5
5.1 - 6.0	1.1	1.5	0.7	0.1	3.5
6.1 -	0.7	-	-	0.1	0.9
Total	26.8	51.8	18.3	3.1	100.0

Note) FO = Full Owners,
L = Lessee,
CLT = Certificate of Land Transfer.

Annual household income in the rural area was ₱ 21,875 (1985) on the nation-wide average and ₱ 10,649 (1986) at the beneficial area of the Balog-Balog Multipurpose Project in the middle part of Tarlac Province. On the other hand, annual average household income in the irrigation area of this Project was ₱ 9,573 based on the farm economic survey as shown below :

(Unit : ₱)

Reservoir Area	Farm Income	Off-farm Income	Total
Mangillog	10,175	3,451	13,626
Bulelatin	5,044	3,509	8,553
Pangasan	2,966	4,737	7,703
Balnges	4,861	4,049	8,910
Project Area	5,674	3,899	9,573

Note : Farm income is of crop and livestock.
Off-farm income is of wage, bamboo processing and bamboo work.