


**BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT  
FOR  
HIGHLAND INTEGRATED RURAL DEVELOPMENT  
IN  
LA TRINIDAD  
PROVINCE OF BENGUET  
THE REPUBLIC OF THE PHILIPPINES**

APRIL 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 decided to conduct a Basic Design Study on the Project for Highland Integrated Rural Development in La Trinidad and entrusted the study to the Japan International Cooperation Agency (JICA).


JICA sent to Philippines a survey team headed by Mr. Itsuro Tsuruki, Director of Okinawa Development Office, Japan Agricultural Land Development Agency, from December 20, 1988 to January 28, 1989.

The team exchanged views with the officials concerned of the Government of Philippines and conducted a field survey in La Trinidad, Province of Benguet. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss the 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.

April, 1989



Kensuke Yanagiya

President

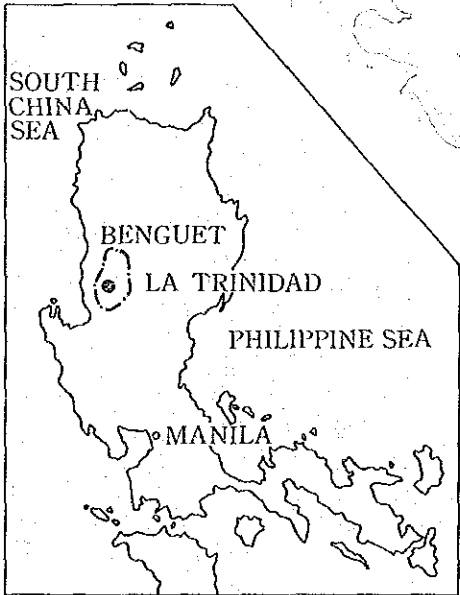
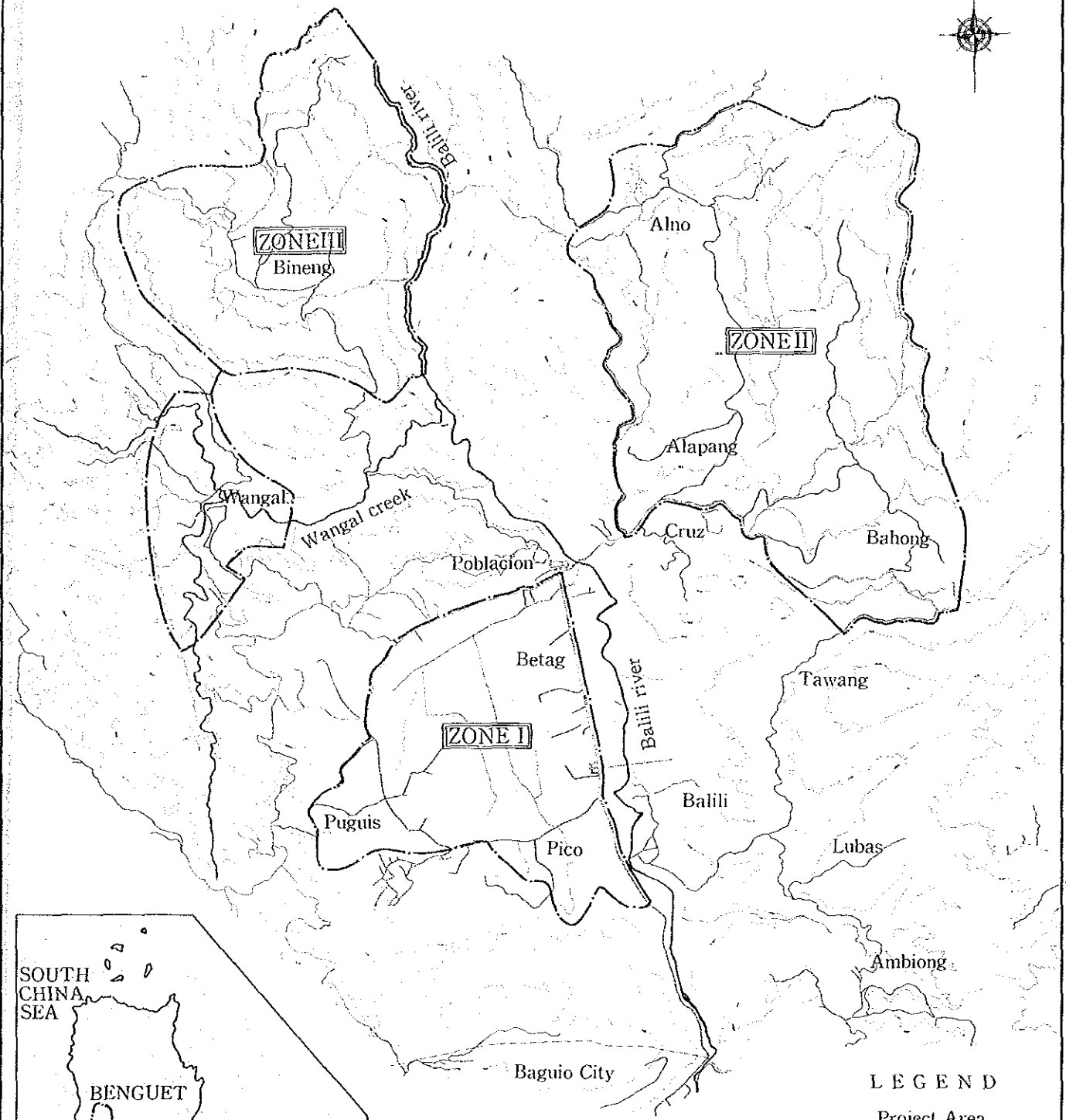
Japan International Cooperation Agency



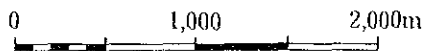


# LOCATION MAP

THE HIGHLAND INTEGRATED RURAL DEVELOPMENT PROJECT  
IN LA TRINIDAD



SCALE 1 : 10,000,000



SCALE 1 : 40,000

## LEGEND

Project Area















## A R E A

Zone I	290 ha
Zone II	680 ha
Zone III	450 ha
<b>Total</b>	<b>1420 ha</b>

# GENERAL PLAN OF THE PROJECT



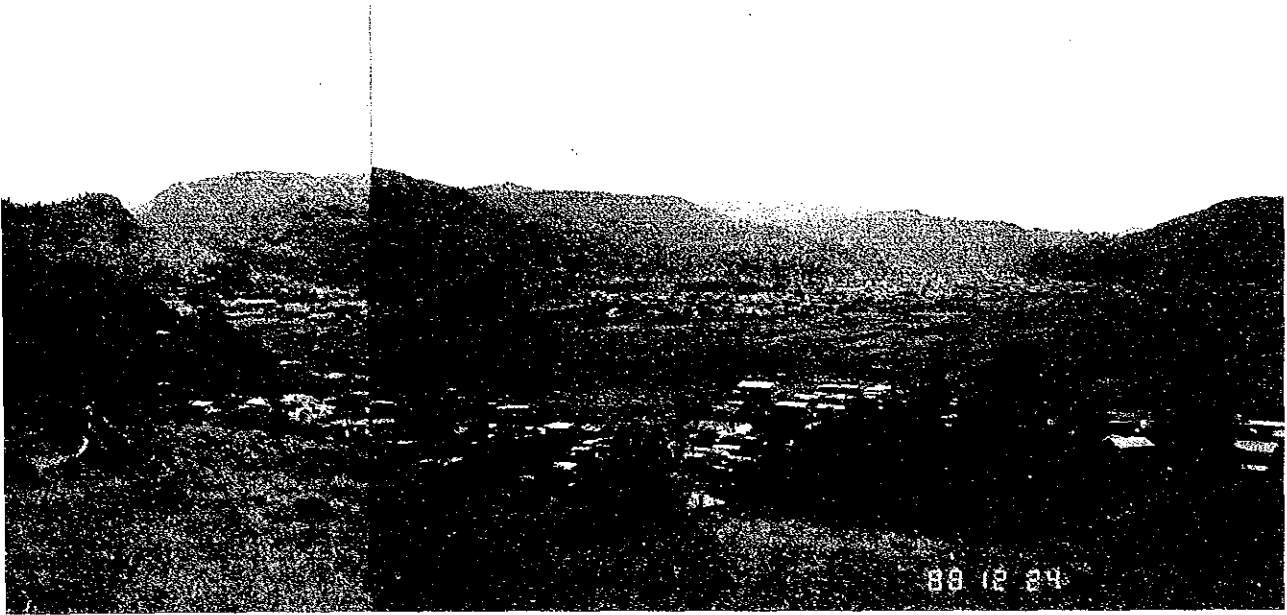
## LEGEND

-  : Pond for irrigation water supply
-  : Weir
-  : Well for irrigation water supply
-  : Irrigation canal (pipe)
-  : Rehabilitation of road
-  : Construction of road
-  : Well for drinking water supply
-  : Improvement of river
-  : Improvement of creek
-  : Sewage canal
-  : Rural Community Centers
-  : Agricultural land

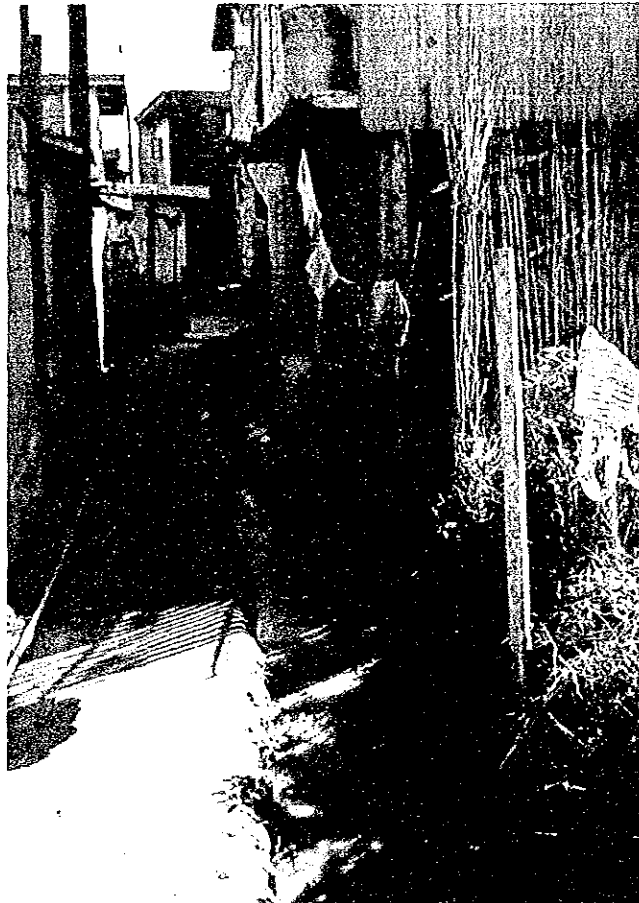


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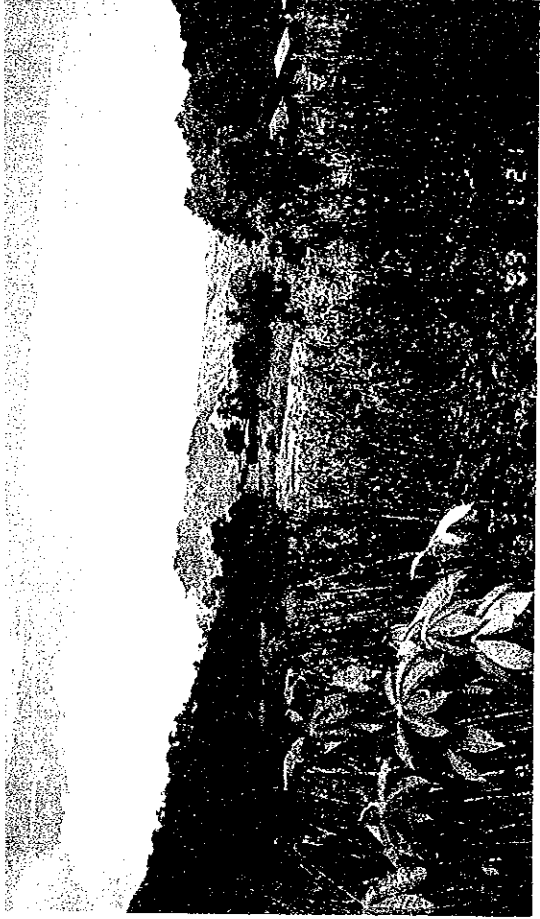


A Distant View of Zone I

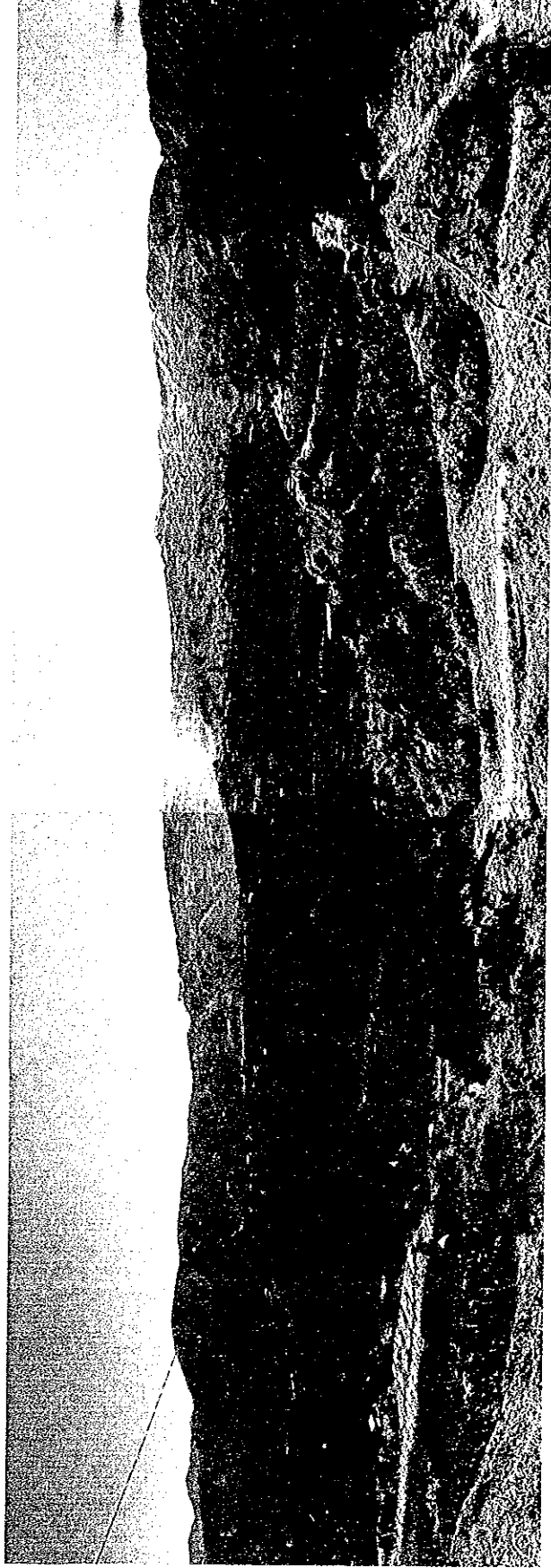


Sewage Condition in Residential Area of Zone I





A Rural Landscape of Zone II



A Distant View of Zone II





A Distant View of Zone III



Cultivating Condition in Zone III



Paddy Field Area in Zone III







Present Condition of Existing Road ( Zone II )



Present Condition of Existing Road ( Zone III )



A Scene of Road Improvement at a Neighboring Site of the PROJECT Area



## SUMMARY

The Republic of the Philippines is earnestly attempting to achieve economic recovery in the short run and sustainable growth in the long run, based on the Medium-Term Philippines Development Plan for 1987 to 1992 (hereinafter called, "Development Plan"), which was formulated in November 1986.

The Development Plan is principally directed towards achieving (a) alleviation of poverty, (b) generation of more productive employment, and (c) development of agriculture in order to promote equity and social justice, and to attain sustainable economic growth. The strategy for reaching these goals is based on implementation of small-scale, labor-intensive infrastructure projects such as feeder roads, communal irrigation systems, school buildings, and rural water supply facilities.

The Government of the Philippines (GOP) has attached much importance to the Cordillera region, which has common and distinctive historical and cultural heritages, and economic and social structures. In 1987, GOP requested that the Government of Japan (GOJ) provide technical cooperation for a feasibility study on rural development in La Trinidad, this development being considered vital and urgent in view of the high potentiality of most of the Cordillera region. In response, the Japan International Cooperation Agency (JICA), from July 1987 to November 1988, conducted a feasibility study (F / S) on the Highland Integrated Rural Development Project in La Trinidad (HIRDP), and formulated a development plan.

GOP watched the formulation of the Project with keen interest, and in May 1988, on the basis of the F / S, requested that GOJ provide grant aid assistance for realizing the HIRDP at the Annual Consultation Meeting May.

In response to this request, GOJ has decided to conduct a Basic Design Study (B / D Study) on HIRDP. JICA sent a Basic Design Study Team to the Philippines to review the Project and evaluate its worthiness for grant aid; the team was in the Philippines from Dec. 20, 1988 to Jan. 28, 1989.

After completing the field survey portion of the B / D Study, the team continued its analysis in Japan, and compiled the Draft Final Report of the B / D Study. JICA dispatched a mission to explain the Draft Final Report. The mission was in the Philippines from April 3,

1989 to April 10, 1989. As the result of the discussion meetings, the GOP has understood the contents of the Report.

Through the field survey and the discussions, during the B / D Study, with the Philippine personnel concerned, the basic concepts of HIRDP (the Project) were defined as follows :

- 1) The objective of the Project is to promote highland agriculture and to improve the living standards in the rural areas in and around La Trinidad, Province of Benguet, the Philippines.
- 2) The Project Area is 1,420 ha, around La Trinidad and is comprised of three (3) zones as : (i) the La Trinidad Valley as Zone I covering 290 ha ; (ii) the right bank of the Balili river as Zone II covering 680 ha ; and (iii) the left bank of the Balili river as Zone III covering 450 ha.
- 3) The Project Area possesses a natural environment advantageous to vegetable production, and the motivation of farmers is high. Productivity is hampered, however, by a number of constraints : insufficient irrigation facilities, inadequate rural roads, inferior drainage (which causes frequent flood damage in Zone I, and contamination of village sewage). It is extremely important for these constraints to be removed.
- 4) The shortage of drinking and domestic water in Zones II and III necessarily creates serious problems. Even present water sources are being progressively contaminated with village sewage. Suitable countermeasures should be implemented as soon as possible.
- 5) Strengthening the farmers' association and promoting agricultural extension are extremely necessary for activating rural development. Within the Project Area, farmers' organizations have not developed due to lack of space and facilities, and the absence of a supporting system. Establishment of a Community Center which would serve as an assembly and as a site for certain farmers' activities is strongly required.
- 6) With the removal of constraints, increased agricultural production and improved living standards will mutually interact to benefit the Project Area. Activities vital

for agriculture and for sound rural life will be built upon the balanced correlation on good productivity and habitability. According, all components targeted in the rural development plan should be kept in balance. In other words, the plan should be an integrated rural development plan.

The basic project design will be implemented based on the concepts listed above. An outline of the Project is presented as follows :

a. Drainage facilities (Zone I)

1) River improvement (3 streams)	2,500 m
2) Regulation gates	2 nos.
3) Construction of a consolidation dam	1 set

b. Irrigation facilities (Zone I, II and III)

1) Intake weirs	9 nos.
2) Ponds	8 nos.
3) Storage tanks (inc. regulation tanks)	9 nos.
4) Small pump stations	4 nos.
5) Deepwells for irrigation water supply	3 nos.
6) Diversion conduit and supplementary conduit from well (inc. related structure)	4,770 m
7) Improvement of Bineng CIS irrigation facilities	1 set
8) Lateral conduit	23,200 m
9) Division tanks	80 nos.
10) Improvement of distribution facilities at outlet of Dinog-Cave	1 set

c. Village sewage facilities (Zone I)

1) Sewage canal	2,450 m
-----------------	---------

d. Rural roads (Zone II and III)

1) Improvement of rural roads	23.4 km
2) New construction of rural roads	2.7 km

- e. Drinking and domestic water supply facilities (Zone II, III)
  - 1) Deepwells (inc. related facilities) 7 sets
  
- f. Rural Community Center (Zone I, II and III)
  - 1) Rural community centers 7 nos.

The following equipment is proposed for carrying out operation and maintenance

- 1) Vehicles 6 nos.
- 2) Equipment for implementation, operation and maintenance 1 set
- 3) Equipment for meteorological observation 1 set
- 4) Equipment for water quality testing 1 set

In the implementation of these construction works, the number and capacity of construction equipment to be used will be restricted due to insufficiency of existing roads, as well as to the necessity of conducting road repairs required for implementing the Project. Moreover, construction efficiency drops markedly in the wet season, when severe rainfall occurs almost every day. Because of these conditions, 24 months will be required for completion of the Project. If the Project is with Japan's Grant Aid Assistance, the construction schedule should be divided into two phases, which extend within each current fiscal year. Estimated construction cost to be borne by the Philippines side is only the cost for land acquisition at 1,147 thousand pesos. This will not be a problem for the Philippines; the amount has already been budgeted.

The term of work for the first phase will be 12 months, and construction work will be concentrated on improvement of rural roads, drainage and other works. The term of work for the second phase will be 12 months, with mainly irrigation facilities and construction work left.

The executive agency which will oversee implementation on the Japanese Grant Aid basis is the Provincial Government of Benguet (PGB). All national agency branch offices in Benguet shall join forces with PGB, and implementation will proceed under PGB's responsibility and control; PGB fulfilled its duties during F / S, with some counterparts assigned. Following completion of F / S, counterparts have undertaken the task of securing land for construction.

On the basis of the above, preparations for implementing Project on the Philippine side have already been completed.

If the Project is completed, the annual cost for operation and maintenance (O & M) is estimated at 1,132,400 pesos. This may be broken down as : O & M for irrigation facilities (mainly made up of pump operation expenses) -200,500 pesos, O & M for drinking and domestic water supply facilities (well pump operation expenses) - 631,000 pesos, O & M for rural community centers - 16,900 pesos, and O & M for the O & M office itself - 284,000 pesos, respectively.

The O & M cost for irrigation facilities will be borne by the farmers who will benefit; at most about 400 pesos per year will be borne by farm households that fully depend upon pumps in the dry season. This amount is considered bearable, because it is equivalent to less than 10 % of the incremental benefits that can be expected to accrue to the farmers upon completion of the irrigation facilities.

The O & M cost for drinking and domestic water supply facilities will be also borne by the beneficiaries, as a water charge. This amount is considered bearable, as it is estimated at 3 pesos per cubic meter of water supply, which is almost equivalent to the LTWD taking service within Zone I.

The O & M cost for the O & M office itself is composed of staff salaries and expenses for operating the facilities. As some of the staff will be assigned from PGB and other governmental agencies, and PGB's provisions will be commonly utilized, it should not be difficult for PGB to bear that cost.

The effects to be expected through implementation of the Project are presented as follows.:

- 1) Improved irrigation facilities will provide stable irrigation, greatly contributing to increasing production, labor productivity, and quality.
- 2) Improved and newly constructed rural roads will greatly reduce transportation expenses, and will greatly activate rural life.
- 3) Improved drinking and domestic water supply facilities will contribute considerably to stable water use for the residents of Zone II and Zone III who



have been hard-pressed for acquiring sufficient reasonable amount and quality, as they do not yet have water supplying services. The water provided by the facilities will be also used for agricultural activities, serving to increase quality and thus also selling.

- 4) The improvement of drainage facilities in Zone I will remove flooding problems. This solution will increase the growing period, which will in turn increase production and farm land rental prices.
- 5) Progressive pollution of the residential area in Zone I, which has not only worsened living conditions but also contaminated the irrigation canal (due to inferior drainage of living sewage water), will be corrected by the construction of a sewage canal.
- 6) The construction of community centers will greatly contribute to strengthening the farmers' organization and promoting farmers' activities. The centers will provide assembly space, accommodation for farmers' movements, health and sanitary care, and training for agricultural extension.
- 7) The implementation of the Project will be beneficial not only due to the individual points mentioned above, but also because of their combined effect, which will activate the rural economy, improve living conditions, stabilize agricultural production prices, improve the agricultural structure, and enhance effective demands.

Because the Project will very greatly benefit the area, and because smooth O & M is anticipated, the Project is considered extremely reasonable.

It is therefore recommended to that the Project be implemented within the grant aid program.

In order to ensure implementation as planned, it is recommended that the following items be undertaken.

- 1) Land for construction, for access roads, and for stockyards should be secured.

- 2) The purpose of the plan should be explained to the affected farmers, whose present water use will be modified. The farmer's should consent to the fact that they will be benefitted by the Project. It should be explained to all farmers that the irrigation aspects of the Project will greatly improve water availability downstream of the Project Area.

After construction, realization of effective operation will depend considerably upon the self-help efforts of farmer as well as the efforts of Philippine officials.

It is recommended that the concerned Philippine personnel conducting necessary activities such as those presented below.

- 1) Assign the counterpart personnel of the B / D study to the Project office , so that they can organize the executor systems, and educate farmers concerning the Project.
- 2) Utilize careful and thoughtful explanation in order to obtain the consent of beneficiaries to bear the charges for supplies of irrigation water and, drinking and domestic water.
- 3) Continue to pursue realization of rural development by means of drastic planning for sewage problems in Zone I, and establishment of city planning corresponding to urbanization, etc.  
The exercise of PGB's own initiative following Project implementation will significantly enhance the value of the Project.



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3. Member List of Persons Concerned
4. Minutes of Discussions

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## GLOSSARY OF ACRONYMS

ACD	:	Agricultural Coordination Division
ADB	:	Asian Development Bank
BAI	:	Bureau of Animal Industry
BAS	:	Bureau of Agricultural Statistics (former BAE con)
BBEC	:	Baguio Buguias Experiment Center
BES	:	Baguio Experimental Station
BENECO	:	Benguet Electric Cooperative, Inc.
BFD	:	Bureau of Forest Development
BL	:	Bureau of Lands
BMGS	:	Bureau of Mines and Geo-Sciences
BSU	:	Benguet State University
BPI	:	Bureau of Plant Industry
CIDP	:	Communal Irrigation Development Project
CIDIP	:	Communal Irrigation Development and Implementation Program
CIP	:	Communal Irrigation Project
CIS	:	Communal Irrigation System
DA	:	Department of Agriculture
DBM	:	Department of Budget and Management
DOH	:	Department of Health
DLG	:	Department of Local Government
DNR	:	Department of Natural Sciences
DPWH	:	Department of Public Works and Highways
GOJ	:	Government of Japan
GOP	:	Government of Philippines
HARRC	:	Highland Agriculture and Resources Research Consortium
HIRDP	:	Highland Integrated Rural Development Project
HADP	:	Highland Agricultural Development Project
ICO	:	Irrigation Community Organizer
IOPS	:	Irrigation Organization Program Supervisor
JICA	:	Japan International Cooperation Agency
LTWD	:	La Trinidad Water District
LWUA	:	Local Water Utilities Administration
MA	:	Ministry of Agriculture
MAO	:	Municipal Agricultural Office

NCSO	:	National Census and Statistics Office
NFA	:	National Food Authority
NEDA	:	National Economic Development Authority
NIA	:	National Irrigation Administration
NPC	:	National Power Corporation
NPCC	:	National Pollution Control Commission
NPRCRTC	:	Northern Luzon Root Crops Research and Training Center
NWRC	:	National Water Resources council
OECD	:	Overseas Economic Cooperation Fund
PAGASA	:	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAO	:	Provincial Agricultural Office
PD	:	Presidential Decree
PGB	:	Provincial Government of Benguet
PIE	:	Provincial Irrigation Engineer
PIO	:	Provincial Irrigation Office
SEC	:	Securities and Exchange Commission
UPLB	:	University of the Philippines, Los Banos, Laguna
USDA	:	United States Department of Agriculture





## CHAPTER I INTRODUCTION

The Government of the Philippines (GOP) had decided to formulate an integrated rural development project for the main vegetable production base of La Trinidad near Baguio which had a high agricultural development potential but was still less developed. GOP subsequently made a request to the Government of Japan (GOJ) for technical cooperation for the envisaged project at the Annual Consultation Meeting in 1986.

As a result, the Implementing Arrangement on Technical Cooperation (I/A) for the Highland Integrated Rural Development Project in La Trinidad (HIRDP or the Project) agreed upon between the Provincial Government of Benguet (PGB) and JICA on March 13, 1987. The I/A is composed of the following three items:

- Work I : Topographic mapping of the Study area on a scale of 1:5,000 with 1 meter contour line,
- Work II : Data collection and field survey, and
- Work III : Formulation of the Highland Integrated Rural Development Plan

In conformity with I/A, the Feasibility Study on HIRDP (F/S) was carried out from July 1987 through August 1988. Final Report of the Feasibility Study on HIRDP was submitted to PGB in November 1988.

GOP had watched the formulation of the Project with keen interest, made a request to the GOJ for grant aid assistance in realization of HIRDP on the basis of the result of F/S at the Annual Consultation Meeting in May 1988.

In response to the request, GOJ has decided to conduct a Basic Design Study (B/D Study) on HIRDP. Japan International Cooperation Agency (JICA) has sent a Basic Design Study team headed by Mr. Itsuro Tsuruki, Director of Okinawa Development Office, Japan Agricultural Land Development Agency, in order to review and justify the Project as a grant aid program, for forty days from 20th of December 1988 to 28th of January 1989. (Member list and survey schedule of the B/D Study Team, list of personnel concerned and minutes of discussions are herein attached in the Appendix.)

After completion of the field survey of the B/D Study, the team compiled the Draft Final Report of the B/D Study through analyses in Japan. JICA has sent a mission headed by Mr. Mitsuhiro YOSHIDA, Director of Land Improvement Technical Service Center, Kyushu Regional Agricultural Administration Office, MAFF, for explanation of the Draft Final Report. As the result of the discussion meetings, the contents of the Report were acknowledged by PGB.

## **CHAPTER II      BACKGROUND OF THE PROJECT**

### **2.1      Medium-Term Philippine Development Plan 1987 - 1992**

In the Philippines, the 6th Five year Development Plan (1983 - 1987) aiming at continuous economic prosperity, has been discontinued in accordance with the historic political reform of 1986.

Economic recovery in the short run and sustainable growth in long run have been attempted with the formulation of the Medium-Term Philippine Development Plan for 1987 to 1992 as a framework of development policy of the Philippines.

In the Medium-Term Philippine Development Plan, four goals of Philippine development efforts have been indicated: (1) alleviation of poverty, (2) generation of more productive employment, (3) promotion of equity and social justice, and (4) the attainment of sustained economic growth. Agricultural and rural development has been given the highest priority in keeping with the goals. Development strategy of GOP is particularly insistent upon the implementation of regional development projects, including the construction of small-scale, labor-intensive infrastructures such as rural roads, communal irrigation system, school buildings and rural water supply.

Also, the poverty reduction targets have been laid down so that the national poverty incidence will fall to 45.4 percent of the total number of families in 1992; in particular, the rural poverty incidence is to decline from 63.7 percent in 1985 to 48.1 percent in 1992.

Annual average growth rates for the period from 1987 to 92 under the Plan are targeted to be GDP, 6.9 percent, Agricultural sector, 5.0 percent, Manufacturing sector, 7.6 percent, Mining and quarrying sector, 4.2 percent, Construction sector, 16.5 percent, Electricity, gas, water sector, 8.4 percent and Services, 6.6 percent.

### **2.2      Cordillera Administrative Region**

The Province of Benguet in which the Project area is located, had been within the jurisdiction of Region I. At present, the Cordilleras' mountainous area, including the Province of Benguet, forms the Cordillera Autonomous Region (CAR) independent of administrative regions besides the Region I.

Section 15, Article X of the Constitution provides that autonomous regions in the Cordilleras and in Muslim Mindanao, which share common and distinctive historical and cultural heritage, economic and social structures shall be created.

President of Philippines, Corazon C. Aquino decided to realize the statement, and declared the creation of the CAR in Executive Order No. 220, dated July 15, 1987.

The Executive Order appointed and constituted the Cordillera Regional Assembly (CRA) and the Cordillera Executive Board (CEB), which are the policy formulating body and the development body as the implementing arms of CAR, respectively.

CAR is now composed of five (5) highland provinces and one (1) chartered city, i.e., Abra, Benguet, Ifugao, Kalinga-Apayao and Mountain Province, and Baguio City.

The objective of the creation of CAR is the promotion of social and economic development of Cordillera mountainous area having original history and their own culture, especially acceleration of agricultural development as the principal industry of this region.

General view of respective provinces comprising CAR are as follows:

Province	Population	Household	Total Area (ha)	Area of Agricultural Land (ha)
Abra	177,931	33,202	395,555	7,411
Benguet*	435,337	84,308	265,538	31,875
Ifugao	131,304	27,892	251,780	22,012
Kalinga-Apayao	227,697	41,887	704,750	76,783
Mountain	177,433	41,886	209,733	10,088
<b>Total</b>	<b>1,089,681</b>	<b>221,695</b>	<b>1,829,356</b>	<b>148,169</b>

\* including Baguio City

Data Source: DENR - CAR Regional Profile

Notwithstanding that the CAR development plan is being prepared at present, the realization of this HIRDP has been expected as a forerunner of rural development projects directly after the establishment of CAR.

### 2.3 Present Conditions of the Province of Benguet

Benguet, a province falling within the scope of the Project, is located at the heart of the Cordillera mountainous area, forming some of the Philippine's highest mountain areas, rising from 300 m to 2,700 m above sea level. Some seventy percent of the total land area of the Province (approximately 2,655 square kilometers) is covered with forests, while the agriculturally exploited land is only a fraction of about 12 percent of this, with 31,900 ha under cultivation.

The Province of Benguet is administratively divided into 13 municipalities and 138 Barangays . The Province's total population was estimated (in 1987) as being 273,753 inhabitants. (The birth rate is 26/1,000 persons and the death rate 3/1,000 persons.) The population is increasing at a rate of 2.3%. The problem is aggravated by positive population migration into the Province from other provinces, accounting for a migratory population increase of 1.3%, so that Benguet is facing some serious social problems.

Agricultural production in Benguet Province is centered mainly on vegetable cropping, a cultivation that takes advantage of the cool climate prevailing in the high mountain areas. The small farmable land is intensively used, with great efforts being made to enhance agricultural yield and profitability. Roughly 63 percent (i.e., 21,700 ha) of the entire farmable land is under vegetable cultivation, yielding a production output of 219,900 tons (in 1986) a year.

The main crop of the Philippines is rice, but the land area under rice plantation amounts to only about 16 percent of the country's total farming land. Benguet's agricultural pattern is clearly based on small-scale field crop farming.

Under the six-year plan for the period from 1987 through 1992, the Philippines envisages a Medium-term Philippine Development plan that is to pave the way to full commitment to a national development program in anticipation of the year 2000. The Province of Benguet has taken up this Medium-term Development Plan and drawn up a development investment plan that is being executed. The entire budget for this plan amounts to roughly 27.2 billion pesos, and virtually the total amount will be spent on providing the necessary infrastructure. The main areas of development under the plan are given as follows.

- 1) Establishment of a road network, improvement of existing rural roads and new road construction

- 2) Development of irrigation water sources and provision of irrigation facilities
- 3) Provision of potable water supply facilities in the rural areas
- 4) Establishment of a telecommunication service network
- 5) Electric power development
- 6) Extension and expansion of public facilities

The Provincial Government of Benguet has passed the legislative proposals and embarked on the implementation of the development plan in its Administrative Region I. The future will see many more development plans of this nature being acted upon in the wake of this decisive step towards administrative reform undertaken by one of the Cordillera Administrative Regions.

## 2.4 Present condition of the Project area

### 2.4.1 Socio-economic station

The table below gives the population and land surface data for ten barangays in the Project area .

Barangay	Land Area	Farm Area	1986					
			Population	Family	Household	Farm Family	Farm Household	Farm Size per Farm Household
<b>Zone I</b>								
Poblacion	197.6	51.1	4,293	704	607	100	86	0.59
Puguis	940.8	171.9	2,581	436	402	145	134	1.29
Pico	733.0	52.5	6,687	1,091	815	297	222	0.24
Betag	167.5	4.1	2,876	531	261	125	61	0.07
Sub-total	2,038.9	279.6	16,437	2,762	2,085	667	503	0.56
<b>Zone II</b>								
Alapang	143.8	49.7	1,321	265	229	146	126	0.39
Alno	1,012.8	232.2	1,110	190	169	152	135	1.72
Bahong	410.0	60.0	1,894	372	348	186	174	0.34
Tawang	855.9	30.9	1,506	275	261	124	118	0.26
Sub-total	2,422.5	372.8	5,833	1,102	1,007	608	553	0.67
<b>Zone III</b>								
Bineng	693.1	183.5	838	156	125	109	87	2.10
Wangal	1,113.4	64.1	1,017	187	153	126	103	0.62
Sub-total	1,806.5	247.6	1,852	343	278	235	190	1.30
<b>Total</b>	<b>6,267.9</b>	<b>900.0</b>	<b>24,122</b>	<b>4,207</b>	<b>3,370</b>	<b>1,510</b>	<b>1,246</b>	<b>0.72</b>

On a zonal basis, the current trend in the growth of the barangays' populations shows that the most recent estimated data for 1986 indicate a significant population increase over 1985. This increase is 17% for Zone I, 8% for Zone II, and 14% for Zone III.

Zone I with its significant population movement has the strong characteristics of a satellite region in the downstream of the Baguio city. The same trends are also in evidence in



Zone III, where the direction of population flow is from Zone I. In Zone II, however, a drop in the population can be detected due to the continuing migration from this zone.

These population trends can also be clearly recognized from the conversion of farming land to residential land. The table below shows this conversion trend from farming to housing/trading land for the period from 1983 through 1987. It can be seen how prevalent this trend is in Zone I where the conversion of farming to residential land usage reflects the increasing population trend of this zone.

Conversion of Agricultural to Residential Land Usage (1983 - 1987) by Zone  
(unit : m<sup>2</sup>)

Zone	1983	1984	1985	1986	1987
I	27,192	25,872	22,968	15,048	17,424
II	3,960	5,544	5,544	3,696	6,864
III	264	264	0	264	264

The average annual income per head of population in the three zones is given as 37,000 pesos in Zone I, 27,000 pesos in Zone II, and 19,200 pesos in Zone III. (The proportion of farming households in the total number of households is 24% for Zone I, 55% for Zone II, and 68% for Zone III.)

This suggests that the villages in each zone have their own characteristic pattern. And any development plan must take this diversity of direction in which the villages move on a zonal basis into account rather than impose a stereotype plan with no flexibility in direction and detail upon this complex web of socio-economic differentiation. Rather, a development plan and its many components must be selected so as to meet the diversity of direction.

Thus, a further continuation of land conversion to housing usage is identified in Zone I. This trend therefore leads to difficulties in maintaining the agricultural villages functional in this zone, and a form of development will be required that allows the village to meet the current trend to allocate land for house building.

In Zone II, a deterioration in the general climate of agricultural production is recognized so that the development plan must bring basic improvements in the production environment and the living conditions and standards of the village population to this zone.

Similarly to Zone II, the development plan must provide for improvements in the agricultural output of Zone III. At the same time, it must also enhance the living conditions and standards of the village population as these are currently the worst in this zone.

## 2.4.2 Agriculture

### (1) Land Use

The land use in each Zone is classified into five categories, i.e., upland crop field, lowland rice field, swamp, residential/commercial area, forest/grass land and others. The areas in each Zone are estimated as shown below:

(Unit: ha)

Land Use	Zone I	Zone II	Zone III	Total
1. Agricultural Land				
Upland field	210 (73%)	310 (46%)	60 (13%)	580 (41%)
Lowland rice field	0 (0%)	0 (0%)	40 (9%)	40 (3%)
2. Swamp	4 (2%)	6 (1%)	0 (0%)	10 (0%)
3. Residential/Commercial	67 (23%)	30 (4%)	5 (1%)	102 (7%)
4. Forest/grass	0 (0%)	264 (39%)	295 (66%)	559 (40%)
5. Others	9 (2%)	70 (10%)	50 (11%)	129 (9%)
Total	290 (100%)	680 (100%)	450 (100%)	1,420 (100%)

The land in Zone I is characterized by large occupation ratios of upland crop field (73%) and resident/commercial area (23%). The upland crop field is mainly utilized for production of vegetables and flowers. Zone II is the second most developed area following Zone I, upland crop field and residential/commercial areas occupy 46%, 4% respectively, and the rest is mostly forest/grass land. In Zone III, lowland rice field and upland crop field occupy about 9%, 13% of the area respectively, and the rest is mostly forest/grass land on steep slope.

### (2) Land tenure and land holding system

Presidential Decree 705 launched in 1975 classifies land with 18° slope and over as non-alienable and prohibit private ownership of the land in order to reserve the country's land area as forest for ecological purposes. At present about 70% of the farmers in the Project area is supported to have the land titles while about 95% of the farmers are owner-operators.

Average farm size in La Trinidad is estimated at 0.83 ha.

(3) Cropping pattern

1) Kind of crops being grown

The main vegetables being grown in La Trinidad are legumes like string beans which is called Baguio beans, garden peas, leafy vegetables like Chinese cabbage, pechay, cabbage, lettuce, celery, green onion, cauliflower, broccoli, asparagus, fruit vegetables like cucumber, eggplant, tomato, sweet pepper, root crops like white potato, radish, taro, sweet potato, carrot. The main cut-flowers produced in the area are roses, gladiolus, chrysanthemum, dahlia, etc. Anthilium has been also introduced recently.

Banana, mango, coffee, avocado, and guava are mostly planted in home garden, and large scale plantation of these kinds of crops are not common in the area. Rice is cultivated only in Bineng and Alno barangays in the Project area, rice cultivation including upland rice is not found in any other place in the area. Strawberries, introduced recently, are cultivated mainly in Zone I including the production farm of BSU.

2) Cropping pattern

The temperature condition of the Project area is suitable for your round cultivation of temperate vegetables. The cropping calendar and cultivated area in the Project area are mainly affected by excessive rainfall, strong wind, damages of typhoon in the wet season, and shortage of irrigation water in the dry season.

In Zone I, strawberry occupies about one third of the area, and the rest is used for vegetables cultivation. In Zone II, roses are introduced with about 40% of the area, most of the other field can possibly be used for vegetable production for five times of croppings a year. In Zone III, lowland rice is cultivated over 40 ha in the wet season while in the dry season, rice cultivation area decreases to about 25 ha mainly due to shortage of irrigation water. Upland crop fields cover about 60 ha in Zone III.

#### (4) Farming practices

The advanced farming practices of vegetables and flowers have become wide spread in the Project area especially in Zone I which has been called as "salad bowl in Philippines", cultivation methods like planting density, fertilization, etc. are mostly in a uniform manner all over the area. Most vegetables and flowers are cultivated on ridge. Cabbage, celery are usually grown in transplanting method while Chinese cabbage, pechay are in direct sowing method. Organic manures like chicken manure, mushroom compost, Sagana 100, chemical fertilizer like 14-14-14 urea, ammonium sulfate are applied commonly. Most of farm management work is carried out by manpower. Pests and diseases control is done with knapsack type sprayer.

Rice is cultivated with the ordinary transplanting method. The nursery period is about 30 days. After ploughing and paddling the main field by buffalo, transplanting of seedlings is done by manpower. Usually no fertilizer is applied to rice. Mostly local varieties are dominated in the Project area.

Irrigation is required for about 6 months from November to April. Irrigation water is drawn with channel or hose by gravity, the water is usually kept in a pit in the field or water tank and applied to the crops by using watering cans or by furrow method. Sprinklers are used by some farmers. Irrigation by pumps is found in Alno and Zone I areas.

#### (5) Agricultural production

The average annual total area and production of vegetables for past four years in La Trinidad is estimated at about 1,700 ha and 17,000 tons, respectively. The cultivated area of vegetables has slightly expanded at a rate of 10% a year and the total production of vegetables increased from 18,600 tons to 22,400 tons during the last three years from 1985 to 1987. The average annual cultivated area and production of rice is about 110 ha and 210 tons, respectively. Area and production of cut-flowers are 43 ha and 480 thousand dozen for roses, 198 ha and 2,920 thousand dozen for gladiolus, 164 ha and 1,100 thousand dozen for the other flowers.

Besides the above mentioned crops, citrus trees have been recently introduced but the planted area is only about 10 ha. The planted area of coffee has decreased to about 10% during the last three years.

Most households in the area keep livestock for their own use or consumption except for some commercial poultry farms. Cattle, buffalo and goats are usually fed with natural grass in bush and grass lands. Livestock raising is not the mainline industry but it is somewhat important in the Project area.

(6) Marketing and prices

There are basically two marketing channels for the disposal of farm products. The first is through traders. The traders visit farmers, make an estimate of the products and procure them before it is harvested. The second is by farmers themselves.

The bulk of vegetables produced in the area goes to Metro Manila directly or through Baguio wholesale market, while some go to Central Luzon such as Pangasinan, Tarlac, Pampanga, Cabanatuan City and Olongapo City. But before vegetables reach these areas, the products pass through several tiers of middlemen.

Prices of vegetables generally show a distinct seasonal pattern, higher from July to September and lower from March to April.

Because plenty of product of vegetables owing of good adequate irrigation water at the term of planting of the vegetables in the beginning of dry season, cause a fall in the prices from March to April. And small product of vegetables for lack of irrigation water at the term of planting of the vegetables in the mid of dry season and being also affected by typhoon at the growing stage of the vegetables cause a rise in the prices from July to September.

(7) Agricultural support system

1) Research institutes

La Trinidad is the capital municipality of Benguet Province. Many research institutes are located around the municipality. HARRC (Highland Agricultural Research and Resources Center) coordinates agricultural research works in the Study area. There are now the following 8 regular member institutions in HARRC:

- Baguio Experiment Station (BES) of the Bureau of Plant Industry (BPI)
- West Center Luzon Forest Research Center (WCLFRC) of the Forest Research Institute (FORI)
- Baguio Dairy Farm (BDF) of the Bureau of Animal Industry (BAI)

- Cordillera Studies Center (CSC) of the University of the Philippines College Baguio City (UPCB)
- The Northern Philippines Root Crops Research and Training Center (NPRCRTC)
- Sericulture Research and Training Center (SRTC) of the Philippines Textile Research Institute (PTRI)
- Department of Agriculture (DA) Region I
- Benguet State University (BSU)

HARRC, through the consortium, has the primary responsibility for research on fruit crops, ornamental horticultural crops, root crops, vegetable crops, farming systems, soil resources, macro-economics, and applied rural sociology. The primary function HARRC includes planning, coordinating, implementing and monitoring of agricultural research programs designed in support of development of the highland area in the country.

## 2) Agricultural extension

At present, two agencies have conducted agricultural extension services. The Municipal Agricultural Office (MAO) of La Trinidad under the Department of Agriculture has the responsibility for agricultural extension in the Study area. The number of the staff is eight consisting of a municipal agricultural officer and seven Agriculture and Food Technicians (AFTs). They extend extension services which are aligned to the national program. On the other hand, Office of the Provincial Agriculturalist under the Benguet Provincial Government also extends extension services and has the function of planning, supervising and coordinating all agricultural projects and activities of the Provincial Government which are not totally aligned to the national programs.

Technical assistance of the both offices were extended to individuals and groups of farmers through such activities as farm visits as resource person or lecturer, office consultations, distribution of technical bulletins, pamphlets and leaflets on agricultural and social development, etc. The offices have also conducted nursery/seedling production and distributed them to farmers. However, the effectiveness of the extension services has been hampered by a number of factors which include:

- (a) shortage of equipment and facilities for training and demonstration;
- (b) insufficient capacity of extension staff, etc.

### 3) Agricultural credit

There are a number of formal credit channels in and around the Study area which extend agricultural loans. They are the Philippine National Bank (PNB), Development Bank of the Philippines (DBP), the Land Bank of the Philippines (LBP) and Rural Banks. The formal credit, however, is not an important source of funds in meeting rural farmers' needs because (a) the credit needs long administrative procedure, (b) most of loan lending has to be secured by land title, tax declaration, survey plan, chattel mortgage, etc., (c) the banks finance the limited portion of the production costs and (d) the interest rate is high (20 - 30% per annum).

### (8) Farmers' organization

The Government has stepped up efforts to organize farmers into cooperatives or associations. Samahan Nayons were organized in 15 barangays in La Trinidad under the guidance of the provincial or municipal agricultural office. However, almost all of the Samahan Nayons are inactive due to shortage of funds, despite the fact that farmers felt the need for mutual support organization.

The Benguet Farmer's Development Cooperative (BFDC) is the only active farmers' cooperative in the Study area. Products from the members are packed and sent to Metro Manila through a joint marketing system.

## 2.4.3 Geology and Hydrology

### (1) Topography

The Project area adjacent to Baguio City is encircled by mountain ranges having its elevation of 600 m to 1,300 m which belongs to southern central cordillera range of Luzon Island, and located at the mountain slope from north starting from Baguio (EL. 1,500 m) to south.

The Balili, main river of Balili in the Project area starts from Baguio district and finally empties itself into the Lingayan Gulf changing its name Payung river and Naguilian river. Alapang river diverted from the Balili river through the cave in the central area of the Project area is flowing down at the eastern part of the Project area and joins the Payung. Wangal river, the tributary of the Balili river, is passing through the western part of the Project area.

Topographically, the Project area is divided into three (3) zones : Zone I is located in the Trinidad Valley and its area is about 3 km<sup>2</sup>. Upland cultivation is mainly carried out in this zone. Zone II is located at north-east part of Zone I, and is also upland area having a great long slope at a gradient from 8 to 10 degrees. Zone III is located at north-west part and the area of about 0.6 km<sup>2</sup> in this zone has a gradient of about 20 degrees. Land use in this area is mainly paddy field. Middle part of the basin of Wangal river which consists of alluvium is also included in Zone III.

## (2) Geology

The Project area consists of Quarternary deposits and the Tertiary sedimentary rock. The Quarternary deposit in the Project area can be classified into the Alluvium forming the Trinidad Valley and the Talus deposits distributed on the marginal parts of the limestone zone. Details are shown as below.



### Geological Classification in the Project Area

Geological Age		Stratigraphy	Lithophasis	Location
Quaritemary		Alluvium	Sandy and silty deposit	Trinidad Valley
		Talus deposit (lime stone)	Gravel, Sand clay	Alno, Wangal Mountain area of Zone II
Tertiary	Pliocene to Miocene	Klondyke formation	Andestic clastics	Bagto in Zone II
		Kennon formation	Limestone (shell)	Zone II, Trinidad Valley Wangal
	Miocene	Zigzag formation	Conglomerates Shale, Sand stone Agglomerates Lapilli-tuff	Zone II, Zone III Puguis North and East pond of Zone I

### (3) Groundwater

Followings show water sources in dry season.

Water source	Zone I	Zone II	Zone III
River, Creek	Balili, Pugis Bayabas	Alapang Peril	Wangal
Spring	Pico (2 nos.) Ampasit (1 no.)	Peril (2 nos.) Bahong (2 nos.) Alapang (1 no.)	Bineng (2 nos.) Boleweng (1 no.)
Shallow Well	Several portions (no potable)	Bahong (2 nos.) Alno (1 no.)	-
Deep Well	Balili (1 no.) Pugis (1 no.)	-	-

Those existing water sources in the Project area are suffered from shortage of water in dry season. Deep well in Zone I is showing low water level caused by excessed pumping up. Precipitation in Trinidad area is more than 3,000 mm per year and 90% of this is concentrated

into the rainy season from May to October. Most of all the rain water is directly flowing into the river and remaining is infiltrated into under ground. Run-off coefficient is assumed to be 70 % and infiltration volume is estimated as 200 to 300 mm / year of precipitation in the Project area. Velocity of ground water is generally very slow and its coefficient of permeability will be  $10^{-3}$  to  $10^{-5}$  cm / sec. Therefore, if there is an aquifer, ground water can be expected even in dry season.

As a result of geological survey, following formations are recommended for deep well to be constructed in the Project area.

- 1) Fault zone crossing the slope of formation
- 2) Crackey zone such as fault breccia or thick zone of weathered Zigzag series
- 3) Impervious shale or alluvial deposits in a previous massive limestones

Taking account of water demand for irrigation, rather big amount of water will be required. Therefore, intake of irrigation water from deepwell is to be considered without interference upon existing intake facilities.

Required volume of water from deepwell is shown as below.

Zone	Required Volume (l/min)	Remarks
Zone I	1,200	for irrigation
Zone II	1,800	for drinking and domestic water
Zone III	300	for drinking and domesticl water

Specification of the proposed deepwell is as follows.

Name of well	Location	Ground Level (EL. m)	Well Depth (m)	Well Diameter (m/m)	Pumping Capacity (l/min)	Remarks
Bahong W No. 1	Zone II (Tomay)	1,370	100	300	300	F.B., W.Cg (Settled test boring)
Bahong W No. 2	Zone II (Tomay)	1,355	80	300	450	F.B.
Bahong W No. 3	Zone II (Tomay)	1,257	90	350	500	F.B. (Settled test boring)
Bahong W No. 4	Zone II	1,184	80	300	300	F.B.
Alapang W	Zone II	1,223	100	300	400	F.B., W.Cg
Alno W	Zone II	1,083	90	300	350	F.B., W.Cg
Bineng W	Zone II	981.5	80	300	780	C.K. (settled test boring)
Stock Farm W	Zone I	1,314.6	90	350	350	F.B.
Puguis W No. 1	Zone I	1,352	100	300	450	F.B.
Puguis W No. 2	Zone I	1,314	120	350	450	W.Cg, F.B.

There : F.B. Fault Breccia  
W,Cg Weathered conglomerate  
C.K. Crack water

- Depth of deepwell is decided by the result of test boring and electric resistivity survey.
- Diameter of deepwell is determined by water demand and characteristics of layers.
- Pumping capacity is estimated by pump test, size and continuity of lineament and rock formations.
- Water level of test well which was executed on January. 1989 is still showing the same level in dry season.

(4) Deepwell Plan

1) General

Total ten (10) deepwells are planned in the Project area. Three (3) deepwells are in Zone I for irrigation, six (6) are in Zone II and One (1) is in Zone I for drinking and domestic water supply.

Each water demand is 1,200 l/min for Zone I, 1,800 l/min for Zone II and 300 l/min for Zone I.

2) Zone I

- Stockfarm W

Test boring and pumping test were executed on the assumed line of Fault Breccia zone on January 1988. As a result of the tests, 265 l/min of water could be got from the formations of Limestone and Calcareous Sandstone which were estimated as an aquifer by apparent value of electric logging. Drawdown of the ground water here is showing comparatively high because of the formation of Sandstone, Marl and Shale. Therefore rather big size of deepwell will be required to recover the water demand.

- Puguis W No. 1

Location of the deepwell is planned on the line of linearment in Weathered Conglomerate. Taking account of the conditions around the location where are springs, Puguis river and existing deepwell which have adequate and clean water, enough water can be expected from the deepwell.

- Puguis W No.2

As the deepwell is located on the line of linearment in Alluvium fan consist of Weathered Conglomerates, favorable aquifer can be expected here. Proposed depth of the well will be more than 100 meter.

### 3) Zone II

- Bahong W No. 1

It is located at highest portion (EL. 1,300 m) where is an edge of saddle consisted of Sandstone in Zone II. And this point is on the strong linearment where are existing two shallow wells and spring pond. According to the test hole drilling data, ground water will exist in an aquifer of loosed Conglomerates at 24 meters depth.

- Bahong W No. 2

Geologically, Shales dominated by Sandstone are laid in Talus deposit and Conglomerates are also included in this formations. Furthermore, this point is in a continuous linearment and has big catchment area surrounded by mountains.

- Bahong W No. 3

Test boring and pumping test were executed on January 1988 at this point where is on a linearment of Sandstone hill. Maximum water capacity by pumping test was 285 l/ min and drowdown was less than 1 m. Geology is a alternative beds of Limestone, Sandstone, Shales and Conglomerates. As adequate water is expected at this point, it is planned to supply excess water to other inadequate portion by increasing of pumping capacity.

- Bahong W No. 4

This point is located on linearment stretching from west-south to north-east. The formation is consisting of alternative beds of Sandstone, Shales and Conglomerates.

- Alapang W

As this point is located at a toe of mountain of Sandstone, high possibility of aquifer will be expected. Carefull serrection of a deepwell site must be done by taking account of interference with the shallow well at Alapang school.

- Alno W

Alno W is located on the crossing point between north-east and north-north west linearment. Weathered Conglomerates are appeared at the ground surface.

Possibility of existing of aquifer is assumed very high according to the result of electric resistivity survey.

4) Zone III

- Bineng W

This point is located on an extension line of big cracks at a slope of mountains.

Pumping test results 265 l/ min of discharge and 3.40 m of drawdown.

Ground water surface was observed at 30.20 m below.

#### 2.4.4 Meteorology and Hydrology

(1) Meteorology

Meteorologically the Project area falls under Type I which is characterized by two pronounced seasons. One is the dry season affected by the northeast monsoon from November to April and the other is the wet season affected by the southwest monsoon from May to October. It is in a highland area of the Central Cordillera, and frequently attacked by typhoons. Generally during the wet season, annual rainfall on the area is very high and reached above 3,500 mm on an average, so that this is a high-rain region well-known in the world in meteorological terms.

Meteorological stations in and around the Project area are the Baguio station (EL. 1,501 m) and BSU station (EL. 1,344 m), which are being operated by the National Institute of Climatology: PAGASA. The Baguio Station was established in 1949, and its observed data are available for the most of general climatic elements. The BSU station was established in 1977 and mainly deals with the observation of the agrometeorological elements. Annual mean temperature at the Baguio Station is 19.3°C, considerably lower than 27.3°C of the Manila Station. Hence, its cooling rate is estimated at 0.54°C per 100 m rising of the altitude.

According to the average of observed data at the Baguio Station for 1951 - 1985 period, mean air temperature: °C (Jan. = 12.1, May = 20.5, Annual = 19.3), rainfall: mm (Aug. = 847.9, May - Oct. = 3,175, Nov. - Apr. = 387.8, Annual = 3,562), rainy days (Jan. = 4, Aug. = 27, Annual = 169), thunderstorm days (May - Oct. = 79, Nov. - Apr. = 15, Annual = 94), relative humidity: % (Feb. = 78, Aug. = 92, Annual mean = 84), mean atmospheric pressure: mbs (Jan. = 1,012.1, Aug. = 1,006.2, Annual = 1,010.9).

Correlation coefficients of rainfall among twelve stations located adjacent to the Project area were computed. According to the result, only the Baguio station shows a significant correlation with the BSU station in La Trinidad ( $r = 0.97$ ).

Annual evaporation measured by the open pan is 1,080 mm at the Baguio station. The potential evaporation estimated by the Penman method gives a good approximation to the measurement.

Data of both stations have outlined in Table 2.4.1 .

## (2) Hydrology

Only runoff data from the Mamatling station on the Naguilian river among the existing five stations concerning with the Project area, have been hydrologically correlated with rainfall data at the Baguio station. Runoff data at the station are summarized as follows:

(Averaged for the period from 1946 to 1972)

River Name	Gagging Station	Established Year	Catchment Area (km <sup>2</sup> )	Average (m <sup>3</sup> /s)			
				Peak Dis.	Daily Max.	Daily Mean	Daily Min.
Naguilian	Mamatling	1946 - 1972	304	1,321.66	719.37	29.76	1.95

Runoff analysis for the Balili river was conducted in accordance with the data observed in the Feasibility Study team. The results analyzed with the Tank model method are summarized below:

Table 2.4.1 Sammerized Meteorological Data in BSU and Baguio PAGASA Station

BSU PAGASA Station

Averaged for 1977 - 1988

Items	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
Mean Temperature (°C)	16.9	17.3	18.7	20.0	20.3	20.6	20.1	19.9	19.9	19.6	18.9	17.5
Maximum Temperature (°C)	22.4	23.1	24.5	25.0	24.5	24.4	23.6	23.6	23.7	23.8	23.8	22.9
Minimum Temperature (°C)	11.4	11.5	12.8	14.9	15.9	16.8	16.9	16.7	16.2	15.6	14.3	12.5
Dry Bulb Temperature (°C)	16.0	16.6	18.7	20.6	21.2	21.0	20.5	20.0	20.4	20.2	19.2	17.2
Wet Bulb Temperature (°C)	14.0	14.4	16.1	18.1	18.7	18.9	18.8	18.6	18.4	18.0	17.1	15.0
Relative Humidity (%)	82	80	77	76	79	83	85	88	84	82	83	80
Open Pan Evaporation (mm/day)	*	*	*	*	*	*	*	*	*	*	*	*
Duration of Sunshine (min)	398	447	410	372	300	252	242	153	261	274	332	353
Average Wind Velocity (m/sec)	1.3	1.1	1.3	1.5	1.4	1.9	2.1	1.9	1.5	1.4	1.3	1.3
Monthly Rainfall (mm/month)	13.6	12.9	26.3	100.5	399.5	444.9	694.6	898.5	538.2	262.9	156.9	24.9

\* : missing data

BAGUIO PAGASA Station

Averaged for 1949 - 1988

Items	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
Mean Temperature (°C)	17.6	18.4	19.6	20.4	20.6	20.6	20.0	19.6	19.4	19.6	19.1	18.4
Maximum Temperature (°C)	22.7	23.5	24.7	25.2	24.8	23.7	23.1	22.3	23.1	23.5	23.3	22.9
Minimum Temperature (°C)	12.9	13.3	14.3	15.6	16.4	16.3	16.2	15.9	15.8	15.6	14.9	14.0
Dry Bulb Temperature (°C)	16.7	17.2	18.4	19.3	19.5	19.0	18.6	18.2	18.5	18.7	18.2	17.3
Wet Bulb Temperature (°C)	14.6	14.9	16.1	17.2	17.8	17.7	17.3	17.3	17.3	17.2	16.4	15.3
Relative Humidity (%)	82	80	80	82	86	88	90	92	90	87	84	82
Open Pan Evaporation (mm/day)	3.0	3.6	4.1	3.7	3.0	2.8	2.5	2.1	2.4	2.6	2.8	2.9
Duration of Sunshine (min)	425	479	459	443	349	300	238	166	267	353	368	400
Average Wind Velocity (m/sec)	2.0	2.1	1.9	1.9	1.9	2.3	2.3	2.4	2.1	2.1	2.1	2.1
Monthly Rainfall (mm/month)	12.4	9.7	31.0	99.5	326.7	468.9	726.5	880.8	584.3	330.6	137.9	24.9



(Averaged for the period from 1977 to 1988)

Annual average (m <sup>3</sup> /s/km <sup>2</sup> )			Annual Runoff (MCM)	Annual Runoff Ratio (%)
Daily Max.	Daily Mean	Daily Min.		
1.585	0.088	0.064	2.776	77.3

Monthly average of estimated runoff by the analysis is shown as follows:

(Averaged for the period from 1977 to 1988)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
0.010	0.008	0.008	0.014	0.082	0.119	0.182	0.271	0.195	0.081	0.063	0.017

## 2.5 Circumstances and Contents of the Request

### 2.5.1 Summary of the Feasibility Study Report

The Feasibility Study (F/S) on HIRDP was completed, and the final report was submitted to PGB in November, 1988.

The Project area of F/S on HIRDP with a total area of 1,420 ha comprises three (3) zones as: (i) the La Trinidad Valley as Zone I covering 290 ha; (ii) the right bank of the Balili river as Zone II covering 680 ha; and (iii) the left bank of the Balili river as Zone III covering 450 ha. The Project area covers 1,420 ha with gross agricultural land at 534 ha. The population of barangays concerned with the Project is 21,978. The members of the total household and farm household are estimated at 3,370 and 1,246.

The primary objectives of the F/S on HIRDP can be summed up as follows:

- a. to promote agriculture based on the vegetable and cut-flower production as the principal type of crop best suited to the highland climate, land and soil conditions.
- b. to increase the land productivity and enhance the labor productivity by providing agricultural infrastructure development for irrigation and drainage facilities, flood protection facilities, and rural road networks.
- c. to raise the level of the farm income by way of ameliorating the farming system fitted with the provision of a better agricultural infrastructure and to achieve a greater stability of farm management through the strengthening and expanding of the support and service backup systems for the agricultural communities.
- d. to improve a living environment base of the rural area through measures that will provide a more effective infrastructure with the establishment of more efficient drinking and domestic water supply systems, rural electrification facilities, sewage disposal systems, waste and refuse collection, etc. so as to rise the living standard in the rural area.
- e. to adopt measures designed to develop high-quality water sources for irrigation purposes to benefit vegetable production. These measures should result in a higher quality of agricultural produce in the La Trinidad area so that the farmer

can achieve a higher added value after establishing a brand image of clean vegetables and thereby improve the family income. In particular, these measures should include the substitution of the current irrigation water supply from the Balili river by some alternative sources yet to be developed. This is of particular importance in view of the poor quality of the current water supply which is badly contaminated by sewage and drainage waste from the Baguio City catchment area and the industrial wastes that are discharged into the Balili river from the factories and commercial enterprises in the Municipality of La Trinidad.

- f. to create a sound socio-economic framework for the rural society through the provision of rural community centers (Barangay Halls) as a means of expanding the health and hygiene care services and promoting the introduction of more advanced agricultural and irrigation techniques and strengthening the communal irrigation organization, farmers' school and farmers' cooperative activities.

It is proposed that the following components of the plan should be practically implemented to solve those problems that are impeding the development of the rural areas in the Project areas and to overcome major existing constraints.

- 1) Drainage improvement works (Zone I)
- 2) Irrigation improvement works including ponds, water tanks, wells & pumps and on-farm irrigation facilities (Zones I, II, III)
- 3) Sewage canal construction works (Zone I)
- 4) Rural road improvement works and new construction of farm-to-market roads (Zones II, III)
- 5) Drinking and domestic water supply facilities works (Zones II, III)
- 6) Rural community center construction works (Zones I, II, III) and
- 7) Rural electrification works (Zone III)

The financial costs have been estimated as breaking down into an initial investment cost of 301.500 million pesos, operation/maintenance costs of 2.153 million pesos, and replacement costs of 30.297 million pesos.

Given a Project life of 35 years, the Economic Internal Rate of Return (EIRR) has been calculated from the above economic benefits and the economic costs as being 10.2 percent. The benefit/cost ratio (B/C) for the Project amounts to 1.25 at a discount rate 8 percent and the benefit-cost difference (B-C) as being 41.5 million pesos.

The benefits accruing from the implementation of the Project will not only be directly measurable ones that show up in an economic evaluation. Rather, the Project is likely to result in various secondary or intangible benefits in terms of the favorable socio-economic impact which is bound to generate among the rural population and their economy. The principal spinoff effects of the Project may be described as follows.

- 1) increased supply of vegetables and cut-flowers to the Metro Manila and the other consumer market,
- 2) greater employment opportunities associated with the execution of the Project and job training effect,
- 3) rising in a farmer's feeling of happiness and stabilization of rural society as a result of the increased farm household income and increased valuation of the land,
- 4) improvement and expansion of existing local transport systems,
- 5) more convenient transportation and shorter commuting times for junior and middle school children due to the improved rural roads,
- 6) improved standards of public health and cost savings on the health services as a result of the secured provision of drinking and domestic water supply,
- 7) activation of the rural economies as a result of the electrification,
- 8) creation of a healthy, sanitary environment resulting from the installation of sewage canals and regular refuse collection, and
- 9) activating of rural society due to the provision of local community centers, reinforcement of the farmers' organization, advancement of rural cultural activities, enlightenment of the rural women to enhance their social standing.

Calculations of the farm households' financial ability to pay their liabilities have demonstrated that for an average farm household with farm size of 0.87 ha each in zone I,

the net reserves after the Project would be 48,400 pesos/year. For a typical farm household with farm size of 0.7 ha in Zone II, the post-project net reserves would be 29,800 pesos and for a farm household with farm size of 0.91 ha in Zone III, the net reserves would be 29,200 pesos. In view of this significant increase in net available income, it may be assumed that the farm household will be capable of meeting its financial obligations arising in connection with the water utilization works. It can therefore be anticipated that the present project will contribute to a major improvement in the economic position of the farm households in the Project area.

In view of these findings in the F/S it has been concluded that the Highland Integrated Rural Development Project in La Trinidad is technically sound and economically viable and therefore feasible.

It has been recommended in the F/S report that the preparation for the survey falling within the scope of the next phase of the Project should be commenced at the earliest possible opportunity.

#### 2.5.2 Evaluation of the Feasibility Study

The Highland Integrated Rural Development Project in La Trinidad outlined in the F/S report has been drawn up on the base that the Project should be implemented to meet the minimum improvement requirements in terms of providing a sound basis for agricultural production, rural life, and social organization as the essential pre-requisites to the development of the Project area.

The present Project therefore envision a broad variety of measures, including the provision of irrigation system, the improvement of drainage facilities, the rehabilitation and upgrading of existing inadequate rural roads and the construction of new farm to market roads, the construction of drinking and domestic water supply facilities, the electrification of those rural areas which are not yet connected to the public grid, and the building of community centers.

As these components constitute organic related parts as a whole, the viability and effectiveness of the project will not be attained unless all of the above components are put into practice as a package.

It has been demonstrated that there are no particular technical problems preventing the execution of the construction works mentioned above and that the economic internal rate of return (EIRR) attains a level of 10 percent.

The pursuit of the objectives on HIRDP aiming at effectively securing rural people's livelihood and promoting social welfare in rural has been considered to be thoroughly in line with the policy of Grant Aid Program.

Nevertheless, the affirmation in details for implementation mentioned below are required in this Basic Design Study.

- 1) Construction period should be extended within the current fiscal year as a series of construction works to be expected to benefit.
- 2) The recipient country should take the necessary undertaking e.g. securing the land for construction.
- 3) Each kind of construction work to be implemented should be re-examined in accordance with the relevant regulations for Grant Aid Program.

The Basic Design Study was carried out the survey and analysis so as to arrange the most suitable and necessary scale and contents of the Project as a Grant Aid Program.

### 2.5.3 Contents of the request

Components requested by GOP for Grant Aid Program are listed as follows:

#### (1) Zone I

##### a) Drainage improvement works

- |  |          |
|--|----------|
| 1) Improvement of Balili river   | 425 ms   |
| 2) Improvement of Bolo creek and Bayabas creek<br>(Regular gate: 1 place)  | 1,400 ms |
| 3) New flood canal of Bayabas  | 500 ms   |
| 4) Road crossing box culvert No. 1 & No. 2 at Bayabas  | 2 sites  |
| 5) Construction of a consolidation dam (CL = 20 m)<br>and refuse inflow protection screen in front of Dinog Cave | 1 set    |

##### b) Irrigation facilities works

1)	Improvement of Bayabas pond	1 site
2)	Construction of Puguis pond	1 site
3)	Construction of Buyagan pond	2 sites
4)	Construction of Puguis (Gayadan) deep well works	
	(Q = 0.6 m <sup>3</sup> /min)	1 site
	(Q = 0.3 m <sup>3</sup> /min)	1 site
5)	Construction of Stockfarm deep well works	1 site
	(Q = 0.3 m <sup>3</sup> /min)	1 site
c) Inland pollution protection works		
1)	Construction of sewage canal	5,000 ms
2)	Provision of refuse dumping truck	2 units
d) Rural community center works		
-	Puguis Barangay	1 house
-	Pico Barangay	1 house
(2) Zone II		
a) Irrigation facilities works		
1)	Construction of distribution facilities at outlet of Dinog Cave	1 set
2)	Construction ponds	8 sites
	Bahong No. 1, Bahong No. 2, Bahong No. 3	
	Alapang No. 1, Alapang No. 2, Alapang No. 3	
	Peril, Alno	
3)	Construction of intake facilities	
-	Bahong intake weir	3 sites
-	Alapang intake weir	1 site
-	Alno intake weir	1 site

- b) Drinking and domestic water supply system works
- Bahong deep well and pump works      200 liters/min x 4 pump stations
  - Alapang deep well and pump works      200 liters/min x 1 pump station
  - Alno deep well and pump works      200 liters/min x 1 pump station

- c) Improvement of rural road
- Samuyao - Peril route      2.9 kms
  - Samuyao - Alapang route      1.1 kms
  - Camp Dangwa - Alno route      3.8 kms
  - Camp Dangwa - Sadag route      3.4 kms
  - Tomay - Bahong route      1.3 kms
  - Camp Dangwa - Mae Bahong route      0.7 km
  - West Alno - East Alno route      1.6 kms

- d) Construction of rural road (Farm to market road) works
- North Sadag - East Alno route      1.5 kms
  - Sadag - East Alno route      1.6 kms
  - North Bahong - Alapang route      0.9 km
  - West Alno - Peril route      1.0 km

- e) Rural community center works
- Bahong Barangay      1 house
  - Alapang Barangay      1 house
  - Alno Barangay      1 house

(3) Zone III

- a) Rural road improvement works
- Capitol - Bineng - Japos      6.2 kms
  - Bineng - Boleweng      2.5 kms

- b) Construction of rural road (Farm to market road) works
- Boleweng - Lower Bineng route      2.8 kms



- c) Irrigation facilities works
- 1) Bineng CIS improvement
    - Intake 1 site
    - Existing canal 3.8 kms
    - New canal 2.2 kms
    - Division box 6 sites
  - 2) New intake facilities works
    - Wangal intake 1 site
    - Bineng intake 1 site
  - 3) Regulating pond 1 site
- d) Drinking and domestic water supply system works
- 1) Bineng deep well and pumps 200 liters/min x 1 pump station
- e) Rural community center works
- Bineng Barangay 1 house
  - Wangal Barangay 1 house
- f) Rural electrification works
- Extension transmission line 6 kms
- (4) Equipments
- 1) Agricultural-extension equipments Lump sum
  - 2) Agro-meteorology equipment Lump sum
  - 3) Water-quality-test equipment Lump sum
  - 4) Office Equipments (vehicle, office machine, and so on) Lump sum

## CHAPTER III OBJECTIVE AND CONTENTS OF THE PROJECT

### 3.1 Objective of the Project

The Project area is currently suffering from significant problems that not just impede regional development due to the lack of an agricultural production base and the non-existence of an infrastructural base to support rural life but go much further in that they threaten rural life itself.

Under the Project, these detrimental factors are to be resolved in a general manner and its aim is to provide effective help to support the self-help efforts of the local farmer in the Project area towards the development of their own region, a population that is seen to make a serious and sustained effort to farm the land on a very small scale and under the very limited natural conditions that prevail in their region.

### 3.2 Contents of the Project

(1) Detrimental factors in the Project Area based on a very detailed field survey, the main factors that have impeded and are impeding the development of agriculture in the Project area have been identified as follows :

- Inundation of the farming land due to flooding in the wet season
- Inadequate supply of irrigation water of a favorable quality
- Obsolete water intake facilities
- Inavailability of water reservoir facilities
- Inadequacy of rural road constructions non-availability of related constructions
- Non-availability of a road system
- Inadequacy of utility and potable water supplies
- Lack of a service presenting agrotechnical information for the farming population

(2) Integrated rural development Plan

Agricultural development of the Asian developing countries from 1960 until 1970 concentrated on contributions directly aimed at increasing food production in those areas and

entailed the construction of large-scale irrigation and drainage systems designed to create the necessary agricultural infrastructure. The major beneficiaries of these projects, however, were the non-resident big landowners and the major farming and distribution business operator. The benefits of these development projects did not go to the small and petty farmers and passed them by completely, although they form the backbone of the people and account for the majority of the rural population. And, the differential between the big landowners and the petty farmers has continued to widen.

Also under the Medium- Term Philippines Development Plan made by the Aquino administration, priority is given to concrete measures involving "plans for the implementation of small-scale infrastructural schemes centering on the rural region". This policy is the result of a critical re-appraisal of the development projects of the past, and as a result of the new orientation detailed plans are being highlighted that try to meet the grassroot demands for comparatively small-scale agricultural aid schemes as a more effective approach to assisting the rural population. The request for the Project therefore sums up the wishes and expectations of the local farmers and has been directly made by the PGB as the local government body concerned. It is therefore essential different from the aid projects so far that have been conducted under the guidance of central government. This confers particular importance to the Project, and makes it a unique revolutionary step in that it directly addresses itself to the local farmers.

The content of the Project is equally as novel as it not only centers on the improvement of just the main components in terms of agricultural production and rural development but rather constitutes an overall development plan that the village as an organic functional whole.

The rural can be defined as the production and living space in which the agricultural production base must be harmoniously integrated with the living environments of the rural.

Within the limited domain of the village, the rural population leads its ordinary life and engages in agricultural production, with both aspects forming on inseparable and indivisible whole.

It is also in the nature of agriculture that it constitutes a total system of activities that are, for the most part, closely related to human life and involve the utilization of the natural environment. Take the sowing of seeds and the performance of irrigation tasks, harvesting, and transport (and these tasks can be subdivided further into even smaller tasks). All of these activities are not separate from each other, but are part of a whole series of operations and

activities that pervade the fabric of rural life as integral components inseparable from the whole.

In this sense, it will be difficult to deal with the village and its function as a juxtaposition of variety of independent factors as if agricultural production were separable from the living environment of the rural communities.

If the purpose of development is to improve the functioning of the impoverished rural and breathe a new active life into the rural community, then it would not just be inefficient to develop individual components. Given the particular nature of the rural, such a particularized approach would result in the effect of the improvement of individual components being swamped under the other low-level components that are organically linked to the project. To achieve rural development, it is therefore of the utmost importance to devise total development plans that create an effective platform for development by embracing the following viewpoints.

1) Integral functional whole

Through the provision of the infrastructural prerequisites of rural life, the development plan will have an integral effect, contributing to an improvement in the living conditions of the rural inhabitants on the one hand maintaining and strengthening the functioning of the agricultural production base on the other. For example, through the provision of a rural road system, the ordinary traffic needs for the rural population will be improved and at the same time the rural community will be able to use its agricultural machinery in a more effective and smoother manner as the rural road system that forms the production base is completed.

2) Integral execution

With the implementation of facilities that form the agricultural production base such as irrigation and drainage facilities, the living conditions of the rural population will be improved so as to ensure more effective project execution.

### 3) Integral approach to improving the rural conditions

With the provision of better living conditions, the rural population may expect better living standards, and this will contribute, at the same time, to maintaining and assuring better conditions for agricultural production.

For example, through the provision of rural sewage systems, the living standards of the population within the area will be improved, and this will, at the same time, also contribute to creating the functional requirements for agricultural water and sewage facilities and improvements in the water quality of the agricultural water / sewage needs.

Though the Project area has a high agricultural production potential especially for vegetable cropping, living standards in the area have remained at a low level and agricultural production has been unstable due to some direct detrimental factors and their consequential damaging repercussions. The B / D study, however, is conducted to examine these detrimental factors that are damaging to the development of the region and the many components required for the project to function as an overall rural development plan by allowing for the organic link that exists between all of these factors.

As a result, the components that have been requested as a part of such an overall rural development plan are interlinked and form an integral whole, as can be seen from Fig. 3.2 .1. If any one of these components is missing, it will not be possible to achieve effective rural development. For the achievement of regional development and for an activation of rural life, it is felt that rural development will not be attainable unless all of these components are improved, as shown in the figure and unless each and every components is tackled so that the individual improvements can mutually reinforce themselves to generate positive development.

### (3) Contents of the Project

In this Project, consequently, the following components are necessary to be materialized.

- 1) Drainage improvement (Zone I)
- 2) Irrigation development with ponds, water tanks and wells etc. , construction and rehabilitation of intake facilities, irrigation canals and terminal facilities (Zone I, II and III)

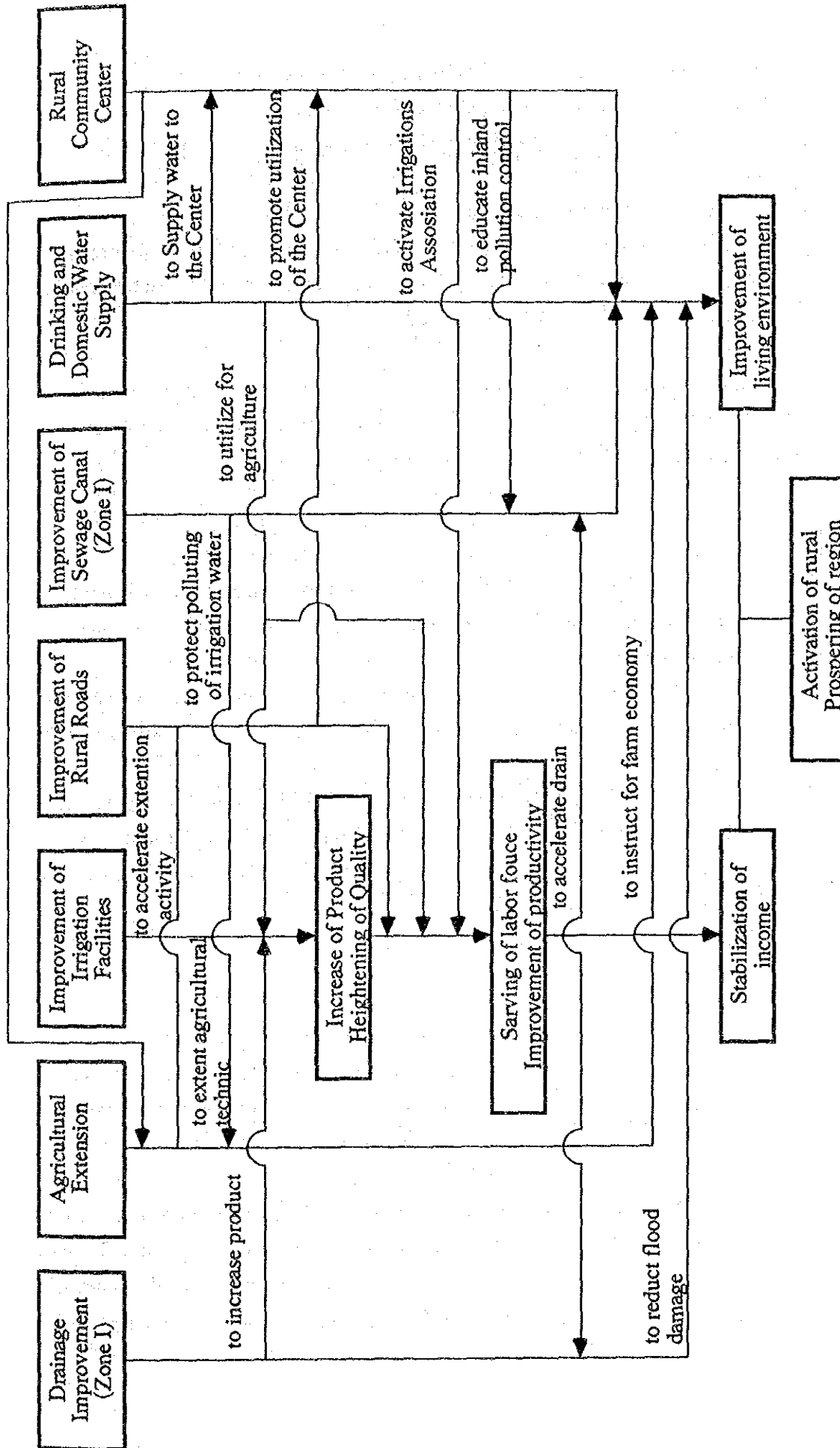


Fig.3.2.1 Basic Concepts of Integrated Rural Development in LT / HIRDP

- 3) Construction of village sewage facilities (Zone I)
- 4) Construction and rehabilitation of roads (Zone II, III)
- 5) Construction of drinking and domestic water supply with deep wells (Zone II, III)
- 6) Construction of community centers (Zone I, II and III)
- 7) Supply of equipments necessary for implementation, operation and maintenance of the Project on transportation, agricultural extension, metrological observation, farm management and water quality testing etc.

In this Basic Design, necessity and feasibility of the contents of these components requested by the GOP (cf. 2.5.3 contents of the request) are examined as a Grant Aid Program, and the following modifications are made to the contents.

a. Planning of irrigation facilities

Concerning the planning of irrigation facilities, fundamental concept of the development in the F/S (basis of the request to Japan) was not changed in the Basic Design.

As difficulty of the land acquisition is restrictive factor of constructing requested ponds, capacities of almost ponds are settled as maximum to be secured as possible.

Concerning construction of terminal facilities, those for minimum 1 ha farmland blocks were proposed in the F/S, but in the Basic Design, those for minimum 5 ha are adopted, in view of giving high public quality to the Project which the Grant Aid Program aims for.

b. Planning of rural roads

Concerning improvement of existing roads, no modification was made except the addition of Cruz-Samuyao route (0.7 km). (Though there is necessity of improvement, this route was omitted in the F/S, for fear that influence of sliding would reach to the road. However, the safety of the route was technically confirmed though the Basic Design studies.)

New construction roads are reduced to 3 routes from 5 routes, as the result of investigation for land acquisition. Planning of paving for new construction roads with gravel in the F/S is changed into that of paving with concrete because of the comparatively steep longitudinal slope, nearly equal to the existing roads near by.

c. Planning of drinking and domestic water supply

In this design, just the same planning as the request is adopted.

d. Planning of drainage improvement

As the result of analysis on drainage of the Project area in the F/S is confirmed to be proper, no big modification is made on the contents of the planning.

In the Basic Design, in principle, the urgent place where there are serious objections are adopted and become the object of the improvement.

Portionally incomplete drainage facilities have been seen. For example, cross road drains in Puguis and Pico need rehabilitation as recommended in the F/S. But, as these facilities actually have function of discharging floods to some extent, and future self-help rehabilitation by e. g. regional government authorities etc. must be possible, and according to the above said principle, these facilities are excluded from the objects of the Project.

e. Planning of sewage facilities

Among the two sewage canals planned in the east and west of Zone I in the F/S, only the eastern sewage canal is adopted, regarding the degree of need.

The western sewage canal is judged to be not so urgent at present, compared with the eastern.

f. Planning of rural electrification

Installation of electric power transmission line (about 6 km length) from existing grid (in Zone I) to unelectrified Zone III was proposed in the F/S. But BENECA has a plan to do the above mentioned installation. This, therefore, is excluded from the objects of the Project.



g. Planning of procurement of equipments

Supply of garbage trucks (dustcarts) seems out of the category of an integrated rural development plan, and is excluded from objects of the Project.

Concerning other equipments proposed in the F / S , the contents of equipments to be procured are modified taking the purpose of utilization and necessity into consideration.

Through the above mentioned studies, objective and effect of implementing the Project is confirmed and the effect of the Project meets to the Grant Aid Program.

The implementation of the Project with Japan's Grant Aid Program, therefore, is concluded to be proper. And to the Project under the Japan's grant Aid Program as a premise, the points of the plan is examined and Basic Design works are carried out .

3.3 Principal features of the Project

Proposed Project area is in rural high land of 1,420 ha and is divided into three (3) zones. The sites of the plenty of facilities to be constructed are spreaded in the whole Project area.

The construction works to be executed in the Project are as follows :

a. Drainage facilities (Zone I)

1)	River improvement (3 streams)	2,500 m
2)	Regulation gates	2 nos
3)	Construction of a consolidation dam	1 set

b. Irrigation facilities (Zone I, II and III)

1)	Intake weirs	9 nos.
2)	Ponds	8 nos.
3)	Strange tanks (including regulation tank)	9 nos.
4)	Small pump stations	4 nos.
5)	Deepwells for irrigation water supply	3 nos.
6)	Division conduits and supplementary conduit from wells (including incidental works)	4,770 m

- |     |  |          |
|-----|--|----------|
| 7)  | Improvement of Bineng CIS irrigation facilities                  | 1 set    |
| 8)  | Lateral conduit  | 23,200 m |
| 9)  | Division tanks   | 80 nos.  |
| 10) | Improvement of distribution facilities at outlet of Dinog - Cave | 1 set    |
- c. Village sewage facilities (Zone I)
- |    |              |         |
|----|--------------|---------|
| 1) | Sewage canal | 2,450 m |
|----|--------------|---------|
- d. Rural roads (Zone II, III)
- |    |                            |         |
|----|----------------------------|---------|
| 1) | Improvement of rural roads | 23.4 km |
| 2) | New construction of roads  | 2.7 km  |
- e. Drinking and domestic water supply facilities (Zone II, III)
- |    |                      |        |
|----|----------------------|--------|
| 1) | Deep-well facilities | 7 nos. |
|----|----------------------|--------|
- f. Rural community center (Zone I, II and III)
- |    |                         |        |
|----|-------------------------|--------|
| 1) | Rural community centers | 7 nos. |
|----|-------------------------|--------|
- g. Equipments to be granted (for operation and maintenance)

Vehicles, equipment for meteorological observation, equipment for water quality testing.

Operation and maintenance of all the facilities after construction will be under control of LT/HIRDP O & M Office which will be established in PGB. Staff of the O & M office will be related technical officials under related government offices, and they will be temporary transferred to the O & M office from their offices. Through the staffs of the O & M office, the related government offices will execute the operation and maintenance of public facilities such as roads and drainage facilities. Operation and maintenance of irrigation and drinking and domestic water supply facilities will be executed by the benefited farmers of the Project area. The O and M office will give the farmers instruction and advices.

Taking these situations into consideration , it is judged that preparations for the implementation of the Project in Philippines side are already completed.

Provided that the Project are completed, the annual costs for operation and maintenance (O & M) is estimated at 1,132,400 pesos. The items of the costs are O & M cost for irrigation facilities at 200,500 pesos mainly made up of pump operation expenses, O & M cost for drinking and domestic water supply facilities at 631,000 pesos made up of well pump operation expenses, O & M cost for rural community centers at 16,900 pesos, and O & M cost for the O & M office at 284,000 pesos respectively.

The O & M cost for irrigation facilities will be borne by farmers as beneficiaries, and about 400 pesos in a year will be required for one farm household assuming that fully depends upon pumps in the dry season. It is judged as bearable for every farmers because that the expense is equivalent to less than 10 % of incremental benefit which can be expected by the completion of the construction for the irrigation facilities.

The O & M cost for drinking and domestic water supply facilities will be also borne by beneficiaries as a water charge. It is inferred bearable for beneficiaries because that the charge is estimated at 3 pesos par one cubic meter of water supply which is almost equivalent to the same of LTWD taking service with in Zone I.

The O & M cost for the O & M office is composed of salary for staffs and expenses for utilization of concerned facilities. As some of the staffs will be assigned from PGB and governmental agencies concern as concurrently serving and PGS's provisions will be utilized in common use, it can be judged for PGB to easily bear with the amount on unstressing scale.

## CHAPTER IV BASIC DESIGN

### 4.1 General for the Basic Design

Basic Design is carried out so as to be suitable on function, economical efficiency and durability.

Construction works of the Project are presented as follows:

#### a. Irrigation facilities

- 1) Intake weir
  - <Zone I> Puguis intake weir
  - <Zone II> Bahong No. 1 intake weir
  - <Zone II> Bahong No. 2 intake weir
  - <Zone II> Bahong No. 3 intake weir
  - <Zone II> Alapang intake weir
  - <Zone II> Alno intake weir
  - <Zone III> Wangal intake weir
  - <Zone III> Bineng intake weir
  - <Zone III> Bineng CIS intake weir
  
- 2) Pond
  - <Zone I> Bayabas pond (inc. small pump station)
  - <Zone I> Puguis storage tank
  - <Zone I> Buyagan ponds (2 nos., inc. small pump station)
  - <Zone I> Buyagan storage tank
  - <Zone II> Bahong No. 1 pond
  - <Zone II> Bahong No. 2 pond
  - <Zone II> Bahong No. 3 storage tank
  - <Zone II> Alapang No. 1 pond
  - <Zone II> Alapang No. 2 storage tank
  - <Zone II> Alapang No. 3 storage tank
  - <Zone II> Peril pond
  - <Zone II> Alno pond
  - <Zone III> Wangal storage tank
  - <Zone III> Bineng storage tank

<Zone III> Bineng CIS regulating tank

3)	Diversion conduit and supplementary conduit from wells for drinking and domestic water supply	4,770 m
4)	Lateral conduit	23,200 m
5)	Division tanks	80 nos.
6)	Wells for irrigation water supply	
	<Zone I> Puguis (Bayagan) deepwell	(Q : 0.45 m <sup>3</sup> /min)
	<Zone I> - do -	(Q : 0.35 m <sup>3</sup> /min)
	<Zone I> Stock farm deepwell	(Q : 0.35 m <sup>3</sup> /min)
7)	Improvement for irrigation facilities of Bineng CIS	
	Improvement of canal	2,030 m
	New construction of canal	1,500 m
	Division works	8 nos.
8)	Improvement of Dinog-cave	L.S.

b. Rural roads

1)	Improvement	23.4 km
	<Zone II> Camp Dangwa - Alno route	4.0 km
	<Zone II> Cruz - Peril route	2.2 km
	<Zone II> Samuyao - Alapang route	1.1 km
	<Zone II> West Alno - East Alno route	1.7 km
	<Zone II> Camp Dangwa - Bahong Proper - Sadag route	3.4 km
	<Zone II> Camp Dangwa - Bahong proper route	0.7 km
	<Zone II> Tomay - Bahong proper route	1.3 km
	<Zone III> Capitol - Bineng Proper - Yapos route	6.4 km
	<Zone III> Bineng Proper - Boleweng route	2.6 km
2)	New construction	2.7 km
	<Zone II> Sadag - East Alno route	1.1 km

<Zone II>	West Alno - Peril route	0.7 km
<Zone III>	Bineng route	0.9 km

c. Drinking and domestic water supply fallibilities

<Zone II>	Bahong deepwells	200 l/min	4 nos.
<Zone II>	Alapang deepwell	200 l/min	1 no.
<Zone III>	Alno deepwell	200 l/min	1 no.
<Zone III>	Bineng deepwell	200 l/min	1 no.

d. Drainage facilities

1)	Balili river improvement	500 m
2)	Bolo creek improvement (inc. sluice gate)	1,400 m
3)	Bayabas creek improvement (inc. sluice gate)	600 m
4)	Consolidation dam (L=36 m)	L.S.

e. Village sewage facilities

1)	Sewage canal	2,450 m
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f. Rural community center

<Zone I>	Puguis	barangay
<Zone I>	Pico	barangay
<Zone II>	Bahong	barangay
<Zone II>	Alapang	barangay
<Zone III>	Alno	barangay
<Zone III>	Bineng	barangay
<Zone III>	Wangal	barangay

g. Equipments to be granted

1)	Vehicles for implementation and O & M	6 nos.
2)	Equipments for O & M	L. S.
3)	Equipments for meteorological observation	L. S.
4)	Equipments for water quality testing	L. S.