Irrigation Project

Priority No.	1	Pinacanauan system rehabilitation
	2	Chico Mallig system development
	3	Dabubu system development
	4	Lulutan system development
	5	Solana system rehabilitation
	6	Gappal system development
	7	Ilagan system development
	8	Tuguegarao system development
	9	Alcala Amulung West system development
	10	Baggao system rehabilitation
	11	Dummom system rehabilitation
	12	Matuno system development
	13	Tumauini system rehabilitation
	14	Zinundungan system development

Hydroelectric Project

Priority No.	1	Matuno No. 1 hydroelectric project
	2	Ibulao hydroelectric project
	3	Tanudan hydroelectric project
	4	Diduyon hydroelectric project

The hydroelectric projects incidental to the irrigation water supply dams are to be also implemented corresponding to the proposed implementation schedule of relevant irrigation projects. In addition to the irrigation projects, agricultural development in the sloped uplands is also to be implemented as recommended.

11.4 Selected Candidate Schemes for Inclusion in the Proposed Master Plan

11.4.1 Principle of Selection

In 2005, the impact of the annual flood damage on the region will depend on the growth of population and the values of assets and is estimated to be ₱8,998 x 10^6 at 1985 current price levels under the present

river condition. A damage amount of around ₱4,500 x 10^6 or 50% of the total is likely to be occurred in the industrial and service sectors according to the flood damage study conducted. The amount is estimated as the opportunity production which would otherwise be derived from industries and services in the flooded areas but would actually be deprived by flooding. In order to ensure the industrial and service GVAs envisioned, it is assumed that 10% of the possible flood damage in industrial and service sectors should be protected in the year 2005. Flood control works to conform to the requirement mentioned above eventually bring about the total flood protection of ₱900 x 10^6 at 1985 current price levels.

In other words, the annual flood control benefit would be ₱900 x 10^6 or more in 2005 at 1985 current price levels. On these lines, it is considered that schemes to be selected in the Master Plan should satisfy this flood control benefit.

In conformity with the policy of the Philippine government, it is assumed that the low lying areas are to be developed fully for agricultural use. Consequently, all the irrigation candidate schemes are scheduled to be implemented by the year 2005. Diversified crops, cattle grazing and permanent crops development are also included in the proposed Master Plan. Further, the improvement of operation and maintenance for the Magat River Integrated Irrigation is being studied. The improvement plan proposed thereby is to be implicated in the proposed Master Plan together with the 14 irrigation plans.

Some hydropower development schemes are selected by the JICA Luzon Hydropower Potential Study on the basis of the least costly alternative method. The implementation of these schemes is imperative because of the projected deficit of power supply in the future. And it is decided to include these schemes in the proposed Master Plan. In addition, secondary purpose hydropower development scheme subordinate to a water supply dam is also included in the proposed Master Plan if the water supply dam is selected in the Plan.

11.4.2 Overall Evaluation of Project

A multipurpose dam serves several schemes with different purposes. A group of these schemes which are correlated with each other by a multipurpose dam is defined as a multipurpose project in this Study. These are the projects of Mallig, Siffu, Matuno and Alimit. Although the Dummon, Paranan and Zinundungan dams have two purposes of irrigation water supply and hydropower generation, the main purpose is irrigation water supply. Accordingly these are defined as single purpose projects.

The schemes included in each multipurpose project are listed as follows;

1) Mallig project : Chico-Mallig irrigation scheme and Mallig flood control scheme

2) Siffu project : Siffu flood control scheme, Siffu hydropower scheme and the supplement of Magat dam (Magat irrigation and M & I water supply)

3) Matuno project : Matuno hydropower scheme, Matuno irrigation scheme, M & I water supply and the supplement of Magat dam (Magat irrigation and M & I water supply)

4) Alimit project : Alimit hydropopower scheme, the supplement of Magat dam (Magat irrigation and M & I water supply) and the compensation of Magat dam (flood control)

Studies of overall costs and benefits show EIRRs of 15.2%, 14.5%, 15.3% and 12.1% for Mallig project, Siffu project, Matuno project and Alimit project respectively. EIRR of a multipurpose project is considered to represent the overall economic viability of the schemes included therein, and the EIRR of each component scheme is revised accordingly by reallocation of costs. The priority order of flood control schemes then

becomes as follows;

Mallig flood control scheme is ranked at 3rd priority and Siffu flood control scheme next to it. The flood control scheme by Magat and Alimit dams is ranked at 5th priority. The order of the rest is not to be changed.

EIRRs of the multipurpose projects are not greatly affected by those of their irrigation schemes and the revision thereof turn out to be insignificant. Consequently the priority order of irrigation schemes previously proposed can stand without any revision.

The supplementing of Magat dam storage is not evaluated nor compared with other schemes. However it is explicit that works supportive of Magat project, the most substantial project in the basin, are among the top priority ones.

11.4.3 Selected Schemes

The priority order of schemes discussed in the previous section is determined by referring to the basic principles of candidates selection presented in 11.4.1. And several schemes are selected for inclusion in the proposed Master Plan.

The principal features of the selected schemes are summarized below;

(1) Multipurpose Projects

1) Siffu project: The project comprises the schemes of Siffu flood control, Siffu hydropower generation and the supplement of the water deficit forecast in Magat reservoir. The project is to be supported by the proposed Siffu No. 1 multipurpose dam with a height of 58 m, an embankment volume of 1,660 x 10^3 m^3, an effective storage capacity of 93 x 10^6 m^3, a flood control space of 115 x 10^6 m^3 and a hydropower generating capacity of 5,400 kW. The layout the proposed dam is presented in Fig. 11.5.

2) Matuno project: The project comprises the schemes of Matuno hydropower generation with a capacity of 180 MW, Matuno irrigation of 12,860 ha, municipal water supply and the supplement of the water deficit forecast in Magat reservoir. The highlight of the project is the proposed Matuno multipurpose dam with a height of 147 m and an effective storage capacity of 97 x 10^6 m^3. The required embankment is 10,000 x 10^3 m^3.

3) Mallig project: The project comprises the schemes of Chico Mallig irrigation with a proposed service area of 31,200 ha and Mallig flood control. In order to support the project, Mallig No. 2 dam, a rockfill dam, with a height of 84 m, an embankment volume of 2,365 x 10^3 m^3, a storage capacity of 545 x 10^6 m^3 and a flood control space of 112 x 10^6 m^3 is proposed. A layout of the proposed dam is presented in Fig. 11.6.

4) Alimit project: The main purpose of the project is to provide a flood control space in the Magat reservoir. In order to subrogate the storage volume of Magat reservoir ceded to flood control volume, Alimit No. 1 dam is proposed. The height of the concrete dam is 89 m with an effective storage capacity of 156 x 10^6 m^3. The concrete volume is estimated to be 647 x 10^3 m^3. The project provides a flood control volume of 139 x 10^6 m^3 to Magat reservoir. Power generation of 12,200 kW is expected. The layout of the proposed dam is presented in Fig. 11.7.

(2) Flood control

1) Tuguegarao dike scheme: The scheme aims at the protection of the town proper in Tuguegarao municipality from the 25-year flood and bank erosion by constructing a confining dike with revetment with a total length of 22.1 km. The estimated quantities of major works are 2,350,000 m^3 of embankment, 190,000 m^2 of revetment and 33 units of drainage sluices.

2) Narrow improvement scheme (Nassiping left bank Site-NLL): The scheme aims at lowering the flood water level by widening the narrow sections in the lower reach of the Cagayan river. The proposed excavation site is located on the left bank of the river, opposite to Nassiping. Estimated excavation volume amounts to 5,830,000 m^3 from the land area of 184,000 m^2.

3) Cabagan dike scheme: The scheme aims at the protection of the town proper in Cabagan Municipality from the 25-year flood and bank erosion by constructing a confining dike with revetment with a total length of 15.4 km. The estimated quantities of major works are 1,240,000 m^3 of embankment, 82,200 m^2 of revetment and 23 units of drainage sluices.

4) Narrow improvement scheme (Nassiping right bank Site-NLR): The scheme aims at lowering the flood water level by widening the narrow sections in the lower reach of the Cagayan river. The proposed excavation site is located at Nassiping on the right bank. Estimated excavation volume amounts to 17,620,000 m^3 from the land area of 985,000 m^2.

5) Bank protection scheme: The scheme aims at protecting the towns and villages, highways, bridges, and other important facilities from damage caused by erosion of river banks. The critical bank erosion sites are located along the Cagayan river and its tributaries. Estimated quantities of works are 838,000 m^2 of revetment and 1,880 units of groynes for the proposed 75 sites.

(3) Agriculture

1) Pinacanauan irrigation scheme: Rehabilitation of the existing system with a service area of 1,200 ha.

2) Chico Mallig irrigation scheme: Service area of 31,200 ha. Mallig No. 2 dam with a height of 84 m, embankment volume of 2,365 x 10^3 m^3, and effective storage of 545 x 10^6 m^3. Transbasin

diversion tunnel with a diameter of 4.0 m and a length of 4.0 km and opencut headrace channel with a length of 1.6 km. Diversion canal with a maximum discharge capacity of 59.3 m^3/s and a length of 34.7 km.

3) Dabubu irrigation scheme: Service area of 1,200 ha. Santo Niño earthfill dam with a height of 18 m, embankment volume of 145.1 x 10^3 m^3. Main canal with a maximum discharge capacity of 1.2 m^3/s and a length of 13.6 km. The layout of the proposed dam is presented in Fig 11.8.

4) Ilagan irrigation scheme: Service area of 3,200 ha. Main canal with a maximum discharge capacity of 7.2 m^3/s and a length of 16.9 km.

5) Solana irrigation scheme: Rehabilitation of existing system with a service area of 2,829 ha.

6) Lulutan irrigation scheme: Service area of 2,950 ha. 4 units of pumps with gross head of 26 m.

7) Gappal irrigation scheme: Service area of 4,400 ha. Santa-Maria, Calaocan and Colorado earthfill dams with heights of 26.5 m, 30.5 m and 32.5 m. Total embankment volume of 1,083.1 x 10^3 m^3. Main canal with a maximum discharge capacity of 5.98 m^3/s and a length of 40.3 km. The layouts of the proposed dams are presented in Figs. 11.9 to 11.11.

8) Alcala-Amulung scheme: Service area of 6,750 ha. 6 units of pumps with gross head of 28.6 m. Main canal with a maximum discharge capacity of 9.4 m^3/s and a length of 27.8 km.

9) Tuguegarao irrigation scheme: Service area of 1,400 ha. Main canal with a maximum discharge capacity of 1.5 m^3/s and a length of 9.5 km.

10) Baggao irrigation scheme: Service area of 1,812 ha. Paranan multipurpose rockfill dam with a height of 50 m and earth embankment volume of 640 x 10^3 m^3. Effective storage volume of 18.1 x 10^6 m^3. Main canal with a maximum discharge capacity of 2.2 m^3/s and a length of 24.8 km. The layout of the proposed dam is presented in Fig. 11.12.

11) Matuno irrigation scheme: Service area of 12,860 ha. Multipurpose rockfill dam with a height of 147 m and embankment volume of 10 x 10^6 m^3. Storage volume of 97 x 10^6 m^3. Main canal with a maximum discharge capacity of 12.6 m^3/s and a length of 90.4 km.

12) Dummun irrigation scheme: Service area of 2,070 ha. Dummon multipurpose rockfill dam with a height of 36 m and embankment volume 493.3 x 10^3 m^3. Effective storage volume of 24.1 x 10^6 m^3. Main canal with a maximum discharge capacity of 4.9 m^3/s and a length of 20.4 km. The layout of the proposed dam is presented in Fig. 11.13.

13) Zinundungan irrigation scheme: Service area of 1,750 ha. Zinundungan multipurpose concrete gravity dam with a height of 48 m and embankment volume of 60.5 x 10^3 m^3. Effective storage capacity of 53.1 x 10^6 m^3. Main canal with a maximum discharge capacity of 5.9 m^3/s and a length of 27.6 km. The layout of the proposed dam is presented in Fig. 11.14.

14) Tumauini irrigation scheme: Service area of 3,987 ha. San Vicente earthfill dam with a height of 30 m and embankment volume of 384 x 10^3 m^3. Storage volume of 6.9 x 10^6 m^3. Main canal with a maximum discharge capacity of 9.2 m^3/s and a length of 23.5 km. The layout of the proposed dam is presented in Fig. 11.15.

15) Diversified crops development: 170,000 ha under rainfed condition

16) Permanent crops development : 57,000 ha with small impounding

17) Pasture land development : 210,000 ha with small impounding

18) Improvement of Magat River Integrated Irrigation System O & M: Improvemnt of O & M for 97,400 ha.

(4) Hydropower

1) Matuno hydropower scheme: Installed capacity of 180 MW. Energy output of 528 GWh. 2 Francis type turbine units with maximum gross head of 220 m.

2) Ibulao hydropower scheme: Installed capacity of 17 MW. Energy output of 85 GWh. 3 Francis type turbine units with gross head of 274 m.

3) Tanudan hydropower scheme: Installed capacity of 25 MW. Energy output of 130 GWh. 2 Francis type turbine units with gross head of 270 m.

4) Diduyon hydropower scheme: Installed capacity of 352 MW Energy output of 957 GWh. 2 Francis type turbine units with maximum gross head of 486 m.

5) Alimit hydropower scheme: Installed capacity of 12.2 MW. Energy output of 80.6 GWh. 2 Francis type turbine units with maximum gross head of 75 m.

6) Siffu hydropower scheme: Installed capacity of 5.4 MW. Energy output of 41.1 GWh. 2 Francis type turbine units with maximum gross head of 40 m.

7) Paranan hydropower scheme: Installed capacity of 0.6 MW. Energy output of 4.96 GWh. 2 Cross flow type turbine units with maximum gross head of 39 m.

8) Dummon hydropower scheme: Installed capacity of 0.6 MW. Energy output of 4.21 GWh. 2 Cross flow type turbine units with maximum gross head of 25 m.

9) Zinundungan hydropower scheme: Installed capacity of 1.4 MW. Energy output of 10.21 GWh. 2 Cross flow type turbine units with maximum gross head of 33 m.

The locations of all the schemes included in the proposed Master Plan are shown in Fig. 11.16.

11.4.4 Implementation Schedule of the Proposed Schemes

The implementation schedule of the proposed schemes is worked out in consideration of the following;

1) The implementation of schemes with same purpose are distributed evenly throughout the period of master planning as much as possible.

2) The annual increase of irrigation service area is made constant as much as possible up to the year 2005.

3) The urgency of schemes from the viewpoint of safety is duly regarded for flood control schemes.

4) The urgency of meeting deficits is taken into account for water supply and hydropower generating schemes.

5) The alternative implementation schedules are studied with regard to the supplemental and compensation dams of the Magat dam. The study shows that the implementation in the order of Siffu No. 1 dam, Matuno No. 1 dam and Alimit No. 1 dam is the optimum one. This study results are to be observed.

6) The improvement plan of the operation and maintenance for the Magat Integrated Irrigation System is discussed in the report titled MASTER

PLAN STUDY ON THE IMPROVEMENT PROJECT OF THE O & M OF MAGAT RIVER INTEGRATED IRRIGATION SYSTEM IN THE REPUBLIC THE PHILIPPINES. This implementation schedule reflects well the proposals mentioned therein.

As for flood control schemes, the Tuguegarao dike and bank protection works are proposed to be implemented first because of the urgency from the safety point of view.

The Pinacanauan irrigation rehabilitation scheme is proposed to be implemented first because of ease of implementation and expected high return. The largest Chico-Mallig irrigation scheme follows in second place in accordance with the implementation of Mallig multipurpose project.

Because the water deficit forecast in the Magat project is considered to be significant, the Siffu multipurpose project is proposed as the first multipurpose project to supplement the deficit. The Matuno multipurpose project is proposed as the second project which is to share a partial function of the Magat dam. The dam should be completed by the year 1997 in order to satisfy the power demand of Luzon grid.

The implementation schedules of these schemes are presented in Fig. 11.17. The financial costs to be incurred are disbursed over the target period of the Master Plan as shown in Table 11.2.

11.5 Assessment of the Proposed Water Resources Development Master Plan

11.5.1 Impact to the Regional Water Demand and Supply Balance

As described before, certain areas are subject to the water deficit even at present, especially at the existing irrigation system sites. According to the results of water demand and supply balance study, a deficit of 40×10^6 m^3 is estimated at the Chico irrigation intake site in the year 1985 and 15×10^6 m^3 at the Chico West intake site with recurrence interval of 5 years. Same deficit of 7×10^6 m^3 is incurred at the existing Tumauini irrigation intake site. The estimated 1/5 probable annual water deficits at the existing Paranan, Zinundungan and Dummon

irrigation intake sites are 6 x 10^6 m^3, 14 x 10^6 m^3 and 16 x 10^6 m^3 respectively. There are some more deficits and the global water deficit in the Cagayan river basin is estimated to be 109 x 10^6 m^3 in 1985 if no water resources development project is implemented. The deficit is to be covered completely by the proposed Master Plan except for the deficit of 5 x 10^6 m^3 in the Chico river, in which no water resources development is proposed because of the present social circumstances.

The water deficit is projected to grow year by year in accordance with the increase of water demand due to the population and economic growths.

The proposed water resources development master plan will to augment the low flows by means of flow regulating dams to be provided and to dissipate the water deficit. The global water demand will be 7,181 x 10^6 m^3 in 2005 and this demand will incur a global 5-year water deficit of 1,373 x 10^6 m^3 within the Cagayan river basin unless a water source is developed. The Master Plan will reduce the deficit to 11 x 10^6 m^3 including the deficits in the Chico river.

The reliable water supply will help to increase the productivity of agriculture, industry and services in the study area. And accordingly the living standard of the people will be improved. The year-round agricultural production activities will bring about stable job opportunities to the local people. The regulation of river flow by the proposed dams will control the flood discharge and will mitigate flood damages. Since the Master Plan provides for river maintenance flow, the normal functions of river will be secured. This is considered to be effective to maintain the environmental conditions of the river basin. The reliable water supply will improve the sanitary conditions of the residents.

11.5.2 Socio-Economic Impact of the Proposed Master Plan

(1) Improvement of living standards

Upon completion of the proposed projects, the living standards of the people in the basin will be improved because their family income will increase in proportion to the rise of regional economy as mentioned in Section 3.2.4. The level of the living standards should reach the average level of the country excluding NCR and Region IV, which is the target of the proposed Master Plan.

Thus, the agencies concerned should endeavor to help the people to improve the quality of their lives through increased income and improvement of industrial productivity by means of appropriate incentives.

(2) Improvement of social activities and development of community

The recurrent disasters by flooding hinder development of improved agricultural systems. The flood control measures proposed will serve to remedy the problem. The number of people who will be relieved from flooding by the proposed Master Plan is estimated to be 462,000 persons or 84,000 families by the year 2005 in case a flood with a return period of 2 years occurs. The area to be protected is estimated to be 50,000 ha.

The present electrification ratio is as low as 40% in the basin. The proposed hydropower schemes will help to raise the ratio especially in the rural area.

With the implementation of the projects, social development will be accelerated. For instance, the density of roads, in the region, is 0.336 km/km^2, the lowest among all regions as of 1984. Health facilities, represented by hospital beds per thousand inhabitants was 1.2 in 1984, which is far below the standard (5.0 hospital beds per thousand people) recommended by WHO. These supporting systems will be considerably improved by the end of the target year. Such improvements will further promote economic development.

(3) Inequality of income distribution and redistribution policy

After completion of the proposed projects, the people in the project area will gain the fruits of development. For instance, net farm income under new irrigation schemes is expected to increase by 3.8-8.7 times the present income. Even in rehabilitation schemes, it is expected to increase by 3.4-4.7 times. The better the proposed projects go on, the bigger becomes the difference in farm income between inside the project areas and outside thereof. Although it will provide an incentive for increasing agricultural productivity, inequality of income distribution is inevitable in the course of implementing the projects. In this context, a redistribution policy will be quite important in order to attain more equitable distribution of the fruits of development. In selection of such a redistribution policy, the real disparities should be taken into consideration not only in the agricultural sector but also in the economic sectors. The essence of this policy must be stimulation of activities in the private sector.

(4) Promotion of related industries and creation of job opportunities

In order that industry was grow soundly, it is essential to promote industries related to and supporting the main industry. In the agriculture sector, for example such activity would include: rice-mills, fertilizer production, agricultural implements, food canning, etc. These related industries can be clarified by means of inter-industrial relationship analysis in the basin. In any case, the agencies concerned should endeavor to promote these supporting industries as well as the main industry. According to the results of a preliminary Input Output Analysis using the inverse matrix prepared by NEDA for the economic data in 1978, the factor of GVA induction is estimated to be 1.01 for construction works. This implies all the schemes proposed herein will have much more economic impacts than that measured by means of EIRRs. Accordingly it may be no exaggeration to say that all the schemes considered in this report are economically feasible even though some of them may have low EIRRs.

In this respect, the construction of the proposed projects creates opportunities of temporary jobs during the construction period. These temporary workers and some construction materials will be supplied from areas inside and outside the basin, and supporting services and other materials for these construction works are procured in the basin. These supporting businesses result in creating job opportunities. Incidentally, requirement of labour in the region in the year 2005 is estimated on the basis of the labour requirement by sector in 1980 as follows, on the assumption that per labour GVAs of main sectors grow in proportion to the growth of per capita GRDP: 550×10^3 in the agricultural sector; 80×10^3 in the industrial sector; and 250×10^3 in the services sector. The expected number of labour force would be 880×10^3 in total. Since the population in productive ages is estimated to be $2,070 \times 10^3$ and the labour participation rate is assumed to be about 55%, the labour force would be $1,140 \times 10^3$ and can be supplied sufficiently within the region even in the year 2005.

(5) Strengthening of related authorities to support the productivity

Although implementation of the projects is essential to improve economic conditions in the basin, maintenance of the improved conditions is as important as implementation activity. Functions of supporting authorities and agencies are summarized as follows: (a) operation and maintenance of facilities constructed under the projects; (b) guidance and instruction on technological innovation for improvement of productivity; (c) organization and propagation of private cooperation for marketing and purchasing; and (d) management of credit service programs. Since authorities and agencies in charge of new systems and new facilities have little experience in operation and maintenance, it seems to be difficult for them to maintain and activate themselves efficiently. In order to operate and to maintain the implemented projects, the competent authorities should strengthen themselves at first. For this purpose, the staffs of the authorities have to make every effort to improve themselves and to exchange the acquired know-how with each other. In other words, the implementation, operation and maintenance will stimulate and promote the eventual technical improvement in the region.

11.5.3 Environmental Assessment

(1) Environmentally Critical Projects

The environmental impact of the Master Plan is assessed in compliance with the Philippine Environmental Impact Statement System. The DPWH established a guideline for the assessment to specify the environmentally critical projects and areas. If a project falls within a critical category or is located in a critical area, a regular Environmental Impact Assessment (EIA) is necessary. Along these lines, it is judged necessary to study the environmental impacts of dam, hydropower, agricultural development such as livestock and irrigation, and river improvement works.

(2) Aspects to be Assessed

The aspects to be assessed for the proposed Projects were selected according to guidelines for EIA and the characteristics of each contemplated scheme. Although various aspects are considered, Air Pollution, Noise Vibration Hazard, and Offensive Odors are omitted because of their temporary or slight impacts to the environment. Also, aspects of Climate, Compensation and Resettlement, and Economic Activities being assessed separately in the relevant sectoral studies, are not discussed in this section. Consequently, only the following 6 aspects are included in the EIA for the Project:

1) Land
2) Water
3) Fauna and Flora
4) Areas of Aesthetic or Academic Potential
5) Cultural Communities or Tribes
6) Public Health

(3) Preliminary Assessment

In the Cagayan river basin, noteworthy areas are forest reserves (See Fig. 11.18), national parks, bird sanctuaries and habitats of endangered species (See Fig. 11.19). In addition to those of the noteworthy areas, attention must be paid to malaria endemic area.

Site reconnaissance surveys and preliminary analysis of data relating to the environmental aspects mentioned in the previous section reveal the following possibilities of environmental impacts;

Dam scheme

Mallig No. 2 dam has the possibility of suffering eutrophication of the reservoir. Mallig No. 2, Siffu No. 1, Disabungan, Alimit No. 1 and Matuno No. 1 dams are located in the watershed forest reserves and forest reserves. (See Fig. 11.18)

Diduyon and Casecnan dams would be located in the habitats of some endangered species, such as the Philippine Deer and Blue-naped Parrot. (See Fig. 11.19)

Moreover Mallig No. 2, Siffu No. 1 and Disabungan dams may cause interruption to migration of a kind of fish, a kind of Mullet, called Ludong in the Philippines. (See Fig. 11.19)

As for public health, it is possible that the proposed dams would provide new habitats for vectors related to water-borne parasitic diseases such as malaria and dengi fever. Mallig No. 2, Siffu No. 1, Disabungan and Matuno No. 1 dams may have some impacts on public health in and around the project areas.

Dams will ensure river maintenance flow and will avoid extremes of drought. Thereby improving the environment for some fauna and flora. Dams will also mitigate the sediment load of the river by the trap effects thereof.

The improvement of sanitary conditions will be one of the main indirect benefits of a flood control scheme. As mentioned before the provision of dams for flood control will have such incidental effects.

River improvement scheme

As for the proposed river improvement schemes, it is considered that there will be only two principal impacts on the environment of the project area. These will be on the prime agricultural lands and on the public health.

Agricultural development

It is not considered that the proposed agriculture development will cause any serious problems for the environment. However, proper management and maintenance will be needed to minimize the environmental deterioration, such as soil erosion due to over-grazing, pollution of water by chemicals and epidemics of several infectious diseases due to unhygienic management of livestock farming.

As a whole, the impacts of the selected schemes on the environment are positive. There may be some negative effects although they are deemed to be insignificant.

XII SHORT TERM PLAN

12.1 Short Term Plan

The early implementation of certain schemes included in the proposed Master Plan is necessary in order to secure the safety, and to ensure the achievement of the contemplated socio-economic development target. These schemes are examined and identified among the schemes recommended in the proposed Master Plan in order to formulate the Short Term Plan. The necessary action plan for implementation of these schemes is envisaged and recommended herein. In principle, schemes which are programmed to be implemented before 1995 are selected as components of the proposed Short Term Plan.

In addition to the schemes discussed above, the model schemes of a small dam and a pond are also included in the proposed Short Term Plan as pilot schemes. These pilot schemes are expected to furnish valuable information regarding the development of the uplands which is considered as one of the most urgent and key measures for development of the Cagayan river basin.

12.2 Selected Projects and Schemes

The selected multipurpose projects are Mallig multipurpose project, Siffu multipurpose project and Matuno multipurpose project. The multipurpose projects comprise Siffu flood control scheme, Mallig flood control scheme, Chico Mallig irrigation scheme, Matuno irrigation scheme, Matuno hydropower scheme and Siffu hydropower scheme. In order to support these schemes, Mallig No. 2 dam, Siffu No. 1 dam and Matuno No. 1 dam are required.

The selected specific flood control schemes are Tuguegarao dike and the narrows improvement scheme of Nassiping left bank (Site-NLL). The bank protection works are also included in the proposed Short Term Plan.

The selected single purpose agricultural schemes are Pinacanauan rehabilitation scheme and Dabubu irrigation development scheme. Provision of a small dam is necessary to suffice water demand of Dabubu irrigation. Further, agricultural development in upland in the vicinity of the proposed Santor dam and Carmencita pond is to be included as pilot schemes. These proposed pilot schemes will furnish important and useful data for upland development. And thereby they will contribute much to the execution of the Master Plan Study on the upland development in the Cagayan river basin as proposed by DAF. The layout plans of the pilot schemes are presented in Fig. 12.1 and Fig. 12.2.

No single purpose hydropower development scheme is included in the Short Term Plan because all the hydropower development schemes are included in the proposed multipurpose projects.

12.3 Action Plan and Implementation Schedule

Since the projects and schemes proposed herein are to be implemented in the early stages, prompt actions are required in this respect. The necessary actions are identified for each project and scheme as presented below.

(1) Mallig Multipurpose Project

1) Clarification of the scope of works and preparation of a Project Proposal and Terms of Reference for feasibility study.

2) Budgetary arrangement for topographic surveys

- Irrigation area of 31,200 ha (1:5,000)
- Profile and cross section surveys along the proposed canal with a length of 135 km
- Damsites of 100 ha (1:500)

3) Budgetary arrangement for core drilling

- Damsites (300 m)
- Along the proposed tunnel alignment (800 m)

(2) Siffu Multipurpose Project

1) Clarification of scope of works and preparation of a Project Proposal and a Terms of Reference for feasibility study.

2) Topographic surveys

- Damsite of 100 ha (1:500)
- Along the river of 15,000 ha (1:5,000)

3) Geological survey at the proposed damsite

- Core drilling (400 m)

4) Asset surveys in the proposed reservoir area.

(3) Matuno Multipurpose Project

1) Clarification of scope of works and preparation of a Project Proposal and a Terms of Reference for detailed design including a review of the feasibility studies.

2) Arrangement of finance sources for the project implementation.

(4) Tuguegarao Dike Scheme

1) Preparation of Project Proposal and Terms of Reference for feasibility study.

2) Topographic surveys in the town of Tuguegarao and its hinterlands to be protected by the proposed dike (scale: 1 to 5,000).

3) Cross sectional surveys of the Cagayan river for 30 km from about 12 km downstream of Buntun bridge toward upstream reach at intervals of 200 m.

4) Cross sectional surveys of the Tuguegarao river for about 10 km long from the confluence toward upstream reach at 200 m intervals.

(5) Narrows Improvement Scheme on Nassiping Left Bank

1) Preparation of Project Proposal and Terms of Reference for feasibility study.

2) Cross-sectional survey of the Cagayan river from the river mouth to Tuguegarao at intervals of 200 m.

3) River bed profile surveys in 3 longitudinal lines extending from Lalo to Alcala by echo sounder.

4) Topographic surveys of 400 ha in the proposed excavation area (scale: 1 to 5,000).

5) Boring and subsurface soundings of the proposed excavation site.

(6) Bank Protection Scheme

1) Inventory survey of proposed bank protection sites and their priorities.

2) Preparation of Project Proposal and Terms of Reference for detailed design.

3) Financial arrangement for implementation.

(7) Pinacanauan Rehabilitation Scheme

1) Preparation of a Project Proposal and a Terms of Reference for detailed design.

2) Topographic surveys in the project area of around 1,500 ha (1:5,000)

(8) Dabubu Irrigation Scheme

1) Preparation of a Project Proposal and a Terms of Reference for feasibility study.

2) Topographic surveys

- Irrigation area of 1,000 ha (1:5,000)
- Damsite of 50 ha (1:500)
- Cross sectional surveys along the proposed main canal of 13.6 km

3) Budgetary arrangement for core drilling (200 m)

(9) Santor Dam and Carmencita Pond Schemes

1) Preparation of Project Proposals and Terms of Reference for feasibility studies.

2) Topographic surveys at damsite and pond site (1:500)

3) Core drilling at the damsite and the pond site (200 m each)

4) Financial arrangements for detailed design and project implementation.

The implementation of the pilot schemes (Santor dam and Carmencita Pond schemes) will contribute much to development of upland areas if it is well coordinated with the Master Plan Study on the Upland Development

promoted by DAF, The implementation schedules are studied and presented in Fig. 12.3.

TABLES

Table 1.1 List of Members of the Steering Committee

OSCAR L. RODRIGUEZ (From Oct.1985 to July 1986) Deputy Minister, MPWH	Chairman
TEODORO G. GENER (From Aug.1986 to July 1987) Undersecretary, DPWH	Chairman
TEODORO T. ENCARNACION Undersecretary, DPWH	Vice-Chairman
JOSE B. DEL ROSARIO (From Oct.1985 to June 1, 1986) Asst. Administrator, NIA	Member
JOSE PENDOZA Regional Director, Region II, DPWH	Member
DR. ANGEL ALEJANDRINO Executive Director, NWRC	Member
JESUS M. SUNGA Director, Infrastructure Staff, NEDA	Member (by invitation)
LIRIO ABUYUAN Regional Director, Region II, NEDA	Member (by invitation)
MARCIANO C. AVENDANO Manager, Hydropower Project Department NAPOCOR	Member (by invitation)
GUMERSINDO LASAM Director, Region II Department of Agriculture and Food	Member (by invitation)
EDMUND V. CORTES (From Oct. 1985 to March 1986) Director, Bureau of Forest Development, MNR	Member (by invitation)
DR. ROMAN L. KINTANAR Administrator, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Member (by invitation)

Table 1.2 List of Members of Advisory Committee and Technical Working Group

Designation	Name	Agency
ADVISORY COMMITTEE		
Project Manager IV	Antonio A. Alpasan	Project Management Office for Major Flood Control Projects, DPWH
Chief	Trino-Trinicad G. Meris	Planning Service DPWH
Project Manager III	Roger A. Flores	Project Management Office for Major Flood Control Projects, DPWH
TECHNICAL WORKING GROUP		
Chief Civil Engineer	Jose C. Guanzon (Chairman, TWG)	DPWH
Head Civil Engineer	Manuel S. Alconis	DPWH
Assistant Chief	Rawlinson B. Dimayuga	Water Resources Division Infrastructure Staff NEDA
Division Manager	Isidro R. Digal (Co-Chairman, TWG)	NIA
Chief Water Resources Staff Officer	Melchor O. Baltazar	NWRC
Chief	Lorenzo V. Guillermo	Watershed Division BFD
Desk Officer	Alex M. Laurecio	BFD
Director	Cipriano C. Ferraris	NFFO, Director PAGASA
Division Chief	Rodolfo C. dela Cruz	NAPOCOR
Principal Engr. C	Patricia L. Lopez	NAPOCOR
Regional Soil Technologist	Teofilo C. Ferraris	DAF, Region II
Head	Edilberto Davis	Infrastructure Sector NEDA, Region II

(to be continued)

(Continuation)

Designation	Name	Agency
Assistant Head	Pablo Carbonell	Infrastructure Sector NEDA, Region II
Supervising C.E.III	Cecilia de Veyra	DPWH, Region II

Note: DPWH, Region II Representative will be assigned in addition to the above.

Table 1.3 List of Counterpart Officer

Position	Agency	Name
Project Manager	DPWH	Jose C. Guanzon
Deputy Project Manager	DPWH	Manuel S. Alconis
Chief Engineer	DPWH	Malaquias L. Santos
Head, Plan'g/Admin. Staff	DPWH	Oscar L. Astraquillo
Planning Engineer	DPWH	Rebecca T. Garsuta
Highway Engineer	DPWH	Antonio G. Alejo
River Engineer	DPWH	Ricardo E. Fabian
River Engineer	DPWH	Ignacia M. Ramos
Hydrologist	DPWH	Carlos P. Zamora
Hydro Planner	NAPOCOR	Patricia Lopez
Hydrologist	NAPOCOR	Nilda Santiago
Hydrologist	DPWH	Napoleon S. Famadico
Hydrologist	NWRC	Jorge Estioko
Dam Design Engineer	NIA	Cesar Ramos
Dam Design Engineer	NAPOCOR	Angelo V. Vicuna
Geologist	NAPOCOR	Johnny Tolentino
Geologist	NIA	Pablito Supnet
Agronomist	DAF	Antonio Riazonda
Agro-Economist	DAF	Esmenia Gurat
Agro-Economist	NWRC	Francis Hilarie
Irrigation Engineer	NIA	Asterio M. Dagang
Irrigation Engineer	NIA	Cesar F. Carbonell
Economist	NEDA	Lirio Calixto
Economist	NEDA	Segundo Salvador
Economist	DPWH	Jesus O. Averilla
Struct'l/Locating Engr.	DPWH	Jaime L. Samaniego
Survey Expert	DPWH	Noel Barquez
Survey Expert	DPWH R-II	Melanio Briosos
Environmental Expert	DPWH	Belinda L. Fajardo
Environmentalist	DPWH	Marilyn Aquino

Table 1.4 List of Advisory Committee Members (including JICA Coordinator)

Designation	Name	Agency
Chairman	S. Nakamura	River Bureau, Ministry of Construction, Japan
Water Resources Development	T. Uesaka	River Bureau, Ministry of Construction, Japan
Flood Control (Apr. '86 - Jun. '86)	T. Sunakawa	River Bureau, Ministry of Construction, Japan
Flood Control (July '86 - Mar. '87)	S. Fukuda	River Bureau, Ministry of Construction, Japan
Hydrology and Hydraulics	M. Kuriki	Chubu Regional construction Bureau, Ministry of Construction, Japan
Irrigation and Drainage	N. Kanamori	Agriculture Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries, japan
Agronomy	K. Sakai	Agriculture Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries, Japan
JICA Coordinator	H. Kutsuna	Social Development Cooperation Department, JICA

Table 1.5 Officials of Japanese Embassy and JICA Philippines

Designation	Name	Agency
First Secretary	Y. Motoda	Embassit to the Philippines
"	Y. Nakajo	"
Colombo Plan Expert	I. Seko	DPWH (JICA)
"	T. Kawakami	" (")
"	Y. Mishima	NIA (")
"	N. Tamura	" (")
"	O. Umekawa	" (")
	Y. Okazaki	JICA Philippines

Table 2.1 Socio-Economic Profile of the Cagayan River Basin

Item	Unit	Country	Basin	Share (%)
I. Population (1980)				
1) Total	10^3	48,317	1,885	3.9
2) Rural Population	10^3	30,291	1,568	5.2
3) Share of the above in total	%	62.7	84.1	-
4) Total Labor Force	10^3	14,174	542	3.8
5) Agricultural Labor Force				
- Agriculture	10^3	6,513	383	5.9
- Forestry	10^3	708	6	0.9
- Fishery	10^3	73	8	11.0
- Others	10^3	1	-	-
Total	10^3	7,295	397	5.4
6) Shaer of the above in total	%	51.5	73.2	-
II. GDP (1984)				
1) Total	₱10^6	95,555	2,360	2.5
2) Contribution to GDP				
- Agriculture	₱10^6	15,594	747	4.8
(Paddy)	₱10^6	(4,172)	(448)	(10.7)
(Corn)	₱10^6	(1,469)	(130)	(8.9)
(Others)	₱10^6	(9,953)	(299)	(3.0)
- Livestock	₱10^6	4,748	231	4.9
- Fishery	₱10^6	4,032	16	0.4
- Forestry	₱10^6	671	178	26.5
Total		25,045	1,172	4.7
3) Share of the above in total GDP	%	26.2	49.7	-
4) Agricultural Labor Productivity	₱	2,394	1,645	68.7
III. Land Use				
1) Total Area	km^2	300,000	27,300	9.1
2) Agricultural Land				
- Temporary crops	km^2	44,880	3,773	8.4
- Permanent crops	km^2	33,130	270	0.8
- Pasture	km^2	6,100	1,269	20.8
- Others	km^2	6,230	27	0.4
Total		90,340	5,339	5.9
3) Share of the above in total area	%	30.1	19.6	-

Table 3.1 Runoff Estimation

(Unit: $x10^8 m^3$)

Year	Upper Cagayan			Magat			Ilagan			Siffu-Mallig			Chico			Whole Basin		
	Jan. → May	June → Dec.	Annual	Jan. → May	June → Dec.	Annual	Jan. → May	June → Dec.	Annual	Jan. → May	June → Dec.	Annual	Jan. → May	June → Dec.	Annual	Jan. → May	June → Dec.	Annual
1963	16.6	100.2	116.8	10.5	80.0	90.5	8.5	48.0	56.5	3.4	26.1	29.6	9.2	56.2	65.4	56.7	369.4	426.1
1964	20.3	128.4	148.7	16.1	102.8	118.9	11.9	61.2	73.1	5.3	33.6	38.9	9.5	95.8	105.3	72.7	552.4	625.1
1965	18.2	50.7	68.9	25.5	44.8	70.3	13.1	24.2	37.3	8.3	14.6	23.0	23.1	54.5	77.6	111.9	257.1	369.0
1966	16.8	78.3	95.2	15.1	55.8	71.0	9.1	36.2	45.4	4.9	18.2	23.2	20.9	66.0	87.0	91.0	353.1	444.1
1967	21.0	46.4	67.4	18.3	66.6	84.8	13.3	21.6	34.8	6.0	21.8	27.7	11.5	97.0	108.5	95.1	358.1	453.1
1968	10.1	62.7	72.7	24.3	71.4	95.7	5.9	29.0	34.9	7.9	23.3	31.3	15.4	79.6	95.0	74.6	342.2	416.7
1969	10.6	66.7	77.3	10.5	26.3	36.9	6.1	30.0	36.1	3.4	8.6	12.1	11.0	71.5	82.6	49.0	275.1	324.1
1970	18.1	85.6	103.7	19.4	79.4	98.8	10.8	39.2	50.1	6.3	26.0	32.3	20.9	79.5	100.4	94.9	395.8	490.7
1971	30.8	182.0	212.8	33.7	92.4	126.2	16.9	87.4	104.3	11.0	30.2	41.2	11.4	77.8	89.1	118.6	601.8	720.4
1972	50.2	42.5	92.8	25.1	46.4	71.5	29.5	24.4	53.9	8.2	15.2	23.4	20.7	52.0	72.7	162.4	232.8	395.3
1973	11.8	120.3	132.0	9.7	74.8	84.5	8.3	57.2	65.5	3.2	24.4	27.6	12.8	85.9	98.7	54.1	479.2	533.3
1974	19.6	122.6	142.2	10.6	60.9	71.6	13.1	58.1	71.3	3.5	19.9	23.4	17.6	82.6	100.2	83.1	443.1	526.2
1975	23.9	48.6	72.5	17.9	29.5	47.3	15.5	22.9	38.4	5.8	9.6	15.5	17.6	57.3	74.9	98.9	238.0	336.8
1976	23.3	90.1	113.4	27.4	70.2	97.6	12.4	42.2	54.6	8.9	22.9	31.9	12.9	63.7	76.7	101.8	358.2	460.0
1977	22.0	32.0	54.0	17.3	51.9	69.2	13.1	15.2	28.3	5.7	17.0	22.6	8.4	58.7	67.1	77.1	253.6	330.7
1978	9.5	59.6	69.1	10.6	70.1	80.7	5.2	27.0	32.2	3.5	22.9	26.4	7.4	60.4	67.8	46.6	330.9	377.5
1979	18.1	78.7	96.8	18.5	72.0	90.5	9.4	38.0	47.4	6.0	23.5	29.6	10.5	34.2	44.8	76.2	304.1	380.3
1980	10.3	49.1	59.4	20.3	62.9	83.2	6.4	22.3	28.7	6.6	20.6	27.2	15.9	63.4	79.3	74.4	297.9	372.2
1981	10.3	58.3	68.6	29.2	93.7	122.9	6.5	26.1	32.6	9.6	30.6	40.2	12.6	60.1	72.6	82.4	347.4	429.9
1982	8.6	34.0	42.6	33.8	58.3	92.2	5.6	14.4	20.0	11.0	19.1	30.1	10.3	50.8	61.1	82.9	235.4	318.4
1983	12.3	22.7	35.0	9.1	31.3	40.4	6.2	10.2	16.3	3.0	10.2	13.2	8.3	41.2	49.5	50.1	158.0	208.2
1984	16.7	64.9	81.5	23.8	54.2	78.1	6.9	30.0	36.9	7.8	17.7	25.5	14.8	53.5	68.3	85.4	298.5	383.9
Average	18.1	73.8	91.9	19.4	63.4	82.8	10.6	34.8	45.4	6.3	20.7	27.0	13.8	65.5	79.3	83.6	340.1	423.7
Sub-basin	▽1 ~ ▽12			▽13 ~ ▽20			▽22 ~ ▽26			▽28 ~ ▽31			▽40 ~ ▽49					
Drainage Area (km^2)	6,633			5,113			3,132			2,015			4,551			27,281		

Table 3.2 Comparison of Calculated Monthly Runoff with Observed or Studied One

(Unit: m^3/s)

Basin 1 at Palattao (6626 km^2) 1963-1967, 1969-71

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	223	155	124	83	144	353	370	367	394	554	784	675	353
Observed :	211	154	162	83	206	224	331	341	430	690	1095	732	389

Basin 1 at Casecnan Damsite (1150 km^2) 1963-79

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	48	32	23	20	39	72	64	72	77	110	149	111	68
Studied :	67	36	32	26	33	44	62	65	89	125	136	113	69

Basin 2 at Hapid (606 km^2) 1965-66 , 1968-69

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	27	21	14	20	31	61	59	71	56	40	69	58	44
Observed :	25	18	14	11	32	43	77	90	78	47	63	34	45

Basin 2 at Magat Damsite (4143 km^2) 1963-84

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	145	93	85	103	214	267	279	317	327	343	327	226	228
Studied :	134	122	78	81	175	210	305	338	399	408	329	200	232

Basin 2 at Siffu Diversion Damsite (627 km^2) 1963-72

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	28	16	12	13	26	38	45	50	47	45	53	44	35
Studied :	22	14	13	15	24	40	57	54	62	61	62	38	38

Basin 2 at Matuno Damsite (550 km^2) 1963-76

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	28	17	14	13	28	41	41	52	51	52	54	44	36
Studied :	30	19	16	15	27	39	52	55	58	61	52	37	38

Basin 3 at Dipalin (198 km^2) 1966-68

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	8	6	4	4	6	12	8	12	10	9	17	16	9
Observed :	9	7	6	6	7	7	6	7	9	12	17	20	10

Basin 4 a: Calaoagan (308 km^2) 1965-70

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	7	4	3	5	8	13	19	23	18	22	23	14	13
Observed	7	5	3	6	4	10	19	29	13	34	22	10	14

Basin 4 a: Calantac (907 km^2) 1963-66

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	27	19	12	8	37	51	93	95	77	56	153	102	61
Observed :	60	31	12	8	46	21	72	30	72	114	77	194	62

Basin 4 at Antagan (170 km^2) 1965-71

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	7	5	3	4	7	12	19	21	18	25	29	17	14
Observed	18	9	9	5	8	10	12	16	9	26	37	36	16

Basin 5 at Chico 4 Damsite (1410 km^2) 1963-84

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	30	20	14	28	87	119	159	151	151	123	97	53	86
Studied :	34	21	16	26	83	129	168	154	131	106	113	57	86

Basin 6 at Escolta (655 km^2) 1965-72

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Calculated:	20	12	8	16	34	38	53	62	49	57	60	37	37
Observed :	25	19	15	17	25	28	48	41	42	65	57	45	36

Table 3.3 Probable Basin Mean Rainfall in the Base Points

(Unit: mm)

Basin	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/1,000	1/10,000
1-day Probable Rainfall									
Casecnan	155	248	328	400	480	560	650	900	1,250
Cagayan No. 2	150	241	321	390	470	550	640	890	1,250
Cagayan No. 1	138	223	298	360	440	510	620	840	1,200
Diduyon	149	239	316	420	510	600	700	980	1,400
Addalam (A)	115	183	236	315	382	457	539	768	1,209
Matuno No. 1	117	153	176	205	226	247	267	316	386
Alimit No. 1 (A)	83	114	137	168	193	219	247	319	443
Magat	91	123	144	169	188	207	227	272	339
Ilagan No. 1	135	201	247	310	358	408	461	591	804
Disabungan	135	201	251	321	377	439	505	681	998
Siffu No 1 (A)	68	103	128	161	187	214	242	312	426
Mallig No. 2	76	111	136	169	194	221	248	316	427
Chico No. 2	124	171	202	242	271	301	331	403	511
Chico No. 4	97	144	177	220	253	287	323	410	549
Pinukpuk	88	127	153	188	215	242	270	337	444
4-day Probable Rainfall									
Base Point No. 1	168	217	248	286	314	341			
Base Point No. 2	170	229	267	315	351	386			
Base Point No. 3	178	244	288	344	385	427			
Base Point No. 4	188	261	310	372	419	466			
Base Point No. 5	204	285	340	409	462	515			
Base Point No. 6	169	233	276	330	371	412			
Base Point No. 7	165	220	256	301	335	367			
Base Point No. 8	191	264	313	375	421	468			
Base Point No. 9	177	241	283	336	376	416			

Table 3.4 Water Quality in Cagayan River

LOCATION	TURBIDITY	COLOR	pH	EC	HARDNESS			Cl	ALKALINITY		
				μmhos /cm	Ca ppm	Mg ppm	Total ppm	ppm	Bicarb ppm	Carb ppm	CaCo3 ppm
Larion Alto, Tuguegarao	nil	nil	7.20	157	65	15.79	130	70	134.2	0	110
	nil	5	7.70	191	130	15.80	145	120	164.7	0	135
Casile, Mallig	11	55	6.92	190	80	0	100	70	94.5	0	77.5
	107	1,000	7.29	201	110	4.86	100	115	122	0	100
Malalam (Alinguigan)	nil	nil	6.94	85	60	0	70	70	97.6	0	80
	7	30	7.15	115	100	8.50	135	115	134.3	0	110
Palattao, Naguilian	nil	nil	6.92	128	65	7.29	100	80	88.45	0	72.5
	9	120	7.45	201	90	8.51	120	100	195.2	0	160
Cabulay, Santiago	nil	nil	6.93	280	100	21.87	210	80	207.4	0	170
	140	530	7.47	302	160	26.73	250	135	269.4	0	220
Hapid, Lamut (Tupaya)	nil	nil	7.12	178	60	4.86	80	70	97.6	0	80
	nil	5	7.58	240	80	4.86	100	150	122	0	100
Dabubu, Pequino	nil	nil	7.05	108	60	2.43	100	70	97.6	0	80
	nil	10	7.38	128	110	4.86	120	100	231.8	0	190
Dippadiw, Madella	nil	nil	7.07	154	70	7.29	120	80	76.25	0	62.5
	nil	75	7.59	197	100	12.15	130	110	195.2	0	160
Pingkian, Kayapa	nil	0	6.81	260	85	0	160	70	173.85	0	142.5
	34	900	7.94	280	160	32.81	220	110	183	0	150
Bangag	nil	nil	6.83	150	70	9.11	100	70	134.2	0	110
	4	260	7.67	172	120	2.43	107.5	275	183	0	150
Baybayog	10.5	10	7.22	240	130	12.75	182.5	65	183	0	150
	12	280	7.86	350	180	17.01	200	125	256.2	0	210
Rosario	nil	nil	7.40	310	120	0	160	75	256.2	0	210
	nil	5	7.94	320	180	14.58	230	90	280.6	0	230
Tungngod	nil	nil	7.16	250	60	9.75	140	50	158.6	0	130
	nil	10	7.50	300	140	14.58	200	80	244	0	200
Careb	nil	nil	7.33	250	140	24.3	240	60	256.2	0	210
	nil	7	7.68	380	190	27.95	280	70	292.8	0	240
Baliling	nil	nil	6.91	200	130	0	140	60	170.8	0	140
	nil	65	7.87	290	200	21.87	290	120	256.2	0	210
Beti	nil	nil	6.77	112	60	2.43	70	65	146.4	0	120
	1	10	7.70	280	105	8.51	140	100	231.8	0	190
Ilut	nil	nil	7.10	220	70	2.43	120	70	183	0	150
	nil	10	7.30	250	110	9.72	150	100	250.1	0	205
Aurora East	nil	nil	7.59	260	100	12.15	210	70	219.6	0	180
	nil	15	7.83	310	160	36.45	280	100	256.2	0	210
Gamis	nil	nil	6.64	340	130	18.22	250	70	195.2	0	160
	nil	15	7.58	420	180	29.16	300	90	451.1	0	370
Jones	nil	0	6.74	132	60	0	70	60	97.6	0	80
	5	50	7.30	195	160	2.43	160	75	146.4	0	120

Observed in June to August, 1985 by NWRC

Table 4.1 Medium Term Philippines Development Plan

(Unit: 10^6 Pesos at 1972 Prices)

Region	1987	1992	Average Annual Growth Rates 1987/1992
Philippines	96,935	135,331	6.9
NCR	28,208	37,607	5.8
I	4,265	6,099	7.4
II	2,714	3,916	7.7
III	8,530	12,152	7.3
IV	13,862	19,662	7.2
V	3,296	4,753	7.4
VI	7,755	10,923	7.0
VII	6,785	9,452	6.9
VIII	2,423	3,511	7.7
IX	3,490	5,024	7.4
X	4,944	7,109	7.6
XI	6,689	9,452	7.3
XII	3,974	5,671	7.3

Source: NEDA Regional Office
Philippine Development Plan, 1987-1992

Table 4.2 Long-Term GDP Projection

Sector	1985	1990	1995	2000	2005
Gross Domestic product (10^9 Pesos at 1972 Prices)					
GDP	90.5	118.9	154.3	189.3	229.0
- Agriculture	26.2	34.5	44.8	55.5	66.2
- Industry	29.0	38.0	49.2	59.1	74.9
- Services	35.3	46.4	60.3	74.7	87.9
Percentage Distribution (%)					
GDP	100.0	100.0	100.0	100.0	100.0
- Agriculture	29.0	29.0	29.0	29.3	28.9
- Industry	32.0	32.0	31.9	31.2	32.7
- Services	39.0	39.0	39.1	39.5	38.4
Average Annual Growth Rate (%)					
	1985/1990	1990/1995	1995/2000	2000/2005	1985/2005
GDP	5.61	5.35	4.17	3.88	4.75
- Agriculture	5.66	5.36	4.38	3.59	4.74
- Industry	5.55	5.30	3.73	4.85	4.86
- Services	5.62	5.38	4.38	3.31	4.67

Table 4.3 Population Projection by Province in the Basin

Province Region	Projected Basin Population					Density (Persons /km²)	
	1985	1990	1995	2000	2005	1995	2005
Cagayan	473,565	528,167	583,896	638,896	690,034	137	162
Ifugao	122,898	135,435	148,349	160,926	172,370	59	68
Isabela	938,317	1,066,608	1,201,204	1,335,054	1,460,221	146	177
Kalinga-Apayao	141,657	158,083	174,830	191,107	205,767	48	56
Nueva-Vizcaya	265,016	304,301	345,496	386,775	426,492	105	129
Quirino	100,339	119,208	139,969	162,031	184,202	46	60
Mountain Province	86,364	92,300	97,780	102,575	106,590	53	58
Aurora	7,714	9,107	10,637	12,217	13,563	27	34
Total	2,135,869	2,413,208	2,702,161	2,989,325	3,259,238	99	119
Region II-B	2,508,020	2,830,655	3,166,803	3,500,310	3,632,435	87	100
Region II	2,520,974	2,844,695	3,182,116	3,517,966	3,834,664	87	105
Philippines	54,686,332	61,480,180	68,424,077	75,223,853	81,590,921	228	272

Source: EC-326

Table 4.4 Population Projection by Urban/Rural and by Province in the Basin

Province	Urban/Rural	1985	1990	1995	2000	2005
Cagayan	Total	473,565	528,167	583,896	638,639	690,034
	Urban	91,835	110,497	132,114	156,357	117,521
	Rural	381,730	417,670	451,782	482,282	507,555
Ifugao	Total	122,898	135,435	148,349	160,926	172,370
	Urban	12,323	15,108	18,453	22,324	26,607
	Rural	110,575	120,327	129,896	138,602	145,263
Isabela	Total	938,317	1,066,608	1,201,204	1,335,054	1,460,221
	Urban	188,795	243,055	310,001	389,357	479,033
	Rural	749,522	823,553	891,203	945,697	981,188
Kalinga-Apayao	Total	141,657	158,083	174,830	191,107	205,767
	Urban	23,320	31,682	42,554	56,196	72,474
	Rural	118,337	126,401	132,276	134,911	133,293
Nueva-Vizcaya	Total	265,016	304,301	345,496	386,775	426,492
	Urban	60,320	79,860	104,229	133,399	166,809
	Rural	204,690	224,347	241,077	253,087	259,295
Quirino	Total	100,339	119,208	139,969	162,031	184,202
	Urban	21,652	28,845	37,964	49,140	62,184
	Rural	78,687	90,363	102,005	112,891	122,018
Mountain Province	Total	86,364	92,300	97,780	102,575	106,590
	Urban	4,563	5,382	6,311	7,339	8,444
	Rural	81,801	86,918	91,469	95,236	98,146
Aurora	Total	7,714	9,107	10,637	12,217	13,563
	Urban	0	0	0	0	0
	Rural	7,714	9,107	10,637	12,217	13,563
Basin	Total	2,135,869	2,413,208	2,702,161	2,989,325	3,259,238
	Urban	402,808	514,429	651,626	814,112	998,030
	Rural	1,733,061	1,898,779	2,050,535	2,175,213	2,261,208

Source: EC-326

Table 4.5 Long-Term Projection of GRDP in Region II

Sector	1985	1990	1995	2000	2005
Gross Regional Domestic Product (10^6 Pesos at 1972 Prices)					
GDP	2,324	3,270	4,972	6,732	8,490
- Agriculture	1,213	1,496	1,948	2,297	2,587
- Industry	295	480	801	1,685	2,727
- Services	816	1,393	2,223	2,750	3,176
Percentage Distribution (%)					
GDP	100.0	100.0	100.0	100.0	100.0
- Agriculture	52.2	44.4	39.2	34.1	30.5
- Industry	12.7	14.2	16.1	25.0	32.1
- Services	35.1	41.4	44.7	40.8	37.4
Average Annual Growth Rate (%)					
	1985/1990	1990/1995	1995/2000	2000/2005	1985/2005
GDP	7.72	8.09	6.25	4.75	6.69
- Agriculture	4.28	5.42	3.35	2.41	3.86
- Industry	10.23	10.78	16.04	10.11	11.76
- Services	11.30	9.78	4.35	2.92	7.03

Table 4.6 Long-Term Projection of GRDP in the Basin

Sector	1985	1990	1995	2000	2005
Gross Regional Domestic product (10^6 Pesos at 1972 Prices)					
GDP	1,825	2,689	4,014	5,536	7,080
- Agriculture	862	1,062	1,383	1,631	1,837
- Industry	272	444	743	1,568	2,544
- Services	691	1,183	1,888	2,337	2,699
Percentage Distribution (%)					
GDP	100.0	100.0	100.0	100.0	100.0
- Agriculture	47.2	39.5	34.5	29.5	25.9
- Industry	14.9	16.5	18.5	28.3	35.9
- Services	37.9	44.0	47.0	42.2	38.1
Average Annual Growth Rate (%)					
	1985/1990	1990/1995	1995/2000	2000/2005	1985/2005
GDP	8.06	8.35	6.64	5.04	7.01
- Agriculture	4.28	5.42	3.35	2.41	3.85
- Industry	10.31	10.86	16.10	10.16	11.83
- Services	11.33	9.81	4.36	2.93	7.05

Table 5.1 Carrying Capacity of Existing Channels

Rivers/stretches	Ave. capacity(range) (m3/s)	Specific capacity (m3/s/km2)
1. Main Cagayan R.		
- Mouth to Alcala	11,500(7,300-36,600)	0.42
- Alcala to Tuguegarao	4,700(2,500-7,000)	0.23
- Tuguegarao to Magat jct.	7,000(2,300-14,600)	0.37
- Magat jct. to Pangal Norte	7,100(2,100-15,300)	1.07
2. Chico R. (Sta.0-94 km)	4,000(1,100-8,700)	0.88
3. Tuguegarao R. (Sta.0-8 km)	320(160-460)	0.49
4. Siffu-Mallig R.		
- Siffu-Mallig R.	1,900(1,800-2,100)	0.94
- Siffu R. (Sta.5-8 km)	820(440-1,100)	0.77
- Mallig R. (Sta.0-5.5 km)	740(490-1,100)	0.78
5. Ilagan R. (Sta.0-36 m)	2,700(580-4,830)	0.86
6. Magat R. (Sta.0-50 km)	3,300(920-9,070)	0.65

Table 5.2 Flood Mitigation Measures

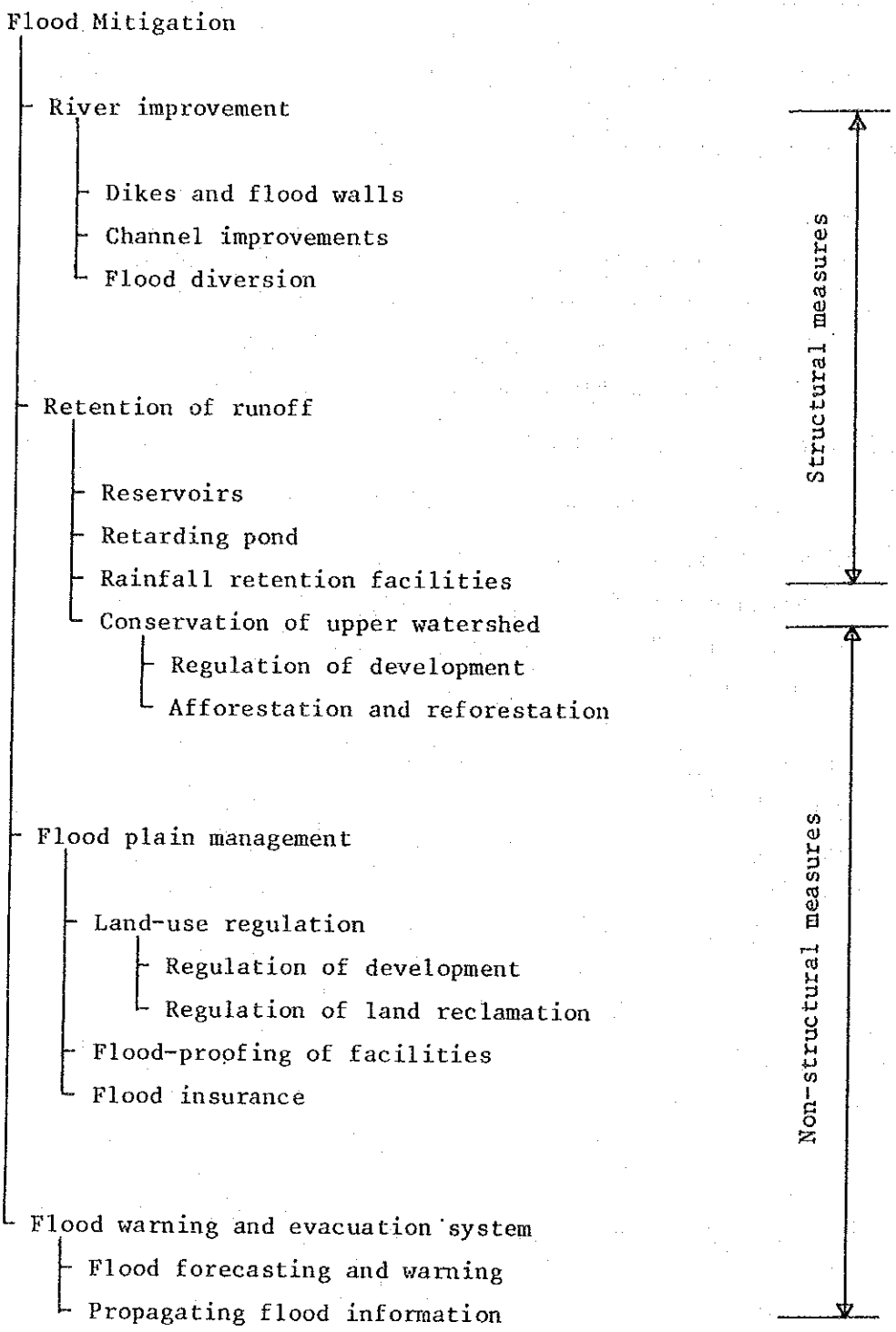

Table 5.3 Standard Unit Construction Costs for Flood Control Facilities (Financial)

Item No.	Work	Unit	Cost (₱) F.C.	L.C.	Total	Remarks
1	Excavation (1)(common)	m3	27	22	49	incl. spoil bank works
2	- do - (2)(coarse material)	m3	31	24	55	- do -
3	- do - (3)(rock)	m3	120	90	210	- do -
4	- do - (4)(rock 33 %, common 67 %)	m3	58	44	102	- do -
5	Dredging	m3	14	16	30	Dredging + piping + spoil bank
6	Embankment (1)(borrowed materials)	m3	34	29	63	incl. exc., embank., sodding
7	- do - (2)(- do -)	m3	65	55	120	High dike (Hd > 10 m)
8	Revetment (1)(masonry, l.w. chan.)	m2	220	730	950	incl. foot protection works
9	- do - (2)(" , h.w. chan.)	m2	130	580	710	- do -
10	- do - (3)(gabion , l.w. chan.)	m2	410	230	640	- do -
11	- do - (4)(" , h.w. chan.)	m2	340	210	540	- do -
12	Wooden pile groyne	unit	7,400	21,300	28,700	
13	Boulder spur dike	m3	60	220	280	
14	Drainage sluice (1)	unit	110,000	428,000	538,000	1.5 m x 1.5 m x 1 gate
15	- do - (2)	unit	146,000	585,000	731,000	1.5 m x 1.5 m x 2 gates
16	Bridge	m2	1,390	5,560	6,950	
101	Land (irrigated)	ha	-	23,000	23,000	
102	" (non-irrigated)	ha	-	10,000	10,000	
103	" (upland crops)	ha	-	8,000	8,000	
104	" (open land)	ha	-	3,000	3,000	
105	" (residential)	m2	-	30	30	
106	Building	nos	-	38,000	38,000	
107	Compensation (average)	m2	-	7.4	7.4	

Remarks : 1. Price level is at the end of December, 1985.
2. Exchange rates referred are US$ 1 = ₱ 19 = ¥ 200.

Table 5.4 Standard Unit Construction Costs for Flood Control Facilities (Economic)

Item No.	Work	Unit	Cost (₱) F.C.	L.C.	Total	Remarks
1	Excavation (1)(common)	m3	27	18	45	incl. spoil bank works
2	- do - (2)(coarse material)	m3	31	20	51	- do -
3	- do - (3)(rock)	m3	120	74	194	- do -
4	- do - (4)(rock 33 %, common 67 %)	m3	58	36	94	- do -
5	Dredging	m3	14	13	27	Dredging + piping + spoil bank
6	Embankment (1)(borrowed materials)	m3	34	24	58	incl. exc., embank., sodding
7	- do - (2)(- do -)	m3	65	45	110	High dike (Hd > 10 m)
8	Revetment (1)(masonry, l.w. chan.)	m2	220	600	820	incl. foot protection works
9	- do - (2)(" , h.w. chan.)	m2	130	480	610	- do -
10	- do - (3)(gabion , l.w. chan.)	m2	410	190	600	- do -
11	- do - (4)(" , h.w. chan.)	m2	340	170	510	- do -
12	Wooden pile groyne	unit	7,400	17,500	24,900	
13	Boulder spur dike	m3	60	180	240	
14	Drainage sluice (1)	unit	110,000	351,000	461,000	1.5 m x 1.5 m x 1 gate
15	- do - (2)	unit	146,000	480,000	626,000	1.5 m x 1.5 m x 2 gates
16	Bridge	m2	1,390	4,560	5,950	
101	Land (irrigated)	ha	-	14,900	14,900	
102	" (non-irrigated)	ha	-	5,060	5,060	
103	" (upland crops)	ha	-	2,800	2,800	
104	" (open land)	ha	-	0	0	
105	" (residential)	m2	-	30	30	
106	Building	nos	-	31,000	31,000	
107	Compensation (average)	m2	-	5.7	5.7	

Remarks : 1. Price level is at the end of December, 1985.
2. Exchange rates referred are US$ 1 = ₱ 19 = ¥ 200.

Table 5.5 Damage Ratios

BUILDINGS

Properties	Inundated depth above ground level						Constitution ratio
	- 0.5 m	0.5 to 1.0 m	1.0 to 1.5 m	1.5 to 2.5 m	2.5 to 3.5 m	3.5 m -	
Buildings	0.030	0.053	0.072	0.109	0.152 (0.534)	0.220 (0.571)	-
Movables							
Household	0.043	0.086	0.191	0.331	0.499	0.690	16.8 %
Non-residential	0.077	0.156	0.985	0.399	0.509	0.597	6.5 %
Farmer & fishery	0.089	0.178	0.304	0.394	0.471	0.571	76.7 %
Weighted mean	0.080	0.161	0.284	0.384	0.478 (0.713)	0.593 (0.776)	100.0 %

Notes : 1. For inundated depth more than 2.5 m, 45 % of buildings are assumed to be completely razed (damage ratio = 1.0).
2. Some modifications to the Philippine conditions were made based on Technical Standard for River and Sabo Works, MOC, Japan.

AGRICULTURAL CROPS

Depth (m) :	- 0.5				0.5 to 1				- 1.0			
Duration (day):	1 to 2	3 to 4	5 to 6	7 -	1 to 2	3 to 4	5 to 6	7 -	1 to 2	3 to 4	5 to 6	7 -
Paddy	0.21	0.30	0.36	0.50	0.24	0.44	0.50	0.71	0.37	0.54	0.64	0.74
Upland crops	0.27	0.42	0.54	0.67	0.35	0.48	0.67	0.74	0.51	0.67	0.81	0.91

Note : Based on Technical Standard for River and Sabo Works, MOC, Japan.

Table 5.6 Flood Control Dams

Dam	Drainage area (km2)	Control Starting discharge		Out-flow rate	Capacity (MCM)			Dam	
		Specific discharge (m3/s/km2)	Discharge		Effective flood control space	Sediment space	Gross storage capacity	Maximum W.L. (El.m)	Dam height (m)
Pinukpuk	856	0.23	200	0.10	196	128	363	115.7	52.7
Chico 4	1,410	0.23	320	0.10	299	211	570	437.5	144.5
Mallig 2	362	0.23	85	0.10	93.4	54	166	148.0	43.0
Siffu 1(A)	656	0.23	150	0.10	96.1	98	213	107.0	44.0
Disabangan	652	0.23	150	0.10	154	98	283	96.0	43.0
Ilagan 1	1,350	0.23	310	0.10	382	203	661	168.0	69.0
Magat	4,143	0.20	830	0.638	200	-	-	-	-
Alimit	559	-	-	-	-	84	324	279.0	84.0
Addalam (A)	864	0.23	200	0.495	153	58	242	162.0	51.0
Cagayan 1	2,364	0.23	540	0.683	318	182	564	158.0	45.0

Remarks : 1. Specific discharge of 0.23 corresponds to average existing channel capacity in the reaches from Alcala to Tuguegarao.

2. Gross storage capacity = 1.2 x (effective space) + sediment space

Table 5.7 Design Discharge Distributions for Alternative Framework Plans

Reaches	Existing	Alt.0D	Alt.5D	Alt.9D	Alt.0DM	Alt.5DM	Alt.9DM
Mouth to Chico jct.	21,600	27,400 (127)	25,300 (117)	25,000 (116)	27,600 (128)	25,400 (118)	25,100 (116)
Chico jct. to Siffu jct.	26,600	28,800 (108)	25,600 (96)	25,200 (95)	28,800 (108)	25,600 (96)	25,200 (95)
Siffu jct. to Ilagan jct.	25,600	27,500 (107)	24,600 (96)	24,300 (95)	27,500 (107)	24,600 (96)	24,300 (95)
Ilagan jct. to Magat jct.	23,900	25,900 (108)	23,100 (97)	22,800 (95)	25,900 (108)	23,100 (97)	22,800 (95)
Magat jct. to Addalam jct.	16,000	16,300 (102)	15,100 (94)	13,500 (84)	16,300 (102)	15,100 (94)	13,500 (84)
Chico R.	8,700	8,700 (100)	8,700 (100)	8,600 (99)	8,700 (100)	8,700 (100)	8,600 (99)
Siffu R.	3,300	3,300 (100)	3,200 (97)	3,200 (97)	3,300 (100)	3,200 (97)	3,200 (97)
Ilagan R.	9,400	9,900 (105)	8,200 (87)	8,000 (85)	9,900 (105)	8,200 (87)	8,000 (85)
Magat R.	10,600	13,800 (130)	9,700 (92)	9,700 (92)	13,800 (130)	9,700 (92)	9,700 (92)
Addalam R.	4,800	4,800 (100)	4,800 (100)	3,100 (65)	4,800 (100)	4,800 (100)	3,100 (65)
Upper Cagayan R.	12,100	12,100 (100)	9,100 (75)	9,100 (75)	12,100 (100)	9,100 (75)	9,100 (75)

Note : 1. Figures without ( ) show design discharge in m3/s and those in ( ) show percentage to the existing runoff.
2. Discharge for Alt.0D with only diking system is called as basic flood discharge.

Table 5.8 Economic Project Cost for Framework Plan

Work item	Unit	Work quantity	Unit cost (₱)	Amount (₱ mil.)	Remarks
I. CHANNEL WORKS					
1. Main Works	-	-	-	(21,124)	
Preparatory w.	l.s.	-	-	1,361	8 %
Dike embankment w.	km	482	-	7,409	
Embankment (1)	m3	102,900,000	58	5,968	
Embankment (2)	m3	13,100,000	110	1,441	High dike
Revetment w.	km	45.1	-	904	
Revetment (1)	m2	739,000	820	606	for low w. chan.
Revetment (2)	m2	488,000	610	298	for high w. chan.
Narrow excavation w.	m3	43,200,000	94	4,061	
Cut-off channel w.	km	34.5	-	3,487	
Excavation (1)	m3	52,800,000	45	2,376	for main Cagayan
Excavation (1)	m3	17,800,000	45	801	for tributarites
Revetment (3)	m2	516,000	600	310	
Bank protection w.	km	112.3	-	550	
Revetment (3)	m2	838,000	600	503	
Groyne	unit	1,880	24,900	47	
Drainage sluice w.	unit	720	626,000	451	
Bridge w.	m2	24,800	5,950	148	
Miscellaneous	l.s.	-	-	2,755	15 % of the above
2. Compensation	m2	-	-	(225)	
Dike	m2	24,600,000	5.7	140	
COC	m2	11,300,000	5.7	64	
Others	m2	3,590,000	5.7	21	10 %
3. Engineering & Adm.	-	-	-	(3,169)	
Engineering	l.s.	-	-	2,112	10 % of (1)
Administration	l.s.	-	-	1,056	5 % of (1)
4. Contingency	l.s.	-	-	(3,678)	15 % of (1+2+3)
Total	-	-	-	28,196	
II. DAM WORKS					
1. Main Works	l.s.	-	-	(4,370)	
Cagayan No.1	l.s.	-	-	991	
Alimit No.1 (A)	l.s.	-	-	1,343	
Ilagan No.1	l.s.	-	-	1,412	
Siffu No.1 (A)	l.s.	-	-	342	
Mallig No.2	l.s.	-	-	282	
2. Compensation	l.s.	-	-	(139)	
3. Engineering & Adm.	-	-	-	(656)	
Engineering	l.s.	-	-	437	10 % of (1)
Administration	l.s.	-	-	219	5 % of (1)
4. Contingency	l.s.	-	-	(1,033)	20 % of (1+2+3)
Total	-	-	-	6,198	
GRAND TOTAL	-	-	-	34,394	

Table 5.9 Principal Features of Framework Plan

1) Channel Works

a)	Dike embankment works:	116,000,000 m3
b)	Revetment works (45.1 km long):	1,227,000 m2
c)	Drainage sluice works:	720 units
d)	Narrow excavation works:	43,200,000 m3
e)	Cut-off channel works (34.5 km long):	70,600,000 m3
f)	Bank protection works:	112.3 km
g)	Appurtenant facility works:	3 bridges
	- Buntun bridge:	Reconstruction
	- Gamu bridge:	Reconstruction
	- Naguilian bridge:	Reconstruction

2) Flood Control dam Works

	(Dam height: m)	(F.C.: MCM)
- Cagayan No.1	45.0	318
- Alimit No.1(A)	84.0	200
- Ilagan No.1	69.0	382
- Siffu No.1(A)	44.0	96.1
- Mallig No.2	43.0	93.4

3) Compensation

a)	Channel works:	39,490,000 m2
b)	Dam works:	113,500,000 m2
	- Cagayan No.1 dam	47,700,000 m2
	- Alimit No.1 dam	10,000,000 m2
	- Ilagan No.1 dam	29,100,000 m2
	- Siffu No.1(A) dam	14,400,000 m2
	- Mallig No.2 dam	12,300,000 m2

4)	Project Cost (Economic):	₱34,394,000,000
a)	Channel works:	₱28,196,000,000
b)	Dam works:	₱ 6,198,000,000

Table 5.10 Economic Project Cost for Long-Term Plan

Work item	Unit	Work quantity	Unit cost (₱)	Amount (₱ mil.)	Remarks
I. CHANNEL WORKS					
1. Main Works	-	-	-	(15,987)	
Preparatory w.	l.s.	-	-	1,030	8 %
Dike embankment w.	km	480	-	3,451	
Embankment (1)	m3	59,500,000	58	3,451	
Revetment w.	km	45.1	-	770	
Revetment (1)	m2	734,000	820	602	for low w. chan.
Revetment (2)	m	276,000	610	168	for high w. chan.
Narrow excavation w.	m3	43,200,000	94	4,061	
Cut-off channel w.	km	34.5	-	3,487	
Excavation (1)	m3	52,800,000	45	2,376	for main Cagayan
Excavation (1)	m3	17,800,000	45	801	for tributarites
Revetment (3)	m2	516,000	600	310	
Bank protection w.	km	112.3	-	550	
Revetment (3)	m2	838,000	600	503	
Groyne	unit	1,880	24,900	47	unit in total
Drainage sluice w.	unit	720	626,000	451	
Bridge w.	m2	17,300	5,950	103	
Miscellaneous	l.s.	-	-	2,085	15 % of the above
2. Compensation	m2	-	-	(176)	
Dike	m2	16,700,000	5.7	95	
COC	m2	11,300,000	5.7	64	
Others	m2	2,800,000	5.7	16	10 %
3. Engineering & Adm.	-	-	-	(2,398)	
Engineering	l.s.	-	-	1,599	10 % of (1)
Administration	l.s.	-	-	799	5 % of (1)
4. Contingency	l.s.	-	-	(2,784)	15 % of (1+2+3)
Total	-	-	-	21,345	
II. DAM WORKS					
1. Main Works	l.s.	-	-	(4,370)	
Cagayan No.1	l.s.	-	-	991	
Alimit No.1 (A)	l.s.	-	-	1,343	
Ilagan No.1	l.s.	-	-	1,412	
Siffu No.1 (A)	l.s.	-	-	342	
Mallig No.2	l.s.	-	-	282	
2. Compensation	l.s.	-	-	(139)	
3. Engineering & Adm.	-	-	-	(656)	
Engineering	l.s.	-	-	437	10 % of (1)
Administration	l.s.	-	-	219	5 % of (1)
4. Contingency	l.s.	-	-	(1,033)	20 % of (1+2+3)
Total	-	-	-	6,198	
GRAND TOTAL	-	-	-	27,543	

Table 5.11 Probable Flood Discharges (Long-Term Plan)

(Without Project) (m3/s)

Stretch	Return Period (year)					
	2	5	10	25	50	100
1	6,300	10,000	12,100	15,900	18,300	21,600
2	6,400	11,000	13,700	18,700	22,000	26,600
3	6,100	10,300	12,900	17,800	21,100	25,600
4	5,400	9,400	11,700	16,300	19,500	23,900
5	3,300	6,000	7,400	10,700	13,400	16,000
6	2,000	3,000	3,800	5,200	7,500	8,700
7	1,200	1,600	2,000	2,700	3,000	3,300
8	2,000	3,400	4,700	6,700	7,600	9,400
9	2,700	4,500	6,000	7,200	9,500	10,600

(With Improved Narrows and Dams) (m3/s)

Stretch	Return Period (year)					
	2	5	10	25	50	100
1	6,200	9,700	11,600	15,100	17,500	20,700
2	6,500	10,400	12,700	17,100	20,200	24,500
3	6,100	9,800	12,000	16,300	19,400	23,700
4	5,400	8,900	11,000	15,100	18,100	22,200
5	3,100	5,500	6,700	9,800	12,300	14,700
6	2,000	3,000	3,800	5,200	7,500	8,700
7	1,200	1,600	2,000	2,700	3,000	3,200
8	1,800	2,800	3,700	5,700	6,500	8,200
9	2,500	4,000	5,300	6,400	8,300	9,300

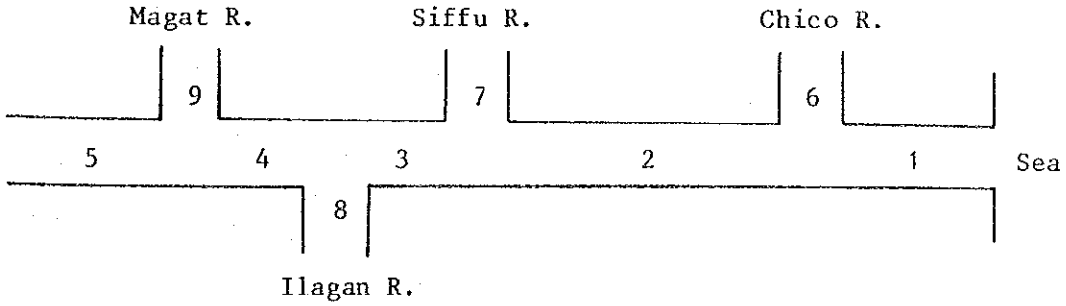

Table 5.12 Probable Flood Damage (Long-Term Plan)

(Unit: ₱ 10^6)

Item	2 year	5 year	10 year	25 year	50 year	100 year
(Without Project: Constant Property Condition)						
Buildings	1,754	3,000	3,863	5,161	5,809	6,402
Agricultural crops	130	231	286	347	380	424
Livestocks	16	29	36	44	48	53
Infrastructure	1,508	2,580	3,322	4,438	4,996	5,506
Sub-total	3,408	5,840	7,507	9,990	11,233	12,385
Indirect damages	170	292	375	500	562	619
Total damages	3,578	6,132	7,882	10,490	11,795	13,004
(With Improved Narrows and Dams: Constant Property Condition)						
Buildings	1,529	2,542	3,176	4,264	5,063	5,785
Agricultural crops	99	192	242	305	341	384
Livestocks	12	24	30	38	43	48
Infrastructure	1,315	2,186	2,731	3,667	4,354	4,975
Sub-total	2,955	4,944	6,179	8,274	9,801	11,192
Indirect damages	148	247	309	414	490	560
Total damages	3,103	5,191	6,489	8,688	10,291	11,752

Table 5.13 Principal Features of Long-Term Plan

1)	Channel Works		
	a) Dike embankment works:		59,500,000 m3
	b) Revetment works (45.1 km long):		1,010,000 m2
	c) Drainage sluice works:		720 units
	d) Narrow excavation works:		43,200,000 m3
	e) Cut-off channel works (34.5 km long):		70,600,000 m3
	f) Bank protection works:		112.3 km
	g) Appurtenant facility works:		3 bridges
	- Buntun bridge:		Reconstruction
	- Gamu bridge:		Extension
	- Naguilian bridge:		Extension
2)	Flood Control dam Works	(Dam height: m)	(F.C.: MCM)
	- Cagayan No.1	45.0	318
	- Alimit No.1(A)	84.0	200
	- Ilagan No.1	69.0	382
	- Siffu No.1(A)	44.0	96.1
	- Mallig No.2	43.0	93.4
3)	Compensation		
	a) Channel works:		30,800,000 m2
	b) Dam works:		113,500,000 m2
	- Cagayan No.1 dam		47,700,000 m2
	- Alimit No.1 dam		10,000,000 m2
	- Ilagan No.1 dam		29,100,000 m2
	- Siffu No.1(A) dam		14,400,000 m2
	- Mallig No.2 dam		12,300,000 m2
4)	Project Cost (Economic):		₱27,543,000,000
	a) Channel works:		₱21,345,000,000
	b) Dam works:		₱ 6,198,000,000
5)	Economic Evaluation	(Const. propertry)	(Vari. property)
	a) Benefit (₱ mil./yr)	1,637.0	3,834.1 /1
	- Flood reduction	1,564.0	3,698.6 /1
	- Bank protection	73.0	135.5
	b) IRR (%)	4.8	14.2

/1 Annual benefit for variable property: as of 2005

Table 5.14 Economic Viability of Candidate Schemes for Master Plan

Sub-project	Cost (₱ mil.)		Constant Prop. C.		Variable Prop. C.		Rank
	Const.	Total O & M	Total B (mil.)	IRR (%)	Total B (mil.)	IRR (%)	
Tuguegarao dike	500.6	117.5	2,867.0	11.6	13,718.2	23.1	1
Cabagan dike	276.9	65.1	817.8	5.3	3,865.1	13.6	4
Narrow imp. (Site-NLL)	900.1	211.5	4,065.5	8.9	19,135.6	18.9	2
- do - (Site-NLR)	2,717.4	638.6	7,919.5	5.2	37,453.6	13.5	5
- do - (Site-NUP)	3,072.5	722.0	230.3	-	1,089.8	-	11
Cagayan No.1 dam	1,487.0	334.6	3,616.7	3.8	17,655.8	11.6	8
Magat/Alimit dam	1,852.8	416.9	5,507.6	5.1	26,389.5	13.1	6
Ilagan No.1 dam	1,964.8	442.1	1,760.9	-	8,636.8	5.4	10
Siffu No.1 (A) dam	489.7	110.2	1,452.6	5.1	6,632.0	12.8	7
Mallig No.2 dam	402.2	90.5	752.0	2.2	3,417.3	9.3	9
Bank protection	903.4	212.3	3,431.0	7.3	10,620.5	13.7	3

Note : 1. Constant and variable Prop. C. denote total benefit and IRR under the constant and variable property conditions of basin during project life of 50 years.
2. Regarding dam projects, single purpose for flood control is assumed.

Table 6.1 Present Agricultural Situation of the Basin

Item	Unit	Country	Basin	Share (%)
I. Population (1985)				
1) Total	10^3	54,668	2,136	3.9
2) Rural Population	10^3	32,847	1,733	5.3
3) Share of the above in total	%	60.1	81.1	-
4) Total Labor Force	10^3	16,110	611	3.8
5) Agricultural Labor Force /1				
- Agriculture	10^3	7,095	416	5.9
- Forestry	10^3	771	7	0.9
- Fishery	10^3	80	9	11.3
- Others	10^3	1	-	-
Total	10^3	7,947	432	5.4
6) Share of the above in total	%	49.3	70.7	-
II. G D P (1985 at 1972 constant price)				
1) Total	₱10^6	90,469	1,650	1.8
2) Contribution to GDP	₱10^6			
- Agriculture	₱10^6	16,336	631	3.9
(Paddy)	₱10^6	(4,370)	(430)	(9.8)
(Corn)	₱10^6	(1,539)	(84)	(5.5)
(Others)	₱10^6	(10,427)	(117)	(1.1)
- Livestock	₱10^6	4,974	77	1.5
- Fishery	₱10^6	4,224	7	0.2
- Forestry	₱10^6	702	147	20.9
Total		26,236	862	3.3
3) Share of the above in total GDP	%	29.0	52.2	-
4) Agricultural Labor productivity /2	₱	3,004	1,702	56.7
III. Land Use				
1) Total Area	Km^2	300,000	27,300	9.1
2) Forestry		111,330	11,500	10.3
3) Grassland (idle)		81,000	10,000	12.3
4) Agricultural Land				
- Temporary crops	Km^2	44,880	3,773	8.4
- Permanent crops	Km^2	33,130	270	0.8
- Pasture	Km^2	6,100	1,269	20.8
- Others	Km^2	6,230	27	0.4
Total		90,340	5,339	5.9
5) Share of the above in total area		30.1	19.6	-

Item	Unit	Country	Basin	Share (%)
IV. Agricultural Production (1982-84 Average)				
1) Harvested Area				
- Palay	10^3 ha	3,268	352	10.8
- Corn	10^3 ha	3,263	301	9.2
- Peanut	10^3 ha	50	25	50.0
- Sugar cane	10^3 ha	458	10	2.2
- Tobacco	10^3 ha	59	16	27.1
- Coconut	10^3 ha	3,189	7	0.2
- Others	10^3 ha	1,581	41	2.6
Total		11,868	752	6.3
2) Production				
- Palay	10^3 ton	7,898	837	10.6
- Corn	10^3 ton	3,254	256	7.9
- Peanut	10^3 ton	42	18	42.9
- Sugar cane	10^3 ton	458	10	2.2
- Tobacco	10^3 ton	53	12	22.6
- Coconut	10^3 ton	3,403	23	0.7
- Others	10^3 ton	13,105	201	1.5
Total		28,213	1,357	4.8
3) Value (Current price)				
- Palay	10^6 ₱	12,319	1,290	10.5
- Corn	10^6 ₱	4,367	402	9.2
- Peanut	10^6 ₱	307	94	30.6
- Sugar cane	10^6 ₱	8,417	115	1.4
- Tobacco	10^6 ₱	520	123	23.7
- Coconut	10^6 ₱	7,192	29	0.4
- Others	10^6 ₱	14,688	274	1.9
Total		47,810	2,327	4.9
4) Yield				
- Palay	ton/ha	2.41	2.38	98.8
- Corn	ton/ha	1.00	0.85	85.0
- Peanut	ton/ha	0.84	0.74	88.1
- Sugar cane	ton/ha	7.35	4.56	62.0
- Tabacco	ton/ha	0.88	0.71	80.7
- Cocount	ton/ha	1.07	3.29	307.5

Notes: /1: Gainful workers 15 years old and over
/2: GDP of Agriculture and Livestock divided by Agricultural Labor force of Agriculture

Source: BAECON, NEDA

Table 6.2 Present Agricultural Production in the Basin (1985)

A. Crop Production

Crops	Physical[2] Area (10^3 ha)	Cropping[2] Intensity (%)	Harvested[2] Area (10^3 ha)	Average[2] Yield (ton/ha)	Pro- duction[2] (10^3 ton)
1) Palay - Irrigated	146.7 [1]	180	264.1	2.63	694
Rainfed	100.3	100	100.3	2.23	224
(Total)	247.0		364.4		918
2) Corn - Diversified Area	102.0	200	204.0	0.94	192
After rainfed Paddy	20.0	100	20.0	0.94	19
(Total)	122.0		224.0		211
3) Peanut	-	-	23.7	0.74	18
4) Tobacco	14.2	100	14.2	0.64	9
5) Sugar cane	10.0	100	10.0	39.20	392
6) Root Crops (Sweet Potato)	4.1	175	7.2	4.76	34
7) Vegetables	-	-	4.4	4.02	18
8) Beans	-	-	2.5	0.34	1
9) Fruit & Nuts	14.4	100	14.4	4.80	69
10) Coffee	6.5	100	6.5	0.37	2
11) Coconut	4.1	100	4.1	2.12	9
12) Others	2.0	100	2.0	3.00	6
Crops Total	404.3 [3]				

B. Livestock Production

Unit: 10^3 head

Livestock, Poultry & Dairy Product	Total Population	Annual Change in No. of Head (1984/85)	No. of Slaughtered	Annual Production
1) Carabao	344	10	28	38
2) Cattle	128	4	9	13
3) Hog	454	16	276	292
4) Goat	47	2	5	7
5) Chicken & Duck	3,023	105	7,317	7,422
6) Egg	-	-	-	6.55 (10^3ton)
7) Milk	-	-	-	472 (10^3ℓ)

C. Fishery Production

	Area (ha)	Unit Yield (t/ha)	Production (ton)
Total Fishery Product	2,725	0.57	1,547

D. Forestry Production

	Area (km^2)	Logwood Production (10^3 m^3)
Total Forestry Product	11,500	715

Source: [1] : Actually cultivated area under irrigation during wet season.
[2] : Estimated based on data from BAECON Statistics Division, MAF, RIARS in Ilagan, NEDA Region II and field inspection survey.
[3] : Excluding corn area after rainfed paddy cultivation.

Table 6.3 Number of Livestock and Poultry in the Basin (1985)

(Unit: head)

Province	Carabao	Cattle	Hog	Goat	Poultry	Duck
Cagayan	147,690	22,030	155,960	9,910	653,560	58,030
- Backyard	147,310	17,070	154,270	9,510	648,060	54,180
- Commercial	380	4,960	1,690	400	5,500	3,850
Ifugao	10,150	13,350	34,890	5,230	315,590	3,980
- Backyard	9,840	4,570	34,720	2,670	313,990	3,980
- Commercial	310	8,780	170	2,560	1,600	-
Isabela	102,640	41,410	138,650	9,860	1,028,250	116,650
- Backyard	102,640	28,610	118,400	9,530	950,300	109,950
- Commercial	-	12,800	20,250	330	77,950	6,700
Kalinga Apayao	33,120	18,900	31,310	3,750	129,380	41,180
- Backyard	32,870	10,030	30,250	3,750	127,130	40,580
- Commercial	250	8,870	1,060	-	2,250	600
Nueva Vizcaya	20,890	15,630	42,610	9,920	300,980	51,120
- Backyard	20,890	8,620	39,810	9,600	266,680	49,430
- Commercial	-	7,010	2,800	320	34,300	1,690
Quirino	15,170	7,820	26,580	6,670	170,650	22,710
- Backyard	15,170	4,630	26,500	6,580	170,650	21,650
- Commercial	-	3,190	80	90	-	1,060
Mt. Province	13,200	8,090	22,550	860	121,300	8,130
- Backyard	13,140	7,800	22,500	860	121,300	8,130
- Commercial	60	290	50	-	-	-
Aurora	440	370	1,250	500	790	600
- Backyard	440	370	1,250	500	790	600
- Commercial	-	-	-	-	-	-
Total	343,300	127,600	453,800	46,700	2,720,500	302,400
- Backyard	342,300	81,700	427,700	43,000	2,598,900	288,500
- Commercial	1,000	45,900	26,100	3,700	121,600	13,900

Source: BAECON

Table 6.4 National Irrigation System/Project

Name of System/Project	Service Area(ha)	Time Completed
1. Existing System	131,480	
(1) Dummun River Irrigation System	2,070	Dec. 1982
(2) Zinundungan River Irrigation System	1,760	Jun. 1983
(3) Baggao Irrigation System	1,812	Jun. 1983
(4) Solana-Tuguegarao Irrigation System	3,143	Dec. 1979
(5) Pinacanauan River Irrigation System	1,200	1980
(6) Tumauini Irrigation System	3,987	Dec. 1983
(7) Chico River Irrigation System, Stage-I	20,108	Jun. 1986
(8) Magat River Integrated Irrigation System	97,400	Jun. 1986
2. On-going Project	19,317	Anticipated Completion Time
(1) San Pablo-Cabagan Irrigation Project	2,890	May 1986
(2) Mallig River Irrigation Project	2,427	Jun. 1986
(3) Cagayan Integrated Agricultural Development Project	14,000	Dec. 1988
Total	150,797	

Table 6.5 Irrigated Area of Existing NIS

Name of System	Service Area (ha)	Irrigated Area (ha)									
		1985		1984		1983		1982		1981	
		WS	DS	WS	DS	WS	DS	WS	DS	WS	DS
1. Zinundungan RIS	1,760	1,726	1,713	1,700	2,173	1,754 /2	787 /2	1,247 /2	1,647 /2	1,249 /2	853 /2
2. Dummun RIS	2,070	1,444	1,370	1,460	1,374	1,460	379	1,441	1,287	1,426	1,292
3. Baggao IS	1,812	1,306	1,051	1,280	964	1,441 /2	451 /2	1,284 /2	688 /2	1,307 /2	912 /2
- Paranan Area	1,263	848	605	791	537	955	329	835	501	925	491
- Pared Area	549	458	446	489	427	486	122	449	187	382	421
4. Pinacanauan RIS	1,200	290	292	319	279	275	279	220	240	222	221
5. Solana - Tuguegarao IS	3,143	-	958	907	972	1,200	1,095	325	551	-	-
- Solana Area	2,829	0	958	907	972	1,106	1,095	210	449	-	-
- Tuguegarao Area	314	-	-	-	-	94	-	115	102	-	-
6. Tumauini IS	3,987	1,447	1,279	1,879	1,872	1,432	302	1,814 /2	1,470 /2	1,965 /2	1,724 /2

/1: Magat Integrated Irrigation System and Chico River Irrigation System are not presented because these are just completed in 1987.

/2: under construction (pertial operation)

Source: NIA Regional Office

Table 6.6 Average Irrigated Area/1 of Existing NIS

Name of NIS	Service Area (ha)	Wet Season Crop		Dry SEason Crop		Annual	
		Irrigated Area (ha)	Ratio of Irrigated Area	Irrigated Area (ha)	Ratio of Irrigated Area	Irrigated Area (ha)	Ratio of Irrigated Area
1. Dummun RIS	2,070	1,446	0.70	1,140	0.55	2,586	1.25
2. Zinundungan RIS	1,760	1,713	0.97	1,943 /3	1.10	3,656	2.07
3. Baggo IS	1,812	1,293	0.71	1,008	0.56	2,301	1.27
4. Solana-Tuguegarao IS /2	3,143	486	0.15	715	0.23	1,201	0.38
5. Pinacanauan RIS	1,200	265	0.22	262	0.22	528	0.44
6. Tumauini IS	3,987	1,586	0.40	1,151	0.29	2,737	0.69
Total	13,972	6,789	0.49	6,219	0.45	13,008	0.93

/1: Average for recent five (5) years or after completion of the system. And Magat IIS and Chico RIS are not presented because these are just completed in 1987.

/2: Pump irrigation system

/3: Including third crop

Table 6.7 Communal Irrigation Systems

	Name of Province	No. of System	Service Area(ha)	Ratio of Irrigated Area		
				Wet Season	Dry Season	Annual
1.	Cagayan	37	6,347	0.91	0.98	1.89
2.	Kalinga-Apayao	103	5,998	0.59	0.42	1.01
3.	Isabela	34	5,560	0.89	0.18	1.07
4.	Ifugao	170	6,473	0.43	0.52	0.95
5.	Nueva Vizcaya	233	25,871	0.87	0.78	1.65
6.	Quirino	36	4,871	0.31	0.27	0.58
7.	Mountain	543	3,170	0.68	0.97	1.65
	Total	1,156	58,290	0.73	0.63	1.36

Table 6.8 Pump Irrigation Systems

	Name of Province	Number of PIS	Service Area (ha)
1.	Cagayan	11	788
2.	Kalinga-Apayao	1	30
3.	Isabela	21	1,652
4.	Ifugao	3	130
5.	Nueva Vizcaya	1	32
6.	Quirino	3	210
7.	Mountain	0	-
	Total	40	2,842

Table 6.9 Private Pump Irrigation Systems

	Name of Province	Pump Issued System		Operation System	
		No. of System	Service Area(ha)	No. of System	Irrigated Area (ha)
1.	Cagayan	889	7,802	456	3,783
2.	Kalinga-Apayao	236	1,741	92	419
3.	Isabela	1,791	17,375	962	4,800
4.	Ifugao	112	708	75	568
5.	Nueva Vizcaya	162	1,996	146	1,849
6.	Quirino	171	1,220	90	629
7.	Mountain	4	30	4	30
	Total	3,365	30,872	1,825	12,078

Table 6.10 Soil and Land Classification

(Unit: Km^2)

Land Categories	Soil Series	Textural Class	Land Capability Class	Areas
1. Tidal Swamp		undifferentiated		170
2. Recent River Terraces	Agustin	sandy loam	R6/U3sf	27
	San Manuel	sandy loam	R6/U3sf	152
	San Manuel	fine sandy loam	R3sf/U2sf	93
	San Manuel	silt loam	R3sf/U2sf	75
	Cauayan	fine sandy loam	R3sf/U2sf	133
		sub-total		480
3. Alluvial Terraces	Toran	clay	R1/U3df	46
	Bigaa	clay	R1/U3df	820
	Bantog	clay	R1/U3df	37
	Bantog	clay loam	R1/U2d	77
	Pada-pada	clay	R1/U3df	29
	Tagulod	clay	R1/U3df	321
	Tagulod	clay loam	R1/U2d	1,130
	Cauayan	clay loam	R1/U2d	815
	Quingua	clay loam	R2s/U1	55
		sub-total		3,330
4. River cut plain Piedmont	Quingua	clay loam	R2s/U1	167
	Quingua	silty clay loam	R2s/U1	172
	Quingua	silt loam	R2s/U1	132
	Rugao	clay loam	R2t/U1	87
	Bago	sandy clay loam	R4st/U3st	401
	Guibalaon	clay loam	R3st/U2st	39
	Nambaran	clay loam	R3st/U2st	42
	Maligaya	clay loam	R3st/U2st	75
	Umingan	loam	R3st/U2st	45
		sub-total		1,160
5. Hill Slopes	Alaminos	clay loam	R6/U3ste	1,960
	Alaminos	sandy clay loam	R6/U4ste	330
	Cauayan	clay loam	R6/U3ste	120
	Bolinao	clay loam	R6/U3ste	152
	Ilagan	sandy clay loam	R6/U4ste	2,377
	Guimbalaon	clay loam	R6/U3ste	555
	Guimbalaon	clay loam gravelly	R6/U4ste	482
	Rugao	clay loam	R6/U3ste	662
	Bauang	clay loam	R6/U3ste	367
	Aroman	clay loam	R6/U3ste	60
	Alimodian	clay loam	R6/U3ste	105
		sub-total		7,270
6. Mountainside		undifferentiated		14,890
		Total		27,300

Note: Land Capability Classifications

R - Rice
U - Upland Crops

1 - Highly suitable
2 - Moderately suitable
3.- Marginally suitable
4 - Limited arable
6 - Not arable

Limitations
1. s - soils
2. t - topography
3. d - drainage
4. f - flood
5. e - erosion

Source: Soil description for soil series, BF in Manila
Soil map prepared by consultants

Table 6.11 Estimate of Potential Maximum Agricultural Production (GVA)

	1985			Future		
	Physical Area (10^3ha)	GVA per ha (₱/ha)	Total GVA (10^3) /1	Physical Area (10^3ha)	GVA per ha (₱/ha)	Total GVA (10^3₱)
Lowland						
1. Paddy Field	247	1,780	439	311	3,560	1,107
(Paddy)			(430)			
(Corn)			(9)			
2. Corn Field	102	1,180	120	137	2,360	323
(Corn)			(85)			
(Peanut, Vegetables, & Beans)			(35)			
3. Other Annual Crop Land (Tobacco, Sugarcane, & Root Crops)	28	1,250	35	28	2,500	70
4. Grassland (idle)	99	-	-	-	-	-
(Total)	476		594	476		1,500
Upland						
1. Permanent Crop Land (Fruits & Nuts, Coffee, Coconut & Others)	27	1,370	37	200	2,740	548
2. Pasture Land	127	610	77/2	300	1,220	366
3. Grassland (idle)	450			104	-	-
(Total)	604		114	604		914
T o t a l	1,080		708	1,080		2,414

Note: /1 : See Table 2.7.2
/2 : Total GVA of livestock

Table 6.12 Candidate Schemes for Irrigation Development

Name of Scheme	Project Area (ha, Net) New Area	Existing Irrigation Area	Total	Water Source	Irrigation System
1. New Irrigation Scheme					
(1) Chico Mallig Irrigation Project, Stage II	29,100	2,100	31,200	Chico R.	Gravity
(2) Matuno River Development Project	3,450	9,230	12,680	Matuno R.	Gravity
(3) Dabubu River Irrigation Project	1,000	-	1,000	Dabubu R.	Gravity
(4) Zinundungan Irrigation Extension Project	1,600	150	1,750	Zinundungan R.	Gravity
(5) Alcala Amulung West Irrigation Project	6,750	-	6,750	Cagayan R.	Pump
(6) Tuguegarao Irrigation Project	1,400	-	1,400	Tuguegarao R.	Pump
(7) Lulutan Irrigation Project	2,950	-	2,950	Cagayan R.	Pump
(8) Ilagan Irrigation Project	3,140	60	3,200	Ilagan R.	Pump
(9) Gappal Irrigation Project	4,400	-	4,400	Cagayan R.	Pump
T o t a l	53,790	11,540	65,330		
2. Rehabilitation/Improvement Scheme					
(1) Dummun River Irrigation System	-	2,070	2,070	Dummun R.	Gravity
(2) Baggao Irrigation System	-	1,812	1,812	Pared & Paranan R.	Gravity
(3) Solana-Tuguegarao Irrigation System	-	3,143	3,143	Cagayan R.	Pump
(4) Pinacanauan Irrigation System	-	1,200	1,200	Tuguegarao R.	Gravity
(5) Tumauini Irrigation System	-	3,987	3,987	Pinacanauan R.	Gravity
T o t a l		12,212	12,212		

Table 6.13 Soil Classification and Present Land Use in New Irrigation Schemes

(Unit: ha)

Description / Name of Scheme	Zinundungan Extension	Alcala-Amulung West	Tuguegarao	Lulutan	Ilagan	Gappal	Dabubu	Chico Mallig	Matunc	Total
1. Irrigation Area	1,750	6,750	1,400	2,950	3,200	4,400	1,000	31,200	12,680	65,330
2. Soil Classification										
(1) Tagulod Clay Loam	1,450	3,360	380	2,270	-	2,640	-	12,800	-	22,900
(2) Tagulod Clay	-	-	-	-	-	660	-	-	-	660
(3) Quingua Silty Clay Loam	-	850	-	-	2,400	750	-	640	-	4,640
(4) Quingua Clay Loam	300	680	220	500	240	350	-	-	-	2,290
(5) Quingua Silty Loam	-	-	-	-	560	-	-	1,600	-	2,160
(6) San Manuel Silty Loam	-	470	620	180	-	-	-	-	1,600	2,870
(7) San Manuel Sandy Loam	-	670	-	-	-	-	-	-	-	670
(8) Bontog Clay	-	720	-	-	-	-	-	-	-	720
(9) Carig Sandy Clay Loam	-	-	90	-	-	-	-	6,160	-	6,250
(10) Cauayan Sandy Loam	-	-	-	-	-	-	1,000	-	-	1,000
(11) Bigaa Clay	-	-	90	-	-	-	-	780	-	870
(12) Isabela Clay	-	-	-	-	-	-	-	470	-	470
(13) Bago Sandy Clay Loam	-	-	-	-	-	-	-	8,010	2,920	10,930
(14) Bago Clay Loam	-	-	-	-	-	-	-	740	-	740
(15) Prenza Clay Loam	-	-	-	-	-	-	-	-	3,060	3,060
(16) Maligaya Clay Loam	-	-	-	-	-	-	-	-	5,100	5,100
T o t a l	1,750	6,750	1,400	2,950	3,200	4,400	1,000	31,200	12,680	65,330
3. Present Land Use										
(1) Paddy Field	1,450	3,850	250	2,410	200	3,300	550	22,060	11,050	45,120
- Irrigated	150	0	0	0	60	0	0	2,100	9,230	11,540
- Rainfed	1,300	3,850	250	2,410	140	3,300	550	19,960	1,820	33,580
(2) Diversified Farmland	300	2,900	1,150	540	3,000	1,100	450	3,170	1,630	14,240
(3) Grassland	-	-	-	-	-	-	-	5,970	-	5,970
T o t a l	1,750	6,750	1,400	2,950	3,200	4,400	1,000	31,200	12,680	65,330

Table 6.14 Present Population and Household in New Irrigation Schemes

Name of Scheme	Irrigation Area (ha)	Related Municipality	Total Population	No. of Total Household	No. of Farm Household	Average Irrigation Area per Farm (ha/farm) Household
1. Chico Irrigation Project Stage II						
- Chico East	8,100	Piat & Tuao	20,700	3,800	3,500	2.31
- Liwan Gadu Area	9,000	Enrile & Sta. Maria	22,900	3,800	2,900	3.10
- Enrile Area	4,100	Solana, Enrile & Rizal	23,500	4,100	3,800	1.08
- Magsaysay Area	10,000	Magsaysay, Sto. Tomas & Cabagan	30,200	5,300	4,800	2.08
(Total)	31,200		97,300	17,000	15,000	2.08
2. Matuno River Development Project	12,680	Bagabag, Solano, Bayombong, Bambang & Villaverde	79,300	14,300	7,200	1.76
3. Dabubu Irrigation Project	1,000	San Agustin	5,100	900	800	1.25
4. Zinundungan Irrigation Extension Project	1,750	Lasam	5,100	1,000	800	2.18
5. Alcala Amulung West Irrigation Project	6,750	Alcala, Amulung & Solana	12,900	2,400	2,200	3.07
6. Tuguegarao Irrigation Project	1,450	Tuguegarao	8,800	1,500	900	1.61
7. Lulutan Irrigation Project	2,950	Ilagan	13,000	2,200	1,800	1.64
8. Ilagan Irrigation Project	3,200	Ilagan & Benito Soliven	26,900	4,700	3,800	0.84
9. Gappal Irrigation Project	4,400	Naguilian, Cauayan & Angadanan	21,000	3,600	2,600	1.69
Total	65,330		269,400	47,400	35,100	1.86

Source: Barangay Population Statistics 1980 and
Urban andrural population projection 1980, NCSO

Table 6.15 Present Crop Production in New Irrigation Schemes

Name of Scheme	Paddy	Corn	Peanuts	Sweet Potato	Tobacco	Sugar Cane	Total Cultivated Area (ha)	Irrigation Area (ha)	Cropping Intensity (%)
1. Chico Stage-II									
a. Cultivated Area (ha)	22,060	7,800	630	100	-	500	31,090	31,200	100
b. Unit Yield (ton/ha)	2.3	0.9	0.7	5.0	-	19			
c. Production (tons)	50,740	7,010	440	500	-	19,500			
2. Matuno									
a. Cultivated Area (ha)	17,050	2,970	320	50	-	-	20,390	12,680	161
b. Unit Yield (ton/ha)	2.6	1.0	0.7	5.0	-	-			
c. Production (tons)	44,300	2,970	220	250	-	-			
3. Dabubu									
a. Cultivated Area (ha)	500	820	90	-	50	-	1,460	1,000	146
b. Unit Yield (ton/ha)	2.2	0.9	0.7	-	0.6	-			
c. Production (tons)	1,100	730	60	-	30	-			
4. Zinundungan Extension									
a. Cultivated Area (ha)	1,750	770	60	-	-	-	2,580	1,750	147
b. Unit Yield (ton/ha)	2.5	1.1	0.7	-	-	-			
c. Production (tons)	4,380	850	40	-	-	-			
5. Alcala-Amulung West									
a. Cultivated Area (ha)	3,850	5,410	580	60	-	230	10,130	6,750	150
b. Unit Yield (ton/ha)	2.2	0.9	0.7	5.0	-	39			
c. Production (tons)	8,470	4,870	410	300	-	8,970			
6. Tuguegarao									
a. Cultivated Area (ha)	250	1,890	230	-	-	-	2,370	1,400	169
b. Unit Yield (ton/ha)	2.2	1.2	0.7	-	-	-			
c. Production (tons)	550	2,270	160	-	-	-			
7. Lulutan									
a. Cultivated Area (ha)	2,410	1,340	110	-	60	-	3,920	2,950	133
b. Unit Yield (ton/ha)	2.2	1.0	0.7	-	0.6	-			
c. Production (tons)	5,300	1,340	80	-	40	-			
8. Ilagan									
a. Cultivated Area (ha)	200	4,840	600	60	300	-	6,000	3,200	188
b. Unit Yield (ton/ha)	2.3	0.9	0.7	5.0	0.6	-			
c. Production (tons)	460	4,360	420	300	180	-			
9. Gappal									
a. Cultivated Area (ha)	3,300	2,420	220	-	110	-	6,050	4,400	138
b. Unit Yield (ton/ha)	2.2	0.9	0.7	-	0.6	-			
c. Production (tons)	7,260	2,180	150	-	70	-			
10. Total									
a. Cultivated Area (ha)	51,370	28,260	2,840	270	520	730	83,990	65,330	129
b. Unit Yield (ton/ha)	2.4	0.9	0.7	5.0	0.6	39			
c. Production (tons)	122,590	26,580	1,980	1,350	310	28,470			

Table 6.16 Present Crop Production in Rehabilitation/Improvement Schemes

Name of Scheme	Irrigated Paddy			Rainfed Paddy	Corn	Peanuts/1	Total Cultivated Area (ha)	Irrigation Service Area (ha)	Cropping Intensity (%)	No. of/2 Irrigated Farmers
	Wet	Dry	Total							
1. Dummun R.I.S.										
a. Cultivated Area (ha)	870	470	1,340	1,200	640	(150)	3,180	2,070	1.54	1,320
b. Unit Yield (ton/ha)	3.7	3.8	3.7	2.4	1.0	0.7				
c. Production (tons)	3,219	1,786	5,005	2,880	640	105				
2. Baggao I.S.										
a. Cultivated Area (ha)	800	870	1,670	940	190	(40)	2,800	1,812	1.55	970
b. Unit Yield (ton/ha)	3.3	3.5	3.4	2.3	1.1	0.7				
c. Production (tons)	2,640	3,045	5,685	2,162	209	28				
3. Solana I.S.										
a. Cultivated Area (ha)	445	695	1,140	2,130	430	(100)	3,700	2,829	1.31	1,300
b. Unit Yield (ton/ha)	3.1	3.1	3.1	2.2	1.2	0.7				
c. Production (tons)	1,380	2,155	3,535	4,686	516	70				
4. Pinacanauan R.I.S.										
a. Cultivated Area (ha)	270	260	530	930	190	(40)	1,650	1,200	1.38	520
b. Unit Yield (ton/ha)	3.2	3.8	3.5	2.3	1.2	0.7				
c. Production (tons)	864	988	1,852	2,139	228	28				
5. Tumauini I.S.										
a. Cultivated Area (ha)	1,430	670	2,100	2,550	1,270	(290)	5,920	3,987	1.48	1,840
b. Unit Yield (ton/ha)	3.4	3.4	3.4	2.3	0.9	0.7				
c. Production (tons)	4,862	2,278	7,140	5,865	1,143	203				
6. Total										
a. Cultivated Area (ha)	3,815	2,965	6,780	7,750	2,720	(620)	17,250	11,898	1.45	5,950
b. Unit Yield (ton/ha)	3.4	3.5	3.4	2.3	1.0	0.7				
c. Production (tons)	12,965	10,252	23,217	17,732	2,736	434				

/1:Intercropping with corn.

/2:The average for recent five years of after completion of the System

Table 6.17 Present Population and Household in Rehabilitation/Improvement Schemes

Name of Scheme	Irrigation/1 Area (ha)	Related Municipality	Total/2 Population	No, of/2 Total Household	No, of/2 Farm Household	Average Irrigation Area per Farm Household (ha)
1. Dummun R.I.S.	2,070	Cattaran	6,600	1,200	1,100	1.88
2. Baggao I.S.	1,812	Baggao	8,600	1,500	1,300	1.39
3. Solana I.S.	2,829	Solana	22,900	4,100	3,500	0.81
4. Pinacanauan R.I.S.	1,200	Peñablanca	10,000	1,800	1,400	0.86
5. Tumauini I.S.	3,987	Tumauini	23,800	4,000	3,200	1.25
Total	11,898		71,900	12,600	10,500	1.13

Source: /1: NIA Regional Office, Cauayan.
/2: Barangay Population Census, NCSO.

Table 6.18 Future Land Use and Harvested Area in Irrigation Development Schemes

I. New Irrigation Scheme

(Unit: ha)

Name of Schemes	Future Land Use			Harvested Area in Paddy Field and Diversified Cropland																		
				Paddy Field (Pattern A or B)						Diversified Cropland (Pattern C)											Total Harvested Area	Total Cropping Intensity (%)
				Paddy			Beans	Total	Cropping Intensity (%)	Corn			Vegetables			Tobacco	Beans	Total	Cropping Intensity (%)		
	Paddy Field	Diversified Cropland	Total Service Area	Wet	Dry	Total	Wet			Wet	Dry	Total	Wet	Dry	Total	Dry	Wet				
1. Chico Mallig IP	28,030	3,170	31,200							2,850	2,220	5,070	320	320	640	630	1,590	7,930	250		
(Pattern A&C)				28,030	28,030	56,060	28,030	84,090	300											92,020	295
(Pattern B&C)				28,030	28,030	56,060	-	56,060	200											63,990	205
2. Matuno RIP	11,050	1,630	12,680							1,470	1,140	2,610	160	160	320	330	820	4,080	250		
(Pattern A&C)				11,050	11,050	22,100	11,050	33,150	300											37,230	294
(Pattern B&C)				11,050	11,050	22,100	-	22,100	200											26,180	206
3. Dabubu RIP	550	450	1,000							400	310	710	50	50	100	90	230	1,130	250		
(Pattern A&C)				550	550	1,100	550	1,650	300											2,780	278
(Pattern B&C)				550	550	1,100	-	1,100	200											2,230	223
4. Zinundungan IEP	1,450	300	1,750							210	270	480	30	30	60	60	150	750	250		
(Pattern A&C)				1,450	1,450	2,900	1,450	4,350	300											5,100	291
(Pattern B&C)				1,450	1,450	2,900	-	2,900	200											3,650	209
5. Alcala Amulung West IP	3,850	2,900	6,750							2,610	2,030	4,640	290	290	580	580	1,450	7,250	250		
(Pattern A&C)				3,850	3,850	7,700	3,850	11,550	300											18,800	291
(Pattern B&C)				3,850	3,850	7,700	-	7,700	200											14,950	221
6. Tuguegarao IP	250	1,150	1,400							1,030	800	1,830	120	120	240	230	580	2,880	250		
(Pattern A&C)				250	250	500	250	750	300											3,630	250
(Pattern B&C)				250	250	500	-	500	200											3,380	233
7. Lulutan IP	2,410	540	2,950							490	380	870	50	50	100	110	270	1,350	250		
(Pattern A&C)				2,410	2,410	4,820	2,410	7,230	300											8,580	312
(Pattern B&C)				2,410	2,410	4,820	-	4,820	200											6,170	224
8. Ilagan IP	200	3,000	3,200							2,700	2,100	4,800	300	300	600	600	1,500	7,500	250		
(Pattern A&C)				200	200	400	200	600	300											8,100	253
(Pattern B&C)				200	200	400	-	400	200											7,900	247
9. Gappal IP																					
(Pattern A&C)	3,300	1,100	4,400	3,300	3,300	6,600	3,300	9,900	300	990	770	1,760	110	110	220	220	550	2,750	550	12,650	2882
(Pattern B&C)				3,300	3,300	6,600	-	6,600	200											9,350	213

(to be continued)

(continuation)

II. Rehabilitation/Improvement Scheme

(Unit: ha)

Name of Schemes	Future Land Use			Harvested Area					Cropping Intensity (%)
	Paddy Field	Diversified Cropland	Total Service Area	Paddy			Beans	Total	
				Wet	Dry	Total	Wet		
1. Dummun RIS	2,070	-	2,070						
(Pattern A)				2,070	2,070	4,140	2,070	6,210	300
(Pattern B)				2,070	2,070	4,140	-	4,140	200
2. Baggao IS	1,812	-	1,812						
(Pattern A)				1,742	1,812	3,554	1,812	5,366	296
(Pattern B)				1,812	1,812	3,624	-	3,624	200
3. Solana IS	2,829	-	2,829						
(Pattern A)				2,829	2,829	5,658	2,829	8,487	300
(Pattern B)				2,829	2,829	5,658	-	5,658	200
4. Pinacanauan IS	1,200	-	1,200						
(Pattern A)				1,200	1,200	2,400	1,200	3,600	300
(Pattern B)				1,200	1,200	2,400	-	2,400	200
5. Tumauini IS	3,987	-	3,987						
(Pattern A)				3,730	3,160	6,890	3,987	10,877	273
(Pattern B)				3,987	3,890	7,877	-	7,877	198
* Zinundungan RIS	1,760	-	1,760						
(Pattern A)				1,760	1,760	3,520	1,760	5,280	300
(Pattern B)				1,760	1,760	3,520	-	3,520	200

Table 6.19 Production Cost per Hectare

I. Paddy, Corn and Tobacco

	Unit	Unit Price (₱)	Paddy						Corn				Tobacco			
			Without Project				With Project		Without Project		With Project		Without Project		With Project	
			Rainfed		Irrigated		Irrigated		Rainfed		Irrigated		Rainfed		Irrigated	
1. Level of Unit Yield	(ton/ha)			2.23		3.45		4.75		0.9		3.75		0.6		2.0
2. Farm Inputs			Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)
1) Seed - Paddy	(kg)	8.6	80	688	50	430	46	396								
- Corn	(kg)	18.0							19	342	20	360				
- Tobacco (3,000 seedlings)		72.4											6	435	6	435
2) Fertilizer - N	(kg)	12.4	34	422	70	868	75	930	10	124	75	930	20	248	50	620
- P_2O_5	(kg)	9.1	4	36	14	128	30	273	-	-	85	774	-	-	50	455
- K_2O	(kg)	5.3	4	21	14	74	30	159	-	-	40	212	-	-	50	265
3) Agro-chemicals																
- Liquid	(ℓ)	235	1.5	353	1.7	400	3	705	-	-	2.5	588	2	470	2	470
- Granular	(kg)	21	2.0	42	3.9	82	17	357	-	-	17.0	357	-	-	17	357
Sub-total				1,562		1,982		2,820		466		3,206		1,153		2,602
3. Labor Cost	(man-day)	11														
1) Nursery Preparation			2	22	2	22	3	33	-	-	-	-	3	33	9	99
2) Land Preparation			16	176	16	176	16	176	10	110	11	121	18	198	21	231
3) Transplanting/Planting			18	198	20	220	20	220	9	99	9	99	10	110	11	121
4) Fertilizing			2	22	3	33	3	33	2	22	2	22	3	33	4	44
5) Weeding/Cultivating			4	44	5	55	5	55	7	77	7	77	10	110	11	121
6) Spraying			1	11	2	22	3	33	-	-	2	22	3	33	8	88
7) Irrigating			-	-	2	22	3	33	-	-	2	22	-	-	2	22
8) Harvesting			15	165	16	176	20	220	10	110	12	132	20	220	24	264
9) Threshing			4	44	5	55	13	143	9	99	10	110	32 /1	352	40 /1	440
10) Drying			3	33	4	44	5	55	7	77	8	88	-	-	-	-
11) Others			3	33	3	33	5	55	3	33	7	77	-	-	-	-
Sub-total			68	748	78	858	96	1,056	57	627	70	770	99	1,089	130	1,430
4. Animal Power	(day)	33	13	429	13	429	15	495	14	462	20	660	19	627	30	990
5. Mechanical Power	(day)	620	1	620	2	1,240	2	1,240	-	-	-	-	-	-	-	-
6. Others				171		261		299		75		229		151		248
Total				3,530		4,770		5,910		1,630		4,880		3,020		5,270

Note: /1; Sorting, sticking and others

(to be continued)

(continuation)

II. Peanuts, Sweet Potatoes, Sugar Cane, Beans and Vegetables

	Unit	Unit Price (₱)	Without Project (Rainfed)						With Project (Irrigated)			
			Peanuts		Sweet Potatoes		Sugar Cane		Beans		Vegetables	
1. Level of Unit Yield	(ton/ha)			0.7		5.0		39.0		1.5		13.0
2. Farm Inputs			Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)	Q'ty	Amount(₱)
1) Seed - Peanuts	(kg)	7.9	68	538								
- Sweet Potatoes	(kg)	0.9			450	405						
- Sugar Cane	(1,000 seedlings)	50.0					3.5	175				
- Beans	(kg)	5.4							35	189		
- Vetetables	(kg)	335.0									2	670
2) Fertilizer - N	(kg)	12.4	-	-	15	186	120	1,488	20	248	70	868
- P_2O_5	(kg)	9.1	-	-	15	137	20	182	20	182	90	819
- K_2O	(kg)	5.3	-	-	15	80	20	106	20	106	70	371
3) Agro-chemicals												
- Liquid	(ℓ)	235	-	-	2	470	1.5	353	2	470	8	1,880
- Granular	(kg)	21	-	-	-	-	-	-	-	-	-	-
Sub-total												
3. Labor Cost	(man-day)	11										
1) Nursery Preparation			-	-	2	22	-	-	-	-	-	-
2) Land Preparation			14	154	16	176	3	33	15	165	21	231
3) Transplanting/Planting			4	44	13	143	38	418	5	55	12	132
4) Fertilizing			-	-	1	11	10	110	2	22	16	176
5) Weeding/Cultivating			14	154	3	33	5	55	15	165	15	165
6) Spraying			-	-	1	11	2	22	8	88	36	396
7) Irrigating			-	-	-	-	-	-	2	22	2	22
8) Harvesting			18	198	22	242	40	440	16	176	86	946
9) Threshing			6	66	-	-	-	-	7	77	-	-
10) Drying			4	44	-	-	-	-	4	44	-	-
11) Others			1	11	2	22	4	44	2	22	12	132
Sub-total			61	671	60	660	102	1,122	76	836	200	2,200
4. Animal Power	(day)	33	18	594	25	825	24	792	23	759	20	660
5. Mechanical Power	(day)	620	-	-		-	2	1,240	-	-	-	-
6. Others				87		137		302		140		392
Total				1,890		2,900		5,760		2,930		7,860

Table 6.20 Crop Production under without and with Project Conditions in Irrigation Development Schemes

I. New Irrigation Scheme

Unit : Ton

Item	Proposed Cropping Pattern A&C			Proposed Cropping Pattern B&C		
	Without Project	With Project	Incre-mental	Without Project	With Project	Incre-mental
1. Chico Mallig I P						
Paddy -Wet season	50,738	126,135	75,397	50,738	114,923	64,185
-Dry season	0	140,150	140,150	0	140,150	140,150
(Total)	50,738	266,285	215,547	50,738	255,073	204,335
Corn	7,020	19,013	11,993	7,020	19,013	11,993
Tobacco	0	1,260	1,260	0	1,260	1,260
Vegetables	0	8,320	8,320	0	8,320	8,320
Beans	0	44,430	44,430	0	2,385	2,385
Peanuts	441	0	-441	441	0	-441
Sweet potatoes	500	0	-500	500	0	-500
Sugar cane	19,500	0	-19,500	19,500	0	-19,500
2. Matuno R I P						
Paddy -Wet season	25,415	49,725	24,310	25,415	45,305	19,890
-Dry season	18,900	55,250	36,350	18,900	55,250	36,350
(Total)	44,315	104,975	60,660	44,315	100,555	56,240
Corn	2,970	9,788	6,818	2,970	9,788	6,818
Tobacco	0	660	660	0	660	660
Vegetables	0	4,160	4,160	0	4,160	4,160
Beans	0	17,805	17,805	0	1,230	1,230
Peanuts	224	0	-224	224	0	-224
Sweet potatoes	250	0	-250	250	0	-250
Sugar cane	0	0	0	0	0	0
3. Dabubu R I P						
Paddy -Wet season	1,100	2,475	1,375	1,100	2,255	1,155
-Dry season	0	2,750	2,750	0	2,750	2,750
(Total)	1,100	5,225	4,125	1,100	5,005	3,905
Corn	738	2,663	1,925	738	2,663	1,925
Tobacco	30	180	150	30	180	150
Vegetables	0	1,300	1,300	0	1,300	1,300
Beans	0	1,170	1,170	0	345	345
Peanuts	63	0	-63	63	0	-63
Sweet potatoes	0	0	0	0	0	0
Sugar cane	0	0	0	0	0	0
4. Zinundungan I E P						
Paddy -Wet season	4,375	6,525	2,150	4,375	5,945	1,570
-Dry season	0	7,250	7,250	0	7,250	7,250
(Total)	4,375	13,775	9,400	4,375	13,195	8,820
Corn	847	1,800	953	847	1,800	953
Tobacco	0	120	120	0	120	120
Vegetables	0	780	780	0	780	780
Beans	0	2,400	2,400	0	225	225
Peanuts	42	0	-42	42	0	-42
Sweet potatoes	0	0	0	0	0	0
Sugar cane	0	0	0	0	0	0
5. Alucala Amulung West I P						
Paddy -Wet season	8,470	17,325	8,855	8,470	15,785	7,315
-Dry season	0	19,250	19,250	0	19,250	19,250
(Total)	8,470	36,575	28,105	8,470	35,035	26,565
Corn	4,869	17,400	12,531	4,869	17,400	12,531
Tobacco	0	1,160	1,160	0	1,160	1,160
Vegetables	0	7,540	7,540	0	7,540	7,540
Beans	0	7,950	7,950	0	2,175	2,175
Peanuts	406	0	-406	406	0	-406
Sweet potatoes	300	0	-300	300	0	-300
Sugar cane	8,970	0	-8,970	8,970	0	-8,970
6. Tuguegarao I P						
Paddy -Wet season	550	1,125	575	550	1,025	475
-Dry season	0	1,250	1,250	0	1,250	1,250
(Total)	550	2,375	1,825	550	2,275	1,725
Corn	2,268	6,863	4,595	2,268	6,863	4,595
Tobacco	0	460	460	0	460	460
Vegetables	0	3,120	3,120	0	3,120	3,120
Beans	0	1,245	1,245	0	870	870
Peanuts	161	0	-161	161	0	-161
Sweet potatoes	0	0	0	0	0	0
Sugar cane	0	0	0	0	0	0

(to be continued)

(continuation)

Unit : Ton

Item	Proposed Cropping Pattern A&C			Proposed Cropping Pattern B&C		
	Without Project	With Project	Incre-mental	Without Project	With Project	Incre-mental
7. Lulutan I P						
Paddy -Wet season	5,302	10,845	5,543	5,302	9,881	4,579
-Dry season	0	12,050	12,050	0	12,050	12,050
(Total)	5,302	22,895	17,593	5,302	21,931	16,629
Corn	1,340	3,263	1,923	1,340	3,263	1,923
Tobacco	36	220	184	36	220	184
Vegetables	0	1,300	1,300	0	1,300	1,300
Beans	0	4,020	4,020	0	405	405
Peanuts	77	0	-77	77	0	-77
Sweet potatoes	0	0	0	0	0	0
Sugar cane	0	0	0	0	0	0
8. Ilagan I P						
Paddy -Wet season	460	900	440	460	820	360
-Dry season	0	1,000	1,000	0	1,000	1,000
(Total)	460	1,900	1,440	460	1,820	1,360
Corn	4,356	18,000	13,644	4,356	18,000	13,644
Tobacco	180	1,200	1,020	180	1,200	1,020
Vegetables	0	7,800	7,800	0	7,800	7,800
Beans	0	2,550	2,550	0	2,250	2,250
Peanuts	420	0	-420	420	0	-420
Sweet potatoes	300	0	-300	300	0	-300
Sugar cane	0	0	0	0	0	0
9. Gappal I P						
Paddy -Wet season	7,260	14,850	7,590	7,260	13,530	6,270
-Dry season	0	16,500	16,500	0	16,500	16,500
(Total)	7,260	31,350	24,090	7,260	30,030	22,770
Corn	2,178	6,600	4,422	2,178	6,600	4,422
Tobacco	66	440	374	66	440	374
Vegetables	0	2,860	2,860	0	2,860	2,860
Beans	0	5,775	5,775	0	825	825
Peanuts	154	0	-154	154	0	-154
Sweet potatoes	0	0	0	0	0	0
Sugar cane	0	0	0	0	0	0

(to be continued)

(continuation)

II. Rehabilitation/Improvement Scheme

Unit : Ton

Item	Proposed Cropping Pattern A&C			Proposed Cropping Pattern B&C		
	Witout Project	With Project	Incre-mental	Witout Project	With Project	Incre-mental
1. Dummun R I S						
Paddy-Irrigated(Wet)	3,219	9,315	6,096	3,219	8,487	5,268
(Dry)	1,786	10,350	8,564	1,786	10,350	8,564
-Rainfed (Wet)	2,880	0	-2,880	2,880	0	-2,880
(Total)	7,885	19,665	11,780	7,885	18,837	10,952
Beans	0	3,105	3,105	0	0	0
Corn	640	0	-640	640	0	-640
Peanuts	105	0	-105	105	0	-105
2. Baggao I S						
Paddy-Irrigated(Wet)	2,640	7,839	5,199	2,640	7,429	4,789
(Dry)	3,045	9,060	6,015	3,045	9,060	6,015
-Rainfed (Wet)	2,162	0	-2,162	2,162	0	-2,162
(Total)	7,847	16,899	9,052	7,847	16,489	8,642
Beans	0	2,718	2,718	0	0	0
Corn	209	0	-209	209	0	-209
Peanuts	28	0	-28	28	0	-28
3. Solana I S						
Paddy-Irrigated(Wet)	1,380	12,731	11,351	1,380	11,599	10,219
(Dry)	2,155	14,145	11,990	2,155	14,145	11,990
-Rainfed (Wet)	4,686	0	-4,686	4,686	0	-4,686
(Total)	8,221	26,876	18,655	8,221	25,744	17,523
Beans	0	4,244	4,244	0	0	0
Corn	516	0	-516	516	0	-516
Peanuts	70	0	-70	70	0	-70
4. Pinacanauan I S						
Paddy-Irrigated(Wet)	864	5,400	4,536	864	4,920	4,056
(Dry)	988	6,000	5,012	988	6,000	5,012
-Rainfed (Wet)	2,139	0	-2,139	2,139	0	-2,139
(Total)	3,991	11,400	7,409	3,991	10,920	6,929
Beans	0	1,800	1,800	0	0	0
Corn	228	0	-228	228	0	-228
Peanuts	28	0	-28	28	0	-28
5. Tumauini I S						
Paddy-Irrigated(Wet)	4,862	16,785	11,923	4,862	16,347	11,485
(Dry)	2,278	15,800	13,522	2,278	19,450	17,172
-Rainfed (Wet)	5,865	0	-5,865	5,865	0	-5,865
(Total)	13,005	32,585	19,580	13,005	35,797	22,792
Beans	0	5,981	5,981	0	0	0
Corn	1,143	0	-1,143	1,143	0	-1,143
Peanuts	203	0	-203	203	0	-203
(6. Zinundungan R I S)						
Paddy-Irrigated(Wet)	3,959	7,920	3,961	3,959	7,216	3,257
(Dry)	3,003	8,800	5,797	3,003	8,800	5,797
-Rainfed (Wet)	1,700	0	-1,700	1,700	0	-1,700
(Total)	8,662	16,720	8,058	8,662	16,016	7,354
Beans	0	2,640	2,640	0	0	0
Corn	473	0	-473	473	0	-473
Peanuts	70	0	-70	70	0	-70

Table 6.21 Unit Design Discharge

Name of Scheme	Unit Design Discharge (ℓ/s/ha)	
	Cropping Pattern-A	Cropping Pattern-B
1. New Schemes		
(1) Chico River Irrigation Project Stage II	1.66	1.68
(2) Matuno River Development Project	1.50	1.56
(3) Dabubu River Irrigation Project	1.22	1.15
(4) Zinundungan Irrigation Extension Project	1.48	1.48
(5) Alcala Amulung West Irrigation Project	1.39	1.36
(6) Tuguegarao Irrigation Project	1.10	0.99
(7) Lulutan Irrigation Project	1.42	1.39
(8) Ilagan Irrigation Project	0.95	0.91
(9) Gappal Irrigation Project	1.36	1.33
2. Rehabilitation Schemes		
(1) Dummun River Irrigation System	1.86	1.90
(2) Baggao Irrigation System	1.77	1.77
(3) Solana-Tuguegarao Irrigation System	1.77	1.77
(4) Pinacanauan Irrigation System	1.77	1.77
(5) Tumauini Irrigation System	1.80	1.77

Table 6.22 Salient Features of New Irrigation Schemes

Salient Features of Chico Hallig Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	31,200	31,200
2. Dam & Reservoir		
a) Require storage volume (10^6 m³)	537	480
3. Irrigation Facilities (km)		
a) Diversion canal		
- Open channel	31.4	
- Tunnel	3.3	
b) Main canal (km)	134.5	
c) Lateral/sublateral canals (km)	416.1	
d) Bifurcation (Nos)	5	
e) Headgate (Nos)	140	
f) Turnouts (Nos)	870	
g) Other Strectures (Nos)	940	
4. Drainage Facilities		
a) Main & Collector drains (km)	76.9	
b) Structures (Nos)	20	
5. O & M roads (km)	356.0	

Salient Features of Dabubu Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	1,000	1,000
2. Dam & Reservoir		
a) Required storage volume (10^6. m³)	2.0	1.5
3. Headworks		
a) Diversion weir (Lm x Hm)	200x2	
b) Intake (Bm x Hm x Nos)	2.0x1.5x1	
4. Irrigation Facilities		
a) Main canal (km)	13.6	
b) Lateral/sublateral canals (km)	19.0	
c) Headgates (Nos)	5	
d) Turnouts (Nos)	24	
e) Other structures (Nos)	35	
5. Drainage Facilities		
a) Main & Collector drains (km)	-	
b) Structures (Nos)	-	
6. O & M roads (km)	32.6	

Salient Features of Zinundungan Irrigation Extension Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	1,750 (3,510) /1	1,750 (3,510)
2. Dam & Reservoir		
a) Required storage volume (10^6m³)	53.1	34.7
3. Irrigation Facilities		
a) Main canal (km)	-	
b) Lateral/sublateral canal (km)	37.0	
c) Headgate (Nos)	4	
d) Turnouts (Nos)	43	
e) Other structures (Nos)	69	
4. Drainage Facilities		
a) Main & Collector drains (km)	-	
b) Structures (Nos)	-	
5. O & M roads (km)	32.8	

/1 Including existing service area of Zinundungan RIS.

Salient Features of Matuno River Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	12,680	12,680
2. Dam & Reservoir		
a) Required storage volume (10^6 m³)	66.7	45.5
3. Headworks		
a) Manamtum		
- Weir (Lm x Hm)	127x2.5	
- Intake (Bm x Hm x Nnos)	2.0x1.5x1	
b) Bayombon		
- Weir (Lm x Hm)	305x1.6	
- Intake (Bm x Hm x Nnos)	3.85x1.5x4	
c) Lanog		
- Weir (Lm x Hm)	35x1.8	
- Intake (Bm x Hm x Nnos)	1.5x0.8x2 2.0x1.0x2	
4. Irrigation Facilities		
a) Main canal		
- Existing canal with rehab. (km)	32.4	
- New canal (km)	58.0	
b) Lateral/sublateral canal		
- Existing canal with rehab. (km)	98.6	
- New canal (km)	94.8	
c) Headgates (Nos)	2	
d) Turnouts (Nos)	370	
e) Other structures (Nos)	1,390	
5. Drainage Facilities		
a) Main & Collector drains (km)	194.9	
b) Structures (Nos)	80	
6. O & M roads (km)	343.9	

Salient Features of Alcala Amulung West Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	6,750	6,750
2. Pump Station		
a) Pump type	Vertical mixed flow	
b) Total head (m)	28.6	
c) Unit capacity (m³/min)	112	
d) Bore (mm)	1,000	
e) Nos of Unit	6	
3. Irrigation Facilities		
a) Main canal (km)	27.8	
b) Lateral/sublateral canals (km)	91.9	
c) Headgates (Nos)	22	
d) Turnouts (Nos)	170	
e) Other structures (Nos)	220	
4. Drainage Facilities		
a) Main & Collector drains (km)	9.0	
b) Structures (Nos)	1	
5. O & M roads (km)	59.5	

(to be continued)

(continuation)

Salient Features of Tuguegarao Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	1,400	1,400
2. Pump Station		
a) Pump type	Vertical mixed flow	
b) Total head (m)	23.1	
c) Unit capacity (m³/min)	31.8	
d) Bore (mm)	500	
e) Nos of Unit	4	
3. Irrigation Facilities		
a) Main canal (km)	9.5	
b) Lateral/sublateral canals (km)	14.9	
c) Headgates (Nos)	6	
d) Turnouts (Nos)	28	
e) Other structures (Nos)	44	
4. Drainage Facilities		
a) Main & Collector drains (km)	6.8	
b) Structures (Nos)	4	
5. O & M roads (km)	16.0	

Salient Features of Cappal Irrigation Project (Case-1)

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	4,400	4,400
2. Pump Station		
a) Pump type	Vertical mixed flow	
b) Total head (m)	32.9	
c) Unit capacity (m³/min)	119.6	
d) Bore (mm)	1,000	
e) Nos of Unit	4	
3. Irrigation Facilities		
a) Main canal (km)	40.3	
b) Lateral/sublateral canals (km)	44.1	
c) Headgates (Nos)	15	
d) Turnouts (Nos)	120	
e) Other structures (Nos)	170	
4. Drainage Facilities		
a) Main & Collector drains (km)	-	
b) Structures (Nos)	-	
5. O & M roads (km)	53.0	

Salient Features of Lulutan Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	2,950	2,950
2. Pump Station		
a) Pump type	Vertical mixed flow	
b) Total head (m)	26.0	
c) Unit capacity (m³/min)	83.8	
d) Bore (mm)	800	
e) Nos of Unit	4	
3. Irrigation Facilities		
a) Main canal (km)	13.5	
b) Lateral/sublateral canals (km)	27.0	
c) Headgates (Nos)	10	
d) Turnouts (Nos)	74	
e) Other structures (Nos)	84	
4. Drainage Facilities		
a) Main & Collector drains (km)	18.9	
b) Structures (Nos)	4	
5. O & M roads (km)	23.2	

Salient Features of Cappal Irrigation Project (Case-2)

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	4,400	4,000
2. Dam & Reservoir /1 (Required storage volume 10^6 m³)		
a) Colorado dam	38.4	42.1
b) Calaocan dam	41.0	28.6
c) Sta Maria dam	18.1	16.2
3. Irrigation Facilities		
a) Headreaches (km)	29.4	
b) Main canal (km)	32.2	
c) Lateral/sublateral canals (km)		
d) Headgates (Nos)	15	
e) Turnouts (Nos)	120	
f) Other structures (Nos)	200	
4. Drainage Facilities		
a) Main & Collector drains (km)	-	
b) Structures (Nos)	-	
5. O & M roads (km)	82.4	

/1 Salient features of the dam and appurtenant facilities are shown in ANNEX DA.

Salient Features of Ilagan Irrigation Project

Works	Quantities	
	Cropping Pattern-A	Cropping Pattern-B
1. Net Project Area (ha)	3,200 (5,500) /1	3,200 (5,500)
2. Pump Station		
a) Pump type	Vertical mixed flow	
b) Total head (m)	19.0	19.0
c) Unit capacity (m³/min)	114.9	106.1
d) Bore (mm)	1,000	900
e) Nos of Unit	5	5
3. Irrigation Facilities		
a) Main canal (km)	16.9	
b) Lateral/sublateral canals (km)	46.2	
c) Headgates (Nos)	15	
d) Turnouts (Nos)	86	
e) Other structures (Nos)	120	
4. Drainage Facilities		
a) Main & Collector drains (km)	6.0	
b) Structures (Nos)	3	
5. O & M roads (km)	51.6	

/1 Including 2,300 ha of Tumauini RIS area which would be served by Ilagan Pumping Station

Table 6.23 Salient Features of Rehabilitation/Improvement Schemes

Salient Features of
Dumaun River Irrigation System

Works	Existing Facilities	Proposed Works	
		Rehabilitation	New Construction
1. Dam & Reservoir			
a) Required storage volume (10^6 m³)	-	-	24.1/1 14.2/2
2. Headworks			
a) Intake (Bm x Hm x Nos)	1.3x0.9x3	-	-
3. Irrigation Facilities			
a) Main canal (km)	20.4	18.3	-
b) Lateral/sublateral canals (km)	35.7	22.3	2.7
c) Headgates (Nos)	9	2	-
d) Turnouts (Nos)	66	55	-
e) Other structures (Nos)	194	36	1
4. Drainage Facilities			
a) Drainage canals (km)	25.7	25.7	-
b) Structures (Nos)	7	-	-
5. O & M roads			
a) Roads (km)	35.3	29.5	9.7
b) Gravel metalling (km)	5.8	29.5	9.7
6. On-Farm Facilities			
a) Farm ditches (km)	81.5	65.3	63.4
b) Farm drains (km)	-	-	136.0

/1 For cropping pattern-A
/2 For cropping pattern-B

Salient Features of
Solana-Iuguegarao Irrigation System

Works	Existing Facilities	Proposed Works	
		Rehabilitation	New Construction
1. Pumping Station	(Solana Station)		
a) Pump type	Vertical mixed flow		Vertical mixed flow
b) Bore (mm)	-	-	1,000
c) Pump unit (m³/min)	78	90	109
d) Pump unit (Nos)	4	4	1
2. Irrigation Facilities			
a) Main canal (km)	18.4	11.4	-
b) Lateral/sublateral canal (km)	25.7	10.9	-
c) Headgates (Nos)	8	8	-
d) Turnouts (Nos)	67	63	-
e) Other structures (Nos)	117	5	2
3. Drainage Facilities			
a) Drainage canals (km)	12.9	12.9	-
b) Structures (Nos)	3	-	-
4. O & M roads			
a) Roads (km)	32.9	16.9	-
b) Gravel metalling (km)	16.0	16.9	-
5. On-Farm Facilities			
a) Farm ditches (km)	118.7	90.2	79.4
b) Farm drains (km)	-	-	187.0

Salinet Festures of
Baggao Irrigation System

Works	Existing Facilities	Proposed Works	
		Rehabilitation	New Construction
1. Dam & Reservoir			
a) Required storage volume (10^6 m³)	-	-	18.1/1 10.1/2
2. Headworks			
a) Intake (Bm x Hm x Nos)			
- Pared	1.2x1.2x1	-	-
- Paranan	1.6x1.4x1	-	-
3. Irrigation Facilities			
a) Main canal (km)	24.8	9.8	-
b) Lateral/sublateral canal (km)	34.7	4.0	-
c) Headgates (Nos)	13	4	-
d) Turnouts (Nos)	76	49	-
e) Other structures (Nos)	303	42	6
4. Drainage Facilities			
a) Drainage canals (km)	13.1	13.1	-
b) Strucutres (Nos)	24	-	-
5. O & M roads			
a) Roads (km)	28.2	3.4	27.9
b) Gravel metalling (km)	24.8	3.4	27.9
6. On-Farm Facilities			
a) Farm ditches (km)	116.0	102.0	11.0
b) Farm drains (km)	-	-	120.0

/1 For cropping pattern-A
/2 For cropping pattern-B

Salient Features of
Pinacanauan Irrigation System

Works	Existing Facilities	Proposed Works	
		Rehabilitation	New Construction
1. Headworks			
a) Intake (Bm x Hm x Nos)	1.4x0.8x2	-	-
2. Irrigation Facilities			
a) Main canal (km)	23.1	8.2	-
b) Lateral/sublateral canal (km)	10.6	6.1	-
c) Headgates (Nos)	5	2	-
d) Turnouts (Nos)	71	71	-
e) Other structures (Nos)	161	29	-
3. Drainage Facilities			
a) Drainage canals (km)	2.9	-	-
b) Structures (Nos)	-	-	-
4. O & M roads			
a) Roads (km)	26.4	25.4	3.3
b) Gravel metalling (km)	1.0	25.4	3.2
5. On-Farm Facilities			
a) Farm ditches (km)	34.7	23.9	49.3
b) Farm drains (km)	-	-	79.0

(to be continued)

(continuation)

Salient Features of
Tunauini Irrigecion System

Works	Existing Facilities	Proposed Works	
		Rehabilitation	New Construction
1. Dam & Reservoir			
a) Required storage volume (10^6 m³)	-	-	(6.9)/1 (4.3)/2
2. Headworks			
a) Intake (Nos x Nos x Nos)	1.2x0.9x4	-	-
3. Booster Pump (Nos)	-	-	(800mm x 4units)/1 (700mm x 4units)/2
4. Irrigation Facilities			
a) Main canal (km)	23.5	9.6	-
b) Lateral/sublateral canal (km)	82.3	29.8	10.0
c) Headgates (Nos)	21	13	3
d) Turnouts (Nos)	183	40	-
e) Other structures (Nos)	322	84	6
5. Drainage Facilities			
a) Drainage canals (km)	23.3	23.3	-
b) Structures (Nos)	11	-	-
6. O & M roads			
a) Roads (km)	52.0	16.4	38.4
b) Gravel metalling (km)	35.5	16.4	38.4
7. On-Farm Facilities			
a) Farm ditches (km)	118.0	41.2	16.1
b) Farm drains (km)	11.6	4.1	252.0

/1 For the cropping pattern-A

/2 For the cropping pattern-B

Table 6.24 Possibly Maximum Irrigation Area

(Dependability of 80%)

Name of System	Service Area (ha)	Irrigation Area (ha)			
		Cropping Pattern-A		Cropping Pattern-B	
		Paddy	Beans	Paddy	Beans
Dummun RIS	2,070	1,390(0.67)	2,070(1.00)	2,420(1.17)	-
Baggao IS	1,812	1,790(0.99)	1,812(1.00)	2,308(1.27)	-
Pared Area	549	1,030(1.88)	549(1.00)	1,098(2.00)	-
Paranan Area	1,263	760(0.60)	1,263(1.00)	1,210(0.96)	-
Solana-Tugeugarao IS/1	2,829	3,630(1.28)	2,829(1.00)	3,610(1.28)	-
Pinacanauan RIS	1,200	2,400(2.00)	1,200(1.00)	2,400(2.00)	-
Tumauini IS	3,987	2,290(0.57)	3,987(1.00)	3,820(0.96)	-

Note:

- Figures in parentheses show multi-cropping index.
- Out of the Solana-Tuguegarao service area (3,143 ha), Solana area of 314 ha is abandoned due to change of land use.
- Annual irrigation area is estimated assuming that present pump capacity will be restored to the nominal one.

Table 6.25 Unit Cost for Irrigation System

Work Item	Unit	Unit Cost (₱)		
		F.C.	L.C.	Total
1. Excavation	m^3			
headworks, earth		25	15	40
large canal, earth		15	10	25
small canal, earth		-	30	30
rock		90	60	150
2. Embankment	m^3			
excavated material		15	5	20
borrowed material		40	20	60
3. Backfill	m^3	15	20	35
4. Reinforcement concrete	m^3	850	600	1,450
5. Plain concrete	m^3	800	550	1,350
6. Lining concrete	m^3	800	550	1,350
7. Reinforcement bar	ton	10,600	4,600	15,200
8. Wooden form	m^2	50	200	250
9. Stone masonry	m^3	690	560	1,250
10. Concrete pipe	m			
ϕ400		260	150	410
ϕ500		360	190	550
ϕ600		450	250	700
ϕ700		550	300	850
ϕ800		780	420	1,200
ϕ1,000		910	490	1,400
11. Gravell metalling	m^2	20	15	35

Table 6.26 Project Cost For Each Candidate Scheme

UNIT : 10^6 P

	CHICO-MALLIG		MATUNO		DABUBU		ZINUNDUNGAN		ALCALA-AMULUNG	
	A	B	A	B	A	B	A	B	A	B
I. DAM & RESERVOIR										
1. DIRECT COST	-	-	-	-	18.38	17.23	-	-	-	-
2. INDIRECT COST	-	-	-	-	3.05	2.87	-	-	-	-
3. CONTINGENCY	- *	- *	- *	- *	3.21	3.02	- *	- *	-	-
4. TOTAL	1188.68	1153.08	578.28	460.46	24.63	23.12	226.13	197.40	-	-
II. IRRIGATION										
1. DIRECT COST	1576.34	1576.34	576.93	576.93	55.13	55.13	48.19	48.19	319.58	319.58
2. INDIRECT COST	282.86	282.87	104.00	104.00	9.60	9.60	9.71	9.71	57.61	57.61
3. CONTINGENCY	278.88	278.88	102.14	102.14	9.71	9.71	8.69	8.69	56.58	56.58
4. TOTAL	2138.09	2138.10	783.07	783.07	74.44	74.44	66.59	66.59	433.77	433.77
GRAND TOTAL	3326.77	3291.18	1361.35	1243.53	99.07	97.56	292.72	263.99	433.77	433.77

UNIT : 10^6 P

	TUGUEGARAO		LULUTAN		ILAGAN		GAPPAL-PUMP		GAPPAL-DAM	
	A	B	A	B	A	B	A	B	A	B
I. DAM & RESERVOIR										
1. DIRECT COST	-	-	-	-	-	-	-	-	287.99	269.73
2. INDIRECT COST	-	-	-	-	-	-	-	-	56.10	52.25
3. CONTINGENCY	-	-	-	-	-	-	-	-	51.61	48.29
4. TOTAL	-	-	-	-	-	-	-	-	395.70	370.27
II. IRRIGATION										
1. DIRECT COST	73.34	73.34	135.37	135.37	121.81	120.45	226.89	226.89	153.69	153.69
2. INDIRECT COST	12.97	12.97	24.58	24.58	22.67	22.39	40.02	40.02	29.14	29.14
3. CONTINGENCY	12.94	12.94	23.99	23.99	21.66	21.43	40.04	40.04	27.43	27.43
4. TOTAL	99.25	99.25	183.94	183.94	166.14	164.27	306.95	306.95	210.26	210.25
GRAND TOTAL	99.25	99.25	183.94	183.94	166.14	164.27	306.95	306.95	605.96	580.52

UNIT : 10^6 P

	DUNHUN		BAGGAO		SOLANA-TUGUEGARAO		PINACANAUAN		TUMAUINI	
	A	B	A	B	A	B	A	B	A	B
I. DAM & RESERVOIR										
1. DIRECT COST	-	-	-	-	-	-	-	-	47.69	52.25
2. INDIRECT COST	-	-	-	-	-	-	-	-	10.60	8.20
3. CONTINGENCY	- *	- *	- *	- *	-	-	-	-	11.74	9.07
4. TOTAL	354.56	312.62	355.46	280.93	-	-	-	-	90.03	69.52
II. IRRIGATION										
1. DIRECT COST	24.95	24.95	19.07	19.07	53.89	53.89	16.80	16.80	215.71	199.00
2. INDIRECT COST	4.94	4.94	3.90	3.90	9.70	9.70	3.21	3.21	35.05	32.50
3. CONTINGENCY	4.48	4.48	3.44	3.44	9.54	9.54	3.00	3.00	37.61	34.73
4. TOTAL	34.37	34.37	26.41	26.41	73.13	73.13	23.01	23.01	288.37	266.23
GRAND TOTAL	388.93	346.99	381.87	307.34	73.13	73.13	23.01	23.01	378.4	335.75

*) ALLOCATED COST

Note: A: Cropping pattern-A
B: Cropping pattern-B

Table 6.27 Economic Cost for Each Candidate Scheme

UNIT;P10^6

ITEMS	CHICO-MALLIG		MATUNO		DABUBU		ZINUNDUNGAN		ALCALA- AMULUNG	
	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B
1. DAM	1098.03	1065.50	543.93	433.11	22.38	20.98	208.63	182.12	0.00	0.00
2. IRRIGATION	1888.78	1888.78	718.10	718.10	67.94	67.94	60.67	60.67	403.91	403.91
GRAND-TOTAL	2986.81	2954.28	1262.03	1151.21	90.32	88.92	269.30	242.79	403.91	403.91

UNIT;P10^6

ITEMS	TUGUEGARAO		LULUTAN		ILAGAN		GAPPAL PUMP		GAPPAL DAM	
	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B
1. DAM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	355.05	332.62
2. IRRIGATION	93.09	93.09	172.29	172.29	153.88	152.37	286.80	286.80	192.46	192.46
GRAND-TOTAL	93.09	93.09	172.29	172.29	153.88	152.37	286.80	286.80	547.51	525.08

UNIT;P10^6

ITEMS	DUMUN		BAGAO		SOLANA TUGUEGARAO		PINANCANAUAN		TUMAUINI	
	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B	PAT-A	PAT-B
1. DAM	327.76	288.99	328.59	259.69	0.00	0.00	0.00	0.00	82.94	64.07
2. IRRIGATION	31.03	31.03	23.91	23.91	68.13	68.13	20.98	20.98	271.08	250.08
GRAND-TOTAL	358.79	320.02	352.50	283.60	68.13	68.13	20.98	20.98	354.02	314.15

Table 6.28 Summary of Financial and Economic Prices for Agricultural Outputs and Inputs

Outputs & Inputs			Financial Price (1985)	Economic Price/1 (1995)
Outputs				
- Paddy (import parity)		(₱/ton)	3,500	3,800
- Corn (import parity)		(₱/ton)	3,000	2,700
- Beans		(₱/ton)	9,900	5,300
- Peanuts		(₱/ton)	7,500	5,700
- Tobacco		(₱/ton)	10,000	18,100
- Sugar cane		(₱/ton)	290	300
- Sweet potatoes		(₱/ton)	900	900
- Vegetables		(₱/ton)	3,700	3,700
Inputs				
(1) Seed	- Paddy	(₱/kg)	7.5	8.6
	- Corn	(₱/kg)	20.0	18.0
	- Beans	(₱/kg)	10.0	5.4
	- Peanuts	(₱/kg)	10.4	7.9
	- Tobacco	(₱/3,000 seedlings)	40.0	72.4
	- Vegetables	(₱/kg)	335.0	335.0
(2) Fertilizer	- N	(₱/kg)	9.7	12.4
	- P_2O_5	(₱/kg)	9.5 /2	9.1
	- K_2O	(₱/kg)	9.5 /2	5.3
(3) Agro-chemicals/3	- Liquid	(₱/ℓ)	220	235
	- Granular	(₱/kg)	20	21
(4) Labor		(₱/day)	25	11 /4
(5) Hired animal		(₱/day)	33	33
(6) Operation cost of farm machinery		(₱/day)	620	620

/1 : 1985 constant price

/2 : Economic price of agro-chemicals are estimated as below:

$EP = FP \times SP \times IR$

EP ; Economic price of agro-chemicals
FP : Financial price of agro-chemicals
SP : Conversion factor for shadow price (0.82)
IR : Average increased rate of price for fertilizer from 1985 to 1995 (1.30)

	1985 Cosntant Price		Average Increased Rate
	1985 (US$/ton)	1995 (US$/ton)	
Urea	136	209	1.54
T.S.P	122	149	1.22
KCl	84	97	1.15
Average			1.30

(Source:: IBRD Price Projection)

/3 : Estimated on the basis of compound fertilizer (14:14:14)

/4 : Adjusted by the conversion factor of 0.52 for rural unskilled labor and consumption conversion factor of 0.84 as follows:.

Conversion factor to economic price (0.44) = 0.52 x 0.84

Table 6.29 Annual Incremental Benefits in Irrigation Development Schemes

Name of Scheme	Total Annual Incremental Benefit (10^3P)		Annual Incremental Benefit per ha (P/ha)	
	Proposed Cropping Pattern		Proposed Cropping Pattern	
	A&C	B&C	A&C	B&C
New Irrigation Scheme				
(1) Chico Mallig IP	778,335	596,421	24,946	19,116
(2) Matuno RIP	259,526	187,810	20,467	14,811
(3) Dabubu RIP	24,135	20,565	24,135	20,565
(4) Zinundungan IEP	61,032	49,034	22,563	17,186
	(21,547) /1	(18,960) /1	(12,242) /1	(10,772) /1
(5) Alcala Amulung West IP	159,980	134,993	23,701	19,999
(6) Tuguegarao IP	32,887	31,264	23,491	22,331
(7) Lulutan IP	70,350	54,709	23,847	18,545
(8) Ilagan IP	72,672	71,374	22,710	22,305
(9) Gappal IP	105,041	83,624	23,873	19,006
Rehabilittion/Improvement Scheme				
(1) Dummun RIS	41,328	27,893	19,965	13,475
(2) Baggao IS	33,527	22,567	18,503	12,454
(3) Solana IS	63,341	44,981	22,390	15,900
(4) Pinacanauan IS	25,679	17,891	21,399	14,909
(5) Tumauini IS	71,444	57,896	17,919	14,521

/1 : Irrigation benefits derived from the water supply to the existing Zinundungan River Irrigation System.

Table 6.30 Summary of Annual Equivalent Flood Damages in Irrigation Development Schemes

(Unit: 10⁶P)

Name of Scheme	Proposed Cropping Pattern	
	A&C	B&C
New Irrigation Scheme		
(1) Chico Mallig IP	28.35	20.24
(2) Matuno RIP	31.78	22.64
(3) Dabubu RIP	-	-
(4) Zinundungan IEP & RIS	10.77	7.04
(5) Alcala Amulung West P	27.34	22.07
(6) Tuguegarao IP	4.46	4.11
(7) Lulutan IP	1.61	1.19
(8) Ilagan IP	3.69	3.67
(9) Gappal IP	2.83	2.34
Rehabilitation/Improvement Scheme		
(1) Dummun RIS	3.17	1.96
(2) Baggao IS	-	-
(3) Solana IS	10.22	6.36
(4) Pinacanauan IS	-	-
(5) Tumauini IS	3.94	2.45

Table 6.31 Annual Production Foregone in Irrigation Devleopment Schemes

(Unit: 10⁶P)

Name of Scheme	Proposed Cropping Pattern A&C		Proposed Cropping Pattern B&C	
	Dam Reservoir	Irrigation Facility	Dam Reservoir	Irrigation Facility
New Irrigation Scheme				
(1) Chico Mallig IP	1.42	3.21	1.37	3.21
(2) Matuno RIP	-	2.40	-	2.40
(3) Dabubu RIP	-	0.10	-	0.10
(4) Zinundungan IEP	0.40	0.28	0.37	0.28
(5) Alcala Amulung West IP	-	0.75	-	0.75
(6) Tuguegarao IP	-	0.11	-	0.11
(7) Lulutan IP	-	0.42	-	0.42
(8) Ilagan IP	-	0.25	-	0.25
(9) Gappal IP				
- Dam	0.09	0.65	0.07	0.65
- Pump	-	0.54	-	0.54

Table 6.32 Economic Internal Rate of Returns for Irrigation Devlopment Schemes

(Unit: %)

Name of Scheme	Proposed Cropping Pattern A&C	B&C
New Irrigation Scheme		
(1) Chico Mallig IP	15.7	12.9
(2) Matuno RIP	12.4	10.1
(3) Dabubu RIP	19.5	17.2
(4) Zinundungan IEP	13.4	12.5
(5) Alcala Amulung West IP	17.3	14.9
(6) Tuguegarao IP	19.4	18.7
(7) Lulutan IP	22.8	18.0
(8) Ilagan IP	28.0	27.7
(9) Gappal IP - Pump	20.2	16.2
- Dam	13.5	11.4
Rehabilitation/Improvement Scheme		
(1) Dummun RIS	8.0	5.7
(2) Baggao IS	7.3	5.7
(3) Solana IS	39.0	28.5
(4) Pinacanauan IS	75.7	56.0
(5) Tumauini IS	12.6	11.7

Table 6.33 Net Farm Income per ha of Irrigation Development Schemes (Financial Price)

(Unit: 10^3 P/ha)

Name of Scheme	Proposed Cropping Pattern A & C			Proposed Cropping Pattern B & C		
	Without Project	With Project	(2)/(1)	Without Project	With Project	(4)/(3)
	(1)	(2)		(3)	(4)	
New Irrigation Scheme						
(1) Chico Mallig IP	4	32	8.0	4	20	5.0
(2) Matuno RIP	8	30	3.8	8	20	2.5
(3) Dabubu RIP	4	30	7.5	4	24	6.0
(4) Zinundungan IEP	6	27	4.5	6	19	3.2
(5) Alcala Amulung West IP	4	24	6.0	4	18	4.5
(6) Tuguegarao IP	4	24	6.0	4	22	5.5
(7) Lulutan IP	5	29	5.8	5	18	3.6
(8) Ilagan IP	3	26	8.7	3	25	8.3
(9) Gappal IP - Pump	4	28	7.0	4	18	4.5
- Dam	4	31	7.8	4	22	5.5
Rehabilitation / Improvement Scheme						
(1) Dummun RIS	9	32	3.6	9	20	2.2
(2) Baggao IS	9	33	3.7	9	20	2.2
(3) Solana IS	6	28	4.7	6	16	2.7
(4) Pinacanauan IS	7	33	4.7	7	20	2.9
(5) Tumauini IS	7	27	3.9	7	18	2.6

Table 6.34 Number of Beneficiaries per ha of Irrigation Service Area

(Unit: person/ha)

Name of Scheme	Beneficialies per ha (person/ha)	Index (Total Average = 100)
New Irrigation Scheme		
(1) Chico Mallig IP	3.1	71
(2) Matuno RIP	6.3	141
(3) Dabubu RIP	5.1	115
(4) Zinundungan IEP	2.9	66
(5) Alcala Amulung West IP	1.9	43
(6) Tuguegarao IP	6.1	137
(7) Lulutan IP	4.4	100
(8) Ilagan IP	8.4	190
(9) Gappal IP	4.8	108
(Average)	(4.1)	(93)
Rehabilitation/Improvement Scheme		
(1) Dummun RIS	3.2	72
(2) Baggao IS	4.8	108
(3) Solana IS	8.1	183
(4) Pinacanauan IS	8.3	189
(5) Tumauini IS	6.0	135
(Average)	(6.0)	(137)
Total Average	4.4	100

Table 6.35 Priority Ranking of Irrigation Development Schemes

Name of Scheme	Net Farm Income/1 per Ha under with Project Condition (10^3 ₱/ha)	Ranking by Net Farm Income	Number of Beneficiaries per Ha (Person/ha)	Ranking by Number of Beneficiaries	Overall Ranking
Above 15% of EIRRs					
Pinacanauan IS	33	1	8.3	2	1
Chico Mallig IP	32	2	3.1	8	2
Dabubu RIS	30	3	5.1	5	3
Lulutan IP	29	4	4.4	7	4
Solana IS	28	5	8.1	3	5
Gappal IP (Pump)	28	5	4.8	6	6
Ilagan IP	26	6	8.4	1	7
Tuguegarao IP	24	7	6.1	4	8
Alcala Amulung West IP	24	7	1.9	9	9
Under 15% of EIRRs					
Baggao IS	33	1	4.8	3	10
Dummun RIS	32	2	3.2	4	11
Matuno RIP	30	3	6.3	1	12
Tumauini IS	27	4	6.0	2	13
Zinundungan IEP	27	4	2.9	5	14

Note: /1; Taken the case of proposed cropping pattern A & C.

Table 6.36 Conditions for Irrigation Water Demand Calculation

Name of System/Scheme	Area Code/Base Point No.	Meteoro Station	Rain Gauge	Irrigation Service Area/Irrigation Area (ha)													
				1985			1990			1995			2000			2005		
				SA	W	D	SA	W	D	SA	W	D	SA	W	D	SA	W	D
CISs	UC-3	Consuelo	Consuelo	1,535	370	330	1,535	1,535	460	1,535	1,535	460	1,535	1,535	460	1,535	1,535	460
CIPs	"	"	"	-	-	-	630	630	189	630	630	189	630	630	189	630	630	189
CISs	UC-4	"	"	531	400	350	531	531	350	531	531	350	531	531	350	531	531	350
CISs	UC-5	"	"	445	110	100	445	445	135	445	445	135	445	445	135	445	445	134
CISs	UC-6B	Echague	Ilagan	1,541	1,220	250	1,541	1,541	462	1,541	1,541	462	1,541	1,541	462	1,541	1,541	462
Dabubu River IP	6	"	"	-	-	-	-	-	-	1,000	See Fig. 10.3		1,000	See Fig. 10.3		1,000	See Fig. 10.3	
CIPs		"	"	-	-	-	-	-	-	1,425	1,425	428	2,850	2,850	855	3,680	3,680	1,104
CISs	UC-7	"	"	2,797	780	680	2,797	2,797	840	2,797	2,797	840	2,797	2,797	840	2,797	2,797	840
CIPs	"	"	"	-	-	-	-	-	-	615	615	185	1,550	1,550	465	1,550	1,550	465
Gappal IP	8	"	"	-	-	-	-	-	-	-	-	-	4,400	See Fig. 10.3		4,400	See Fig. 10.3	
CIPs	UC-8B	"	"	-	-	-	-	-	-	-	-	-	480	480	144	1,050	1,050	315
CIPs	UC-9	"	"	-	-	-	-	-	-	-	-	-	-	-	-	300	300	100
Lulutan IP	15	"	"	-	-	-	-	-	-	-	-	-	2,950	See Fig. 10.3		2,950	See Fig. 10.3	
CISs	M-1	Consuelo, Sto Domingo	Consuelo	10,858	8,040	7,170	10,858	10,858	7,170	10,858	10,858	7,170	10,858	10,858	7,170	10,267	10,267	6,780
CIPs	"	"	"	-	-	-	370	370	111	370	370	111	370	370	111	370	370	111
Matuno IP (Manamtam)	10	Sto Domingo, Wacal, Baretbet	Nayon	-	-	-	-	-	-	-	-	-	-	-	-	1,090	See Fig. 10.3	
Matuno IP (Bayombong)	11	"	"	-	-	-	-	-	-	-	-	-	-	-	-	11,590	See Fig. 10.3	
CISs	M-2	Consuelo, Sto Domingo	"	208	90	110	208	208	110	208	208	110	208	208	110	208	208	110
CISs	M-3	Wacal, Baretbet	"	18,015	12,170	11,370	18,015	18,015	11,370	18,015	18,015	11,370	18,015	18,015	11,370	9,376	9,376	5,918
CIPs	"	"	"	-	-	-	200	200	60	1,000	1,000	300	1,000	1,000	300	1,000	1,000	300
Magat RIS	13	Baligatan, Echague	Ilagan	89,800	65,900	62,488	89,800	89,800	89,800	89,800	89,800	89,800	89,800	89,800	89,800	89,800	89,800	89,800
CISs	M-4	Baligatan	Nayon	1,991	860	1,040	1,991	1,991	1,041	1,991	1,991	1,041	1,991	1,991	1,040	1,991	1,991	1,040
CISs	M-5	"	"	110	50	60	110	110	60	110	110	60	110	110	60	110	110	60
Ilagan IP	18	Echague	Ilagan	-	-	-	-	-	-	-	-	-	3,200	See Fig. 10.3		3,200	See Fig. 10.3	
Tumauini IS (Ilagan)	18	"	"	-	-	-	-	-	-	-	-	-	-	-	-	2,300	2,300	2,300
CISs	I-3	"	"	200	160	30	200	200	60	200	200	60	200	200	60	200	200	60
CISs	I-4	"	"	590	470	100	590	590	177	530	530	160	530	530	160	530	530	160
CIPs	"	"	"	-	-	-	570	570	171	800	800	240	800	800	240	800	800	240

(to be continued)

(continuation)

Name of System/Scheme	Area Code/Base Point No.	Meteoro Station	Rain Gauge	Irrigation Service Area/Irrigation Area (ha)														
				1985			1990			1995			2000			2005		
				SA	W	D	SA	W	D	SA	W	D	SA	W	D	SA	W	D
CISs	S-1	Baligatan	Nayon	967	600	840	967	967	840	967	967	840	967	967	840	967	967	840
SIFFU RIS	29	Baligatan, Echague	Ilagan	12,200	9,100	8,400	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200	12,200
CISs	S-3	Baligatan	Naneng	266	150	110	266	266	110	266	266	110	266	266	110	266	266	110
Mallig RIS	31	Alimanao, Tuguegarao	Ilagan	2,427	1,260	1,050	2,427	2,427	1,214	2,427	2,427	1,214	2,427	2,427	1,214	2,427	2,427	1,214
CISs	S-5	"	"	815	550	230	815	815	245	815	815	245	815	815	245	815	815	245
CIPs	"	"	"	-	-	-	570	570	171	1,600	1,600	480	1,600	1,600	480	1,600	1,600	480
CISs	C-1	Bontoc	Bontoc	1,916	1,300	1,860	1,916	1,916	1,860	1,916	1,916	1,860	1,916	1,916	1,860	1,916	1,916	1,860
CISs	C-2	"	Naneng	1,961	1,020	890	1,961	1,961	890	1,961	1,961	890	1,961	1,961	890	1,961	1,961	890
CISs	C-3	"	"	919	540	440	919	919	440	919	919	440	919	919	440	919	919	440
Chico RIS	23	Alimanao, Tuguegarao	Tuguegarao	18,484	11,210	6,970	18,484	18,484	18,484	18,484	18,484	18,484	18,484	18,484	18,484	18,484	18,484	18,484
Chico Mallig IP	30	"	"	-	-	-	-	-	-	31,200	See Fig. 10.3		31,200	See Fig. 10.3		31,200	See Fig. 10.3	
CISs	C-4	"	"	889	510	360	889	889	360	889	889	360	889	889	360	889	889	360
CISs	C-5	"	"	1,019	580	410	1,019	1,019	410	1,019	1,019	410	1,019	1,019	410	1,019	1,019	410
Chico RIS (Chico West)	25	"	Tuao	1,624	1,330	1,150	1,624	1,624	1,624	1,624	1,624	1,624	1,624	1,624	1,624	1,624	1,624	1,624
CISs	C-6	"	"	2,178	810	1,320	2,178	2,178	1,320	2,178	2,178	1,320	1,818	1,818	1,102	1,818	1,818	1,102
CIPs	"	"	"	-	-	-	570	570	171	1,995	1,995	599	2,350	2,350	705	2,350	2,350	705
CISs	LC-1	"	Ilagan	390	310	60	390	390	117	390	390	117	390	390	117	390	390	117
CIPs	"	"	"	-	-	-	200	200	60	200	200	60	200	200	60	200	200	60
Tumauini IS (Tumauini)	33	"	"	3,987	1,450	1,280	3,987	1,450	1,280	3,987	1,450	1,280	3,987	1,450	1,280	1,687	See Fig. 10.3	
San Pablo-Cabagan IS	34	"	Tuguegarao	2,890	60	50	2,890	2,890	1,445	2,890	2,890	1,445	2,890	2,890	1,445	2,890	2,890	1,445
Pinacanauan RIS	35	"	"	1,200	290	290	1,200	See Fig. 10.3		1,200	See Fig. 10.3		1,200	See Fig. 10.3		1,200	See Fig. 10.3	
CISs	LC-5	"	"	3,060	2,420	490	3,060	3,060	918	3,060	3,060	918	1,742	1,742	523	1,742	1,742	523
CIPs	"	"	"	-	-	-	290	290	87	1,715	1,715	515	3,100	3,100	930	3,100	3,100	930
Tuguegarao IP	36	"	"	-	-	-	-	-	-	-	-	-	1,400	See Fig. 10.3		1,400	See Fig. 10.3	
Sol-Tuguegarao IS	37	"	"	3,143	0	960	3,143	0	960	2,829	See Fig. 10.3		2,829	See Fig. 10.3		3,143	See Fig. 10.3	
AI-Amulung West IP	37	"	"	-	-	-	-	-	-	-	-	-	6,750	See Fig. 10.3		6,750	See Fig. 10.3	
CISs	LC-6	"	"	430	150	250	430	430	250	430	430	250	430	430	250	430	430	250
CIPs	"	"	"	-	-	-	-	-	-	1,175	1,175	353	1,220	1,220	366	1,220	1,220	366
CIADP (Iguig Area)	38	"	"	775	410	400	775	775	775	775	775	775	775	775	775	775	775	775
CISs	LC-7	"	"	482	160	280	482	482	280	482	482	280	60	60	35	60	60	35

(to be continued)

(continuation)

Name of System/Scheme	Area Code/Base Point No.	Meteoro Station	Rain Gauge	Irrigation Service Area/Irrigation Area (ha)														
				1985			1990			1995			2000			2005		
				SA	W	D	SA	W	D"	SA	W	D	SA	W	D	SA	W	D
CIPs	LC-7	Alimanao, Tuguegarao	Tuguegarao	-	-	-	-	-	-	375	375	113	1,800	1,800	540	3,650	3,650	1,095
CIADP (Alcala-Amulung Area)	39	"	"	2,350	1,160	1,180	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350
Baggao IS (Pared Area)	40	"	"	549	460	450	549	460	450	549	460	450	549	460	450	549	See Fig. 10.3	
Baggao IS (Paranan Area)	42	"	"	1,263	850	610	1,263	850	610	1,263	850	610	1,263	850	610	1,263	See Fig. 10.3	
CISs	LC-10	"	"	1,981	670	1,130	1,981	1,981	1,130	1,981	1,981	1,130	1,981	1,981	1,130	1,981	1,981	1,130
CIPs	"	"	"	-	-	-	-	-	-	-	-	-	1,370	1,370	411	3,900	3,900	1,170
CISs	LC-11	"	Tuao	76	30	40	76	76	40	76	76	40	76	76	40	76	76	40
Zinundungan RIS	44	"	"	1,760	1,730	1,710	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760
Zinundungan Ext. IP	44	"	"	-	-	-	-	-	-	-	-	-	-	-	-	1,750	See Fig. 10.3	
Dummun RIS	46	"	Aparri	2,070	1,440	1,370	2,070	1,440	1,370	2,070	1,440	1,370	2,070	1,440	1,370	2,070	See Fig. 10.3	
CIPs	LC-12	"	"	-	-	-	-	-	-	-	-	-	200	200	60	200	200	60
CISs	LC-13	"	"	1,340	460	770	1,340	1,340	770	1,190	1,190	684	1,190	1,190	684	1,190	1,190	684
CIPs	"	"	"	-	-	-	-	-	-	-	-	-	845	845	254	2,350	2,350	705
CIADP (Lower Cagayan Area)	47	"	"	10,875	270	60	10,875	10,875	10,875	10,875	10,875	10,875	10,875	10,875	10,875	10,875	10,875	10,875
CISs	LC-14	"	"	780	270	450	780	780	450	780	780	450	780	780	450	780	780	450
CIPs	"	"	"	-	-	-	-	-	-	-	-	-	-	-	-	650	650	195
Total				213,687			217,087			226,063			282,328			296,077		

Table 6.37 Present Irrigation Water Demend (1985)

UNIT: M^3/S

NAME OF SYSTEM	AREA CODE/ BASE POINT NO	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
I. UPPER CAGAYAN BASIN													
CISs	UC-3	0.38	0.46	0.50	0.29	0.11	0.31	0.33	0.18	0.20	0.06	0.00	0.17
CISs	UC-4	0.40	0.49	0.53	0.30	0.12	0.33	0.36	0.19	0.22	0.06	0.00	0.18
CISs	UC-5	0.11	0.14	0.15	0.09	0.03	0.09	0.10	0.05	0.06	0.02	0.00	0.05
CISs	UC-6B	0.25	0.30	0.39	0.21	0.29	1.00	1.50	1.08	0.89	0.21	0.00	0.10
CISs	UC-7	0.69	0.80	1.06	0.56	0.23	0.64	0.96	0.69	0.57	0.13	0.00	0.28
SUB TOTAL		1.83	2.19	2.63	1.45	0.78	2.37	3.25	2.19	1.94	0.48	0.00	0.78
II. MAGAT BASIN													
CISs	M-1	8.52	10.50	11.80	6.87	2.35	7.01	7.79	5.95	5.65	1.93	0.00	3.91
CISs	M-2	0.12	0.15	0.17	0.10	0.03	0.08	0.11	0.08	0.08	0.02	0.00	0.06
CISs	M-3	11.54	20.21	16.66	9.19	3.59	11.30	14.86	13.63	9.85	3.33	0.00	5.47
MAGAT RIS	13	65.07	73.24	14.80	32.19	101.98	71.56	87.84	37.63	0.00	0.00	46.01	37.09
CISs	M-4	1.12	1.36	1.66	1.03	0.30	0.79	1.04	0.90	0.74	0.24	0.00	0.51
CISs	M-5	0.06	0.08	0.10	0.06	0.02	0.05	0.06	0.05	0.04	0.01	0.00	0.03
SUB TOTAL		86.43	105.54	45.19	49.44	108.27	90.79	111.70	58.24	16.36	5.53	46.01	47.07
III. ILAGAN BASIN													
CISs	I-3	0.03	0.04	0.05	0.02	0.04	0.13	0.20	0.14	0.12	0.03	0.00	0.01
CISs	I-4	0.10	0.12	0.16	0.08	0.11	0.39	0.58	0.41	0.34	0.08	0.00	0.04
SUB TOTAL		0.13	0.16	0.21	0.10	0.15	0.52	0.78	0.55	0.46	0.11	0.00	0.05
IV. SIFFU. MALLIG BASIN													
CISs	S-1	0.90	1.10	1.34	0.84	0.22	0.55	0.73	0.63	0.51	0.17	0.00	0.41
SIFFU RIS	29	8.73	9.85	1.99	4.45	14.08	9.88	12.13	5.20	0.00	0.00	6.19	4.99
CISs	S-3	0.12	0.15	0.18	0.11	0.04	0.12	0.16	0.14	0.12	0.04	0.00	0.05
MALLIG RIS	31	1.20	1.56	0.18	0.27	1.63	1.45	1.66	1.40	1.19	0.15	0.77	0.64
CISs	S-5	0.25	0.32	0.39	0.23	0.15	0.50	0.76	0.59	0.43	0.13	0.00	0.10
SUB TOTAL		11.22	12.98	4.08	5.90	16.12	12.50	15.44	7.96	2.25	0.49	6.96	6.19
V. CHICO BASIN													
CISs	C-1	2.30	2.55	2.32	1.01	0.30	0.83	0.52	0.46	0.32	0.24	0.00	0.99
CISs	C-2	1.00	1.16	1.10	0.56	0.24	0.64	0.45	0.39	0.45	0.13	0.00	0.42
CISs	C-3	0.50	0.58	0.54	0.28	0.13	0.34	0.24	0.20	0.24	0.07	0.00	0.21
CHICO RIS	23	9.13	10.35	11.65	1.85	0.00	0.00	4.59	7.57	11.37	8.69	6.90	7.74
CISs	C-4	0.44	0.52	0.63	0.37	0.16	0.50	0.67	0.51	0.41	0.12	0.00	0.18
CISs	C-5	0.50	0.59	0.72	0.42	0.18	0.57	0.76	0.57	0.47	0.14	0.00	0.20
CHICO NEST	25	1.45	1.69	1.91	0.29	0.00	0.00	0.52	0.87	1.35	1.06	0.86	0.86
CISs	C-6	1.56	1.89	2.29	1.29	0.31	0.73	0.99	0.77	0.66	0.19	0.00	0.64
SUB TOTAL		16.88	19.31	21.16	6.07	1.32	3.61	8.74	11.34	15.47	10.64	7.76	11.24
VI. LOWER CAGAYAN BASIN													
CISs	LC-1	0.07	0.08	0.10	0.06	0.06	0.28	0.43	0.33	0.24	0.07	0.00	0.03
TUMAUINI IS	33	1.46	1.90	2.20	0.33	1.87	1.67	1.91	1.61	1.37	0.17	0.94	0.79
S/PAR.CAGA. IS	34	0.06	0.08	0.09	0.01	0.08	0.08	0.07	0.06	0.06	0.01	0.04	0.04
PINACANAUAN RIS	35	0.36	0.45	0.51	0.08	0.39	0.38	0.36	0.30	0.25	0.03	0.22	0.26
CISs	LC-5	0.60	0.71	0.86	0.50	0.62	2.36	3.19	2.40	1.97	0.57	0.00	0.24
S/TUGUEGARAO IS	37	1.24	1.50	1.69	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.85
CISs	LC-6	0.31	0.36	0.44	0.26	0.06	0.15	0.20	0.15	0.12	0.04	0.00	0.12
CIADP(LGUIG)	38	0.52	0.62	0.70	0.11	0.55	0.53	0.51	0.42	0.40	0.05	0.31	0.35
CISs	LC-7	0.34	0.40	0.49	0.29	0.07	0.16	0.21	0.16	0.13	0.04	0.00	0.14
CIADP(A/AMULU)	39	1.53	1.84	2.07	0.32	1.55	1.51	1.45	1.20	1.13	0.14	0.91	1.04
BAGGAO(PARED)	40	0.58	0.70	0.79	0.12	0.61	0.60	0.57	0.48	0.45	0.05	0.35	0.40
BAGGAO(PARANAN)	42	0.79	0.95	1.07	0.17	1.13	1.10	1.06	0.88	0.83	0.10	0.47	0.54
CISs	LC-10	1.38	1.63	1.97	1.16	0.28	0.65	0.88	0.66	0.54	0.16	0.00	0.56
CISs	LC-11	0.05	0.06	0.07	0.04	0.01	0.03	0.04	0.03	0.02	0.01	0.00	0.02
ZINUNDUNGAN RIS	44	2.12	2.64	2.99	0.44	2.16	2.01	2.00	1.72	1.69	0.21	1.35	1.41
DUNHUN RIS	46	1.19	1.88	2.31	0.38	2.01	1.89	1.96	1.62	1.20	0.14	0.94	0.74
CISs	LC-13	0.70	0.97	1.29	0.81	0.20	0.45	0.66	0.50	0.32	0.09	0.00	0.31
CIADP(L/CAGA.)	47	0.05	0.08	0.10	0.02	0.38	0.36	0.37	0.30	0.23	0.03	0.04	0.03
CISs	LC-14	0.41	0.57	0.75	0.47	0.12	0.27	0.38	0.29	0.19	0.05	0.00	0.18
SUB TOTAL		13.78	17.42	20.49	5.83	12.17	14.48	16.25	13.11	11.17	1.96	6.31	8.05
TOTAL		130.27	157.60	93.76	68.79	138.81	124.27	155.16	93.39	47.65	19.21	67.04	73.38

Table 6.38 Future Irrigation Water Demand (2005)

UNIT: M^3/S

NAME OF SYSTEM	AREA CODE/ BASE POINT NO	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
I. UPPER CAGAYAN BASIN													
CISs	UC-3	0.52	0.64	0.70	0.40	0.37	1.28	1.38	0.73	0.85	0.25	0.00	0.24
CIPs	UC-3	0.22	0.26	0.29	0.16	0.15	0.53	0.56	0.30	0.35	0.10	0.00	0.10
CISs	UC-4	0.40	0.49	0.53	0.30	0.14	0.44	0.48	0.25	0.29	0.09	0.00	0.18
CISs	UC-5	0.15	0.19	0.20	0.12	0.11	0.37	0.40	0.21	0.25	0.07	0.00	0.07
CISs	UC-6B	0.47	0.54	0.72	0.38	0.38	1.27	1.90	1.36	1.12	0.26	0.00	0.19
DASUBU IP	6	0.66	0.91	1.09	0.14	0.81	0.56	0.73	0.46	0.21	0.13	0.06	0.39
CIPs	UC-6	1.12	1.30	1.72	0.91	0.92	3.03	4.53	3.25	2.68	0.63	0.00	0.46
CISs	UC-7	0.85	0.99	1.31	0.70	0.70	2.30	3.44	2.47	2.04	0.48	0.00	0.33
CIPs	UC-7	0.47	0.55	0.72	0.39	0.39	1.27	1.91	1.37	1.13	0.26	0.00	0.19
GAPPAL IP	8	3.58	4.55	5.26	0.54	4.37	3.16	3.94	2.51	1.01	0.66	0.24	3.06
CIPs	UC-8B	0.32	0.37	0.49	0.26	0.26	0.86	1.29	0.93	0.77	0.18	0.00	0.13
CIPs	UC-9	0.10	0.12	0.16	0.08	0.08	0.25	0.37	0.27	0.22	0.05	0.00	0.04
LULUTAN IP	15	2.55	3.17	3.63	0.34	3.12	2.28	2.81	1.80	0.70	0.46	0.15	2.16
SUB TOTAL		11.41	14.08	16.82	4.72	11.80	17.60	23.74	15.91	11.62	3.62	0.45	7.76
II. MAGAT BASIN													
CISs	M-1	8.06	9.93	11.16	6.50	2.80	8.95	9.95	7.60	7.22	2.47	0.00	3.69
CIPs	M-1	0.13	0.16	0.18	0.11	0.09	0.32	0.36	0.27	0.26	0.09	0.00	0.06
MATUNO (MANAM.)	10	1.08	1.28	1.36	0.13	1.17	1.21	1.14	0.91	0.27	0.22	0.14	1.02
MATUNO (BAYOM.)	11	11.47	13.57	14.34	1.35	12.39	12.82	12.10	9.65	2.87	2.32	1.44	10.78
CISs	M-2	0.12	0.15	0.17	0.10	0.05	0.19	0.25	0.19	0.19	0.05	0.00	0.06
CISs	M-3	6.01	10.52	8.67	4.79	2.53	8.71	11.45	10.50	7.59	2.57	0.00	2.85
CIPs	M-3	0.30	0.53	0.44	0.24	0.24	0.93	1.22	1.12	0.81	0.27	0.00	0.15
MAGAT RIS	13	117.84	118.74	84.29	55.75	111.00	98.31	142.29	74.11	41.17	29.95	48.87	90.91
CISs	M-4	1.12	1.36	1.66	1.03	0.55	1.83	2.42	2.08	1.70	0.56	0.00	0.51
CISs	M-5	0.06	0.08	0.10	0.06	0.03	0.10	0.13	0.11	0.09	0.03	0.00	0.03
SUB TOTAL		146.19	156.32	122.37	70.06	130.85	133.37	181.31	106.54	62.17	38.53	50.45	110.06
III. ILAGAN BASIN													
ILAGAN IP	18	0.90	1.93	2.64	0.56	1.13	0.54	0.98	0.55	0.48	0.30	0.27	1.02
TUMAUINI(ILA.)	18	2.65	3.24	3.35	0.28	2.97	2.65	3.04	2.00	0.15	0.00	0.00	1.89
CISs	I-3	0.06	0.07	0.09	0.05	0.05	0.17	0.25	0.18	0.15	0.03	0.00	0.03
CISs	I-4	0.16	0.19	0.25	0.13	0.13	0.44	0.65	0.47	0.39	0.09	0.00	0.07
CIPs	I-4	0.24	0.28	0.38	0.20	0.20	0.66	0.98	0.71	0.58	0.14	0.00	0.10
SUB TOTAL		4.01	5.71	6.71	1.22	4.48	4.46	5.90	3.91	1.75	0.56	0.27	3.11
IV. SIFFU, MALLIG BASIN													
CISs	S-1	0.91	1.10	1.34	0.83	0.30	0.89	1.17	1.01	0.83	0.27	0.00	0.41
SIFFU RIS	29	13.68	15.97	16.70	5.50	5.22	14.90	16.90	8.22	7.42	4.79	3.43	11.79
CISs	S-3	0.12	0.15	0.18	0.11	0.07	0.22	0.28	0.25	0.21	0.07	0.00	0.05
MALLIG RIS	31	1.36	1.78	0.84	0.00	1.11	3.25	3.10	2.66	0.92	0.00	0.35	1.03
CISs	S-5	0.27	0.34	0.42	0.24	0.21	0.73	1.13	0.87	0.64	0.19	0.00	0.11
CIPs	S-5	0.53	0.66	0.82	0.47	0.42	1.44	2.22	1.71	1.26	0.37	0.00	0.21
SUB TOTAL		16.87	20.00	20.30	7.15	7.33	21.43	24.80	14.72	11.28	5.69	3.78	13.60
V. CHICO BASIN													
CISs	C-1	2.30	2.55	2.32	1.01	0.42	1.23	0.76	0.68	0.76	0.35	0.00	0.99
CISs	C-2	1.00	1.17	1.10	0.56	0.44	1.24	0.87	0.74	0.86	0.25	0.00	0.42
CISs	C-3	0.50	0.58	0.54	0.28	0.21	0.58	0.41	0.35	0.40	0.12	0.00	0.21
CHICO RIS	23	23.60	28.43	12.99	0.00	8.66	27.08	22.25	18.88	7.19	0.00	3.52	20.07
CHICO MALLIG	30	38.25	44.19	44.76	4.36	38.41	36.93	35.95	23.25	7.88	6.39	2.93	29.44
CISs	C-4	0.44	0.52	0.63	0.37	0.25	0.87	1.17	0.88	0.72	0.21	0.00	0.18
CISs	C-5	0.50	0.59	0.71	0.42	0.28	0.99	1.34	1.01	0.83	0.24	0.00	0.20
CHICO WEST	25	1.99	2.47	1.14	0.00	0.73	2.19	1.81	1.59	0.63	0.00	0.49	1.69
CISs	C-6	1.30	1.58	1.91	1.07	0.52	1.65	2.23	1.72	1.48	0.44	0.00	0.53
CIPs	C-6	0.85	1.01	1.22	0.69	0.60	2.13	2.88	2.23	1.92	0.56	0.00	0.34
SUB TOTAL		70.71	83.09	67.32	8.76	50.52	74.89	69.67	51.33	22.67	8.56	8.94	54.07
VI. LOWER CAGAYAN BASIN													
CISs	LC-1	0.13	0.16	0.20	0.12	0.10	0.35	0.54	0.42	0.31	0.09	0.00	0.05
CIPs	LC-1	0.07	0.08	0.10	0.06	0.05	0.18	0.28	0.21	0.16	0.05	0.00	0.03
TUMAUINI IS	33	0.99	1.21	1.25	0.11	1.84	1.65	1.89	1.24	0.87	0.70	0.22	0.82
S/PAB.CAGA. IS	34	1.84	2.22	1.02	0.00	1.35	4.23	3.48	2.93	1.12	0.00	0.43	1.57
PINACANAUAN RIS	35	1.57	1.78	1.79	0.15	1.60	1.56	1.50	0.97	0.32	0.26	0.11	1.21
CISs	LC-3	0.64	0.75	0.91	0.53	0.46	1.70	2.29	1.73	1.42	0.41	0.00	0.26
CIPs	LC-3	1.14	1.34	1.62	0.95	0.83	3.02	4.08	3.07	2.52	0.73	0.00	0.46
TUGUEGARAO IP	36	0.88	1.33	1.46	0.32	0.69	0.52	0.67	0.42	0.25	0.19	0.15	0.65
S/TUGUEGARAO IS	37	3.71	4.19	4.22	0.36	3.78	3.67	3.53	2.29	0.74	0.61	0.26	2.86
A/AMUL.WEST IS	37	6.44	8.13	8.47	1.22	6.05	5.49	5.71	3.65	1.48	1.16	0.68	4.89
CISs	LC-6	0.30	0.36	0.44	0.26	0.13	0.42	0.57	0.43	0.35	0.10	0.00	0.13
CIPs	LC-6	0.45	0.53	0.64	0.37	0.32	1.19	1.61	1.21	0.99	0.29	0.00	0.18
CIADP(LGUIG)	38	1.01	1.15	1.15	0.10	1.03	1.01	0.97	0.63	0.05	0.00	0.00	0.74
CISs	LC-7	0.04	0.05	0.06	0.04	0.01	0.06	0.08	0.06	0.05	0.01	0.00	0.02
CIPs	LC-7	1.34	1.58	1.91	1.12	0.97	3.56	4.60	3.62	2.97	0.86	0.00	0.55
CIADP(A/AMULU)	39	3.08	3.48	3.50	0.30	3.14	3.05	2.93	1.90	0.16	0.00	0.00	2.24
BAGGAO(PARED)	40	0.63	0.71	0.72	0.06	0.73	0.71	0.68	0.44	0.14	0.12	0.05	0.49
BAGGAO(PARANAN)	42	1.65	1.87	1.88	0.16	1.69	1.64	1.58	1.02	0.33	0.27	0.12	1.28
CISs	LC-10	1.38	1.63	1.97	1.16	0.58	1.93	2.61	1.96	1.61	0.47	0.00	0.56
CIPs	LC-10	1.43	1.69	2.04	1.20	1.04	3.81	5.13	3.87	3.17	0.92	0.00	0.58
CISs	LC-11	0.05	0.06	0.07	0.04	0.02	0.07	0.09	0.07	0.06	0.02	0.00	0.02
ZINUNDUNGAN RIS	44	2.21	2.58	2.61	0.21	2.20	2.05	2.03	1.36	0.12	0.00	0.00	1.63
ZINUN. EXTEN.	44	1.95	2.37	2.43	0.24	1.90	1.72	1.73	1.17	0.43	0.36	0.17	1.50
DUMMUN RIS	46	1.93	2.68	2.93	0.27	2.89	2.72	2.82	1.82	0.52	0.31	0.13	1.67
CIPs	LC-12	0.05	0.08	0.10	0.06	0.06	0.20	0.29	0.22	0.14	0.04	0.00	0.02
CISs	LC-13	0.62	0.86	1.14	0.72	0.37	1.17	1.70	1.29	0.83	0.23	0.00	0.28
CIPs	LC-13	0.64	0.89	1.18	0.74	0.65	2.31	3.35	2.55	1.63	0.45	0.00	0.28
CIADP(L/CAGA.)	47	9.63	14.08	15.52	1.41	15.20	14.31	14.79	9.57	0.62	0.00	0.00	8.52
CISs	LC-14	0.41	0.57	0.75	0.47	0.24	0.77	1.11	0.85	0.54	0.15	0.00	0.18
CIPs	LC-14	0.18	0.25	0.33	0.20	0.18	0.64	0.93	0.70	0.45	0.12	0.00	0.08
SUB TOTAL		46.29	58.66	62.43	12.95	50.10	65.71	73.77	51.69	24.35	8.92	2.32	33.75
TOTAL		295.48	337.86	295.95	104.86	255.08	317.46	379.19	244.10	133.84	65.88	66.21	222.35

Table 6.39 Grass Yield and Total Digestible Nutrients

	Fresh Yield (ton/ha)	Dry Matter Yield (ton/ha)	TDN/1 (kg)
(1) Pasture Grass			
- Guinea grass	40.0	8.4	6.0
- Para grass	70.0	14.7	10.5
- Centro	30.0	6.6	6.9
- Stylo	50.0	9.0	9.1
(Average)	47.5	9.8	8.3
(2) Meadow Grass			
- Guinea grass	70.0	14.7	10.5
- Para grass	90.0	18.9	13.5
- Centro	50.0	11.0	11.5
- Stylo	70.0	12.6	12.7
- Napier grass	140.0	28.0	22.4
- Ipil-ipil	50.0	17.0	12.5
(Average)	80.0	17.0	13.9

Note: /1: Total digestible nutrients

Table 6.40 Cattle Herd Composition in the Average Cattle Farm of 280 ha

Classification of Cattle	Average Age (Month)	Average Weight (kg/head)	No. of Cattle (head)	Percent (%)
(1) Grazing				
a. Breeding				
- Bull	78	over 530	7	2
- Cow	78	over 425	140	38
- Young bull/1	30	470	7	2
- Heifer	30	380	30	8
- Yearling heifer	18	305	46	12
- Yerarling bull	18	355	5	1
(sub total)		(399)	(235)	(63)
b. Calves				
- Male	6	150	48	13
- Female	6	130	48	13
(sub total)		(140)	(96)	(26)
Total of Grazing		324	331	89
(2) Feedlot Feeding		355	41	11
Total		327	372	100

/1: Including young bull of 2 heads for new blood line

Table 6.41 Outlines of Pasture Management and Calf Production

I. Present Condition	
(1) Grazing rate	0.4 heads/ha/year
(2) Average area of cattle farm	280 ha
(3) Capacity of grazing cattle in (2)	120 heads/280 ha
(4) Grazing system	Continuous grazing
II. Future Condition	
(1) Average feed intake	48 kg of fresh grass/head/day
a) TDN of 48 kg (Fresh grass)	8.4 kg/head/day
b) TDN requirement for beef cattle (Average live weight of 320 kg)	5.0 kg/ha
c) % of (a) to (b)	168%
(2) Average fresh grass yield in the pasture	47.5 tons/ha
(3) Possible feed intake ratio	0.55
(4) Grazing rate	$\frac{\text{Avergae Yield/ha} \times \text{Possible feed intake ratio}}{\text{Average feed intake} \times 365 \text{ days}}$
	$= \frac{47.5 \text{ tons/ha} \times 0.5}{0.048 \times 365}$
	= 1.3 heads/ha/year
(5) Area of pasture	275 ha
(6) Maximum capacity of grazing cattle in (5)	357 heads
(7) Number of grazing cattle in the future	331 heads
(8) % of (7) to (6)	93%
(9) Grazing system	Rotational Grazing
a) Number of paddock	6-8
b) Grazing duration	7-10 days/paddock

Table 6.42 Outlines of Feedlot Management

I. Period and Live Weight	
(1) Period	8 months
a) Starting	16 months old
b) Completing	24 months old
(2) Increase in live weight	150 kg or more/head
a) Starting	250 kg/head
b) Completing	400 kg or more/head
(3) Average daily gain	0.65 kg/day

II. Feeding Plan per Day

	Feed Intake (kg)	Dry Matter (kg)	TDN (kg)
(1) Forage grass	19.00	4.06	3.31
(2) Rice bran	2.40	2.19	1.68
(3) Total	21.40	6.25	4.99

III. Meadow	
(1) Average yield of meadow grass	68 tons/ha
(2) Annual number of yearling steers for fattening	41 heads
(3) Feeding period	240 days (8 months)
(4) Forage requirement	4,560 kg/head/240 days (19 kg/day x 240 days)
(5) Area of meadow required	2.8 ha
	$\left(\frac{4.56 \text{ ton} \times 41 \text{ heads}}{68 \text{ tons/ha}}\right)$

Table 7.1 Generation Except NAPOCOR (1984)

Region	Province	Coop	Generation		
I	Ilocos Norte	Inec	Mini-Hydro	-	4,550 kW (Agua Grande, Pagudpud)
			Dendro-Thermal	-	3,100 kW (Solsona/Dingras)
	Ilocos Sur	Iseco	Mini-Hydro	-	525 kW (Dawara, Suyo)
	Pangasinan I	Panelco I	Dendro-Thernam	-	3,400 kW (Bolinao)
	Pangasinan III	Panelco III	Mini-Hydro	-	750 kW (Bachelor, Natividad)
II	Isabela I	Iselco I	Mini-Hydro	-	1,440 kW (Magat A, Ramon)
	Isabela II	Iselco II	Mini-Hydro	-	750 kW (Tumauini: RIS, Tumauini)
			Dendro-Thermal	-	3,100 kW (Ilagan)
IV	Batangas II	Batelec II	Gastfier Plant	-	35 kW
V	Camarines Sur IV	Casureco IV	Dendro-Thermal	-	3,100 kW (Caramoan)
			Mini-Hydro	-	350 kW (Cuyaoyao, Sagnay)
		Total			21,100 kW

Table 7.2 Power Development Record in Luzon by Plant Type (by NAPOCOR)

Year of Commission	Power Plant	Type	No. of Units	Installed Capacity (MW)
1945	Caliraya	Hydro	4 x 8 MW	32
1948	Botocan	Hydro	2 x 8 MW 1 x 1 MW	17
1956	Ambuklao	Hydro	3 x 25 MW	75
1957	Buhi-Barit	Hydro	1 x 1.8 MW	1.8
1959	Cawayan	Hydro	1 x 0.4 MW	0.4
1960	Binga	Hydro	4 x 25 MW	100
1965	Manila 1 (Tegen 1)	Thermal	1 x 100 MW	100
1966	Manila 2 (Tegen 2)	Thermal	1 x 100 MW	100
1967	Angat	Hydro	4 x 50 MW 3 x 6 MW	218
1968	Sucat 1 (Gardner 1)	Thermal	1 x 150 MW	150
1970	Sucat 2 (Gardner 2)	Thermal	1 x 200 MW	200
1971	Sucat 3 (Synder 1)	Thermal	1 x 200 MW	200
1972	Sucat 4 (Synder 2)	Thermal	1 x 300 MW	300
1972	Bataan 1	Thermal	1 x 75 MW	75
1974	Malaya 1	Thermal	1 x 300 MW	300
1977	Pantabangan	Hydro	2 x 50 MW	100
1977	Bataan 2	Thermal	1 x 150 MW	150
1979	Tiwi	Geothermal	6 x 55 MW	330
1979-80-84	Mak-Ban 1 to 6	Geothermal	6 x 55 MW	330
1979	Malaya 2	Thermal	1 x 350 MW	350
1981	Masiway	Hydro	1 x 12 MW	12
1983	Magat	Hydro	4 x 90 MW	360
1983	Kalayaan (Pumped)	Hydro	2 x 150 MW	300
1984	Batangas (Calaca) Coal 1	Coal thermal	1 x 300 MW	300
	Total:			4,101
- Retired - (1955-63)	Rockwell 1 to 5 6 to 8	Thermal	5 x 25 MW 3 x 60 MW	305

Source: NAPOCOR, EPD/PDD

Table 7.3 Demand and Supply in Luzon (1984)

Body	Generation (GWh)	Loss (GWh)	System Input (GWh)	Loss (GWh)	Consumption (Sales demand) (GWh)	Remarks
NAPOCOR	14,655	1,410	-	-	-	
MERALCO	0	0	9,800	1,372	8,428	14% loss
Cooperatives	78	3	1,390	430	960	31% loss
Private Utilities	0	0	686	110	576	16% loss
Industry	0	0	1,070	0	1,070	
Miscellaneous	0	0	374	0	374	
Total	14,733	1,413	13,320	1,915	11,408	23% loss

Table 7.4 Status of Energization in Luzon (1984)

Franchise Body	House Connections		Electrification Ratio (%)
	Potential	Actual	
50-cooperatives	2,281,374	1,423,017	62
MERALCO	1,787,189	1,596,982	89
19-private utilities	337,825	250,986	74
Total in Luzon main island	4,406,388	3,270,985	74

Table 7.5 Energy Sales by Customer Type (MERALCO in 1985)

Customer Type	Consumption (GWh)	(%)
Residential	2,831	36
Commercial	2,612	33
Industrial	2,358	30
Others	78	1
Total	7,879	100

Table 7.6 Status of Energization in the Basin (1984)

Name of Cooperatives	Municipalities		Barangays		House Connections		
	Coverage	Energized	Coverage	Energized	Potential	Actual	%
Region II (Cagayan Valley)							
1. Cagayan I	13	12	361	134	63,238	26,924	43
2. Cagayan II	20	16	446	290	63,553	26,481	42
3. Isabela I	15	15	498	285	73,092	38,864	53
4. Isabela II	21	19	535	249	74,280	24,712	33
5. Ifugao	9	6	123	38	21,795	2,473	11
6. Kalinga-Apayao	9	4	129	33	20,079	5,133	26
7. Nueva Vizcaya	15	14	230	142	40,280	20,456	51
8. Quirino	6	6	120	64	15,660	6,275	39
Sub-total	108	92	2,442	1,235	371,977	151,318	41
Region I (Ilocos)							
9. Mt. Province	9	5	132	45	15,558	3,060	19
Total	117	97	2,574	1,280	387,535	154,378	40

Table 7.7 Hydropower Potential of Selected Dams

Name of Dam		Cagayan No.2	Addalam	Alimit No.1	Ilagan No.1	Disabungan	Siffu No.1	Mallig No.2	Pinukpuk
Catchment Area	(km^2)	481	864	559	1,350	652	656	362	856
Qaverage	(m^3/s)	27.91	37.67	31.26	47.87	36.16	34.85	16.87	51.09
Max. Developed Water	(m^3/s)	13.02	16.67	16.41	28.27	21.36	18.29	8.86	24.67
Required Storage	($x10^6m^3$)	93.0	125.0	112.0	235.0	167.0	110.0	55.0	165.0
Firm Discharge	(m^3/s)	26.04	33.34	32.82	56.54	42.72	36.58	17.72	49.34
High Water Level	(El.m)	223.0	161.0	265.0	159.0	97.0	107.0	144.0	110.0
Rated Water Level	(El.m)	215.5	153.5	255.0	151.5	90.5	101.8	140.0	103.0
Low Water Level	(El.m)	208.0	146.0	245.0	144.0	84.0	96.5	136.0	96.0
Sediment Water Level	(El.m)	207.0	137.0	245.0	144.0	81.5	96.5	136.0	96.0
Tail Water Level	(El.m)	178.0	115.0	197.0	103.0	57.0	67.0	109.0	67.0
Total Head	(m)	37.5	38.5	58.0	48.5	33.5	34.8	31.0	36.0
Effective Head	(m)	33.8	34.7	52.2	43.7	30.2	31.3	27.9	32.4
Dead Storage	($x10^6m^3$)	80.0	100.0	83.9	202.5	120.0	98.4	54.8	128.4
Sediment Storage	($x10^6m^3$)	72.2	58.0	83.9	202.5	97.8	98.4	54.8	128.4
Installed Capacity	(kW)	7,300	9,600	14,300	20,600	10,700	9,500	4,100	13,300
Energy Output	(GWh/yr)	46	60	89	129	70	59	26	83

Table 7.8 Construction Cost of Hydropower Component

(Unit : Mil.Pesos)

Work Item	Alimit No.1			Siffu No.1			Dummon			Paranan			Zinundungan		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
FINANCIAL COST															
A.Hydropower Component															
I. Preparatory Works	1.44	1.16	2.60	0.86	0.68	1.54	0.24	0.19	0.43	0.23	0.17	0.40	0.38	0.30	0.68
II. Civil Works															
Waterway	2.02	1.63	3.65	1.37	0.82	2.19	0.79	0.48	1.27	0.75	0.46	1.21	0.81	0.48	1.29
Powerhouse	15.92	12.85	28.77	9.42	7.63	17.05	2.30	1.86	4.16	2.01	1.63	3.64	4.04	3.27	7.31
Sub-Total of II	17.94	14.48	32.42	10.79	8.45	19.24	3.09	2.34	5.43	2.76	2.09	4.85	4.85	3.75	8.60
III. Metal Works	12.67	1.41	14.08	2.58	0.28	2.86	1.04	0.12	1.16	0.96	0.11	1.07	1.12	0.13	1.25
IV. Electrical Works	82.39	19.54	101.93	53.23	8.13	61.36	10.80	1.20	12.00	9.27	1.03	10.30	18.90	2.10	21.00
Total of I - IV	**114.44**	**36.59**	**151.03**	**67.46**	**17.54**	**85.00**	**15.17**	**3.85**	**19.02**	**13.22**	**3.40**	**16.62**	**25.25**	**6.28**	**31.53**
V. Engineering Service	12.08	3.02	15.10	6.80	1.70	8.50	1.52	0.38	1.90	1.33	0.33	1.66	2.52	0.63	3.15
VI. Government Administration	0	7.55	7.55	0	4.25	4.25	0	0.95	0.95	0	0.83	0.83	0	1.58	1.58
VII. Physical Contingency	18.98	7.07	26.05	11.14	3.52	14.66	2.50	0.78	3.28	2.19	0.68	2.87	4.17	1.28	5.45
Total of I - VII	**145.50**	**54.23**	**199.73**	**85.40**	**27.01**	**112.41**	**19.04**	**5.92**	**24.96**	**16.76**	**5.25**	**22.01**	**31.94**	**9.76**	**41.70**
B.Allocated Dam Cost	**320.39**	**268.73**	**589.12**	**128.93**	**116.13**	**245.06**	**16.50**	**18.99**	**35.49**	**24.13**	**22.97**	**47.10**	**42.21**	**41.43**	**83.64**
Grand Total	**465.89**	**322.96**	**788.85**	**214.33**	**143.14**	**357.47**	**35.54**	**24.91**	**60.45**	**40.89**	**28.22**	**69.11**	**74.15**	**51.19**	**125.34**
ECONOMIC COST															
Grand Total	**465.89**	**263.68**	**729.57**	**214.33**	**113.96**	**328.29**	**35.54**	**19.92**	**55.46**	**40.89**	**23.38**	**64.27**	**74.15**	**39.81**	**113.96**

Table 8.1 Number of Existing Waterworks and Households Served in the Region II (including MT. Province) in 1985

Level of Waterworks	MPWH	LWUA	RWDC	BWP	Total
No. of Waterworks					
Level I	1,599	-	1,820	0	3,419
II	75	-	7	0	82
III	24	5	0	4	33
Total	1,688	5	1,827	4	3,534
No. of Households Served					
Level I	178,506	-	51,712	0	230,218
II	5,518	-	758	0	6,276
III	15,710	5,510	0	15,976	37,196
Total	199,734	5,510	52,470	15,976	273,690
No. of Households in the Region II (including Mt. Province)					463,283
Coverage by Waterworks					59.1%

Sources: EC-118 to EC-120