Philippines
Chico River Irrigation Project: Stage I
Appraisal Report

March 9, 1976
East Asia and Pacific Projects

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Document of the World Bank

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## CURRENCY EQUIVALENTS

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<th>= Pesos (₱) 7.50</th>
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## WEIGHTS AND MEASURES - METRIC SYSTEM

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## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
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<tr>
<td>ADCC</td>
<td>Agricultural Development Coordinating Council</td>
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<td>DAR</td>
<td>Department of Agrarian Reform</td>
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<td>DPH</td>
<td>Department of Public Highways</td>
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<td>MRMP</td>
<td>Magat River Multipurpose Project</td>
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<td>NIA</td>
<td>National Irrigation Administration</td>
</tr>
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<td>NISIS</td>
<td>National Irrigation Systems Improvement Study</td>
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<td>NPC</td>
<td>National Power Corporation</td>
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<td>UPRP</td>
<td>Upper Pampanga River Project</td>
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<td>USBR</td>
<td>United States Bureau of Reclamation</td>
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<td>WMT</td>
<td>Water Management Technologist</td>
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This report is based on the findings of an appraisal mission composed of Messrs. E.G. Giglioli, K.E. Ireland, K.V.S.K. Nathan, M.G. Saddington and J.T. Caparas (Bank).

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Proposed Organization for Operation and Maintenance No. 9535 (R)
Proposed Cropping Calendar No. 9536 (R)
Opportunity Cost for Labor No. 15379

MAP

Chico River Irrigation Project: Stage I No. 11944R
The Government of the Philippines has requested Bank assistance to carry out Stage I of the Chico River Irrigation Project located in the Cagayan Valley of Northern Luzon. Stage I of the project would develop the unregulated water supply of the Chico river for irrigation and improve provincial roads under the adjacent Magat River Multipurpose Project: Stage I (Loan 1154-PH). The irrigation component comprises rehabilitation and upgrading some 7,800 ha of small and scattered gravity and pump irrigation systems and extension of irrigation to 11,900 ha of rainfed rice lands. Stage I also provides technical assistance to the National Irrigation Administration (NIA) for preparation of an erosion control study of the Magat and Pampanga river catchments and setting up an input-output monitoring system for all Bank-assisted irrigation projects in Central and Northern Luzon. A total of about 95 man-months of consultants services would be required. Additionally, a feasibility study for Stage II irrigation would be prepared by NIA under the project. The road component comprises improvement of three provincial roads, with a total length of 65 km.

Major Government objectives in the agricultural sector are to achieve self-sufficiency in basic foods and to correct regional economic and social imbalances. The project would assist in meeting both objectives by expanding double crop rice irrigation into an area where regional per capita income is the lowest in the nation. It would be the first step in the Government's long term plan to develop the land and water resources of the Chico river basin.

The next phase in the basin's development would be construction of the Chico 4 storage dam for hydroelectric power. The dam would also provide a regulated water supply which would permit the expansion of the irrigation system to 49,000 ha under Stage II of the project. The Chico 4 dam, the first in a series of four multi-purpose dams in the basin, was selected as a first priority over the other three dams because it would involve resettlement of only about 75 tribal families whereas a much larger resettlement program would be involved at the other sites and the Government has been experiencing some opposition from the tribesmen to large scale resettlement. Feasibility studies for the Chico 4 project are underway with the help of consultants financed under a bilateral German aid program. The studies are expected to be completed in about two years and construction of the dam is tentatively scheduled to start in 1979. Stage I of the project would derive its water supply from the unregulated flow of the Chico river. It is an economically viable unit on its own and is not dependent on either a storage dam or a second stage irrigation development. The feasibility study for Stage II irrigation would be coordinated with the Chico 4 storage dam study.
iv. The deficit in rice, the main staple food crop, has been a persistent problem for the Philippines, and annual rice imports have averaged around 300,000 tons in recent years. With improved water control being a prerequisite to obtaining optimum results from the new high yielding rice varieties, an annual total of about 50,000 ha of rice lands would have to be rehabilitated or provided with a new irrigation system over the remainder of the decade to allow the country to achieve rice self-sufficiency. The proposed project would be the sixth Bank-assisted project aimed at helping the Government to achieve this goal. The first was the Upper Pampanga River Project (Loan 637-PH), the second the Aurora-Penaranda Irrigation Project (Loan/Credit 984/472-PH), the third the Tarlac Irrigation Systems Improvement Project (Loan 1080-PH), the fourth the Mindoro Rural Development (Loan 1102-PH), and the fifth the Magat River Multipurpose Project: Stage I (Loan 1154-PH). Except for the Magat project, which is in the Cagayan Valley of Northern Luzon, and the Rural Development Project on the island of Mindoro, the other projects are located in Central Luzon.

v. Total cost of the project is estimated at P630.0 million (US$84.0 million) of which US$33.0 million, or approximately 39%, would be in foreign exchange. The Bank would finance the foreign exchange component as well as US$17.0 million of local currency requirements. Civil works costing US$23.9 million and equipment costing US$3.3 million would be put to international competitive bidding in accordance with Bank Group Guidelines. The remaining civil works would not be suitable for international competitive bidding because of their nature and would be carried out by locally advertised contract (US$10.8 million) or by force account (US$7.1 million).

vi. NIA would be the executing agency for the project, except for the provincial roads component which would be carried out by the Department of Public Highways (DPH). NIA’s responsibilities would be carried out by the Special Projects Organization, which is in charge of all Bank-assisted irrigation projects. Both NIA and DPH are well staffed with competent personnel and would be able to implement the project successfully. Due to its size and proximity, the project would be executed as a division of the Magat project.

vii. At full development of Stage I of the project, nine years after commencement of work, annual paddy production from the project area is expected to reach 147,000 tons compared with a current level of production of 50,000 tons. The increased production would make a contribution to the national campaign for self-sufficiency by providing enough rice to feed nearly 600,000 persons per year.

viii. Under the Government’s program of agrarian reform, sharecropping has been abolished and title to land in holdings over 7 ha is now being transferred to the cultivators. When the transfer is completed, tentatively by the end of 1977, about 85% of the land in the project would be
farmed by owner operators and the rest by leasehold tenants of small landlords. Some 8,000 farm families cultivate the project area, working an average unit of 2.5 ha. The project would increase the annual per capita income on a 2 ha farm from $55 at present to $290 at full agricultural development in 1986. For a 4 ha farm at full development in 1986 the per capita income would be US$530. By comparison about 84% of the project’s farm families accounting for 75% of the land are presently at or below the Bank’s estimated absolute per capita poverty level of US$140. These comparisons indicate that the project would narrow the income gap between the project area and other parts of the country for the small farmers (2 ha or less) while for the larger farmers (4 ha or more) per capita farm income would be slightly above the projected national average per capita GNP.

ix. The project would require a controlled cropping timetable to allow for a cropping intensity of 186% which in turn would create an increase in farm labor employment opportunities equivalent to about 4,700 full time jobs. The economic rate of return of the project is expected to be about 15%. The rate of return is only moderately sensitive to increases in costs and delays in benefits. If one-half the cost of the diversion dam is charged to power (which it would ultimately serve for reregulation), the remaining diversion dam costs proportioned between Stages I and II on an area basis and the excess canal capacity is charged to Stage II irrigation for which it would be needed, the economic rate of return increases to 21%.

x. The proposed project is suitable for a Bank Loan of US$50.0 million for a period of 25 years, including a six-year grace period. The borrower would be the Republic of the Philippines.
APPRAISAL OF THE CHICO RIVER IRRIGATION PROJECT: STAGE I

I. INTRODUCTION

1.01 The Government of the Philippines has requested Bank assistance in financing the first stage of the Chico River Irrigation Project in the Cagayan Valley of Northern Luzon, one of the few areas of Luzon where such development potential exists. Stage I would irrigate 19,700 ha by gravity diversion from the Chico river with an assured water supply during the wet season and a dry season supply adequate for 17,000 ha. The diversion dam and main diversion canals would be constructed with capacity for a second stage irrigation development that would expand the irrigated area to 49,000 ha. Stage II irrigation would be dependent on flow regulation provided by a multipurpose storage dam to be constructed on the Chico river about 20 km upstream of the diversion dam. The diversion would also serve as an afterbay for daily reregulation of releases from the storage dam for hydroelectric power generation.

1.02 The principal components of the proposed project are (i) irrigation development and (ii) a provincial roads program. The National Irrigation Administration (NIA) prepared the feasibility report for the irrigation component and the Department of Public Highways (DPH) prepared the feasibility report for the provincial roads program. Mr. F. E. Rippon (consultant) assisted NIA with establishing the design standards in April, 1975. This report is based on the findings of an appraisal mission which visited the Philippines in October, 1975 composed of Messrs. E. G. Giglioli, K. R. Ireland, K.V.S.K. Nathan, M. G. Saddington and J. T. Caparas (Bank).

II. BACKGROUND

2.01 The Philippines covers some 297,000 km² scattered over more than 7,000 islands between the Pacific Ocean and the China Sea. The 45 largest islands account for 98% of the area. The population is around 43 million (1975), growing at a rate of 2.8% annually. Real GNP, which had a trend growth rate of 5% to 6% in the 1960’s, grew by 10% in 1973 due to high prices for export commodities, but has grown at only about 6% in 1974 and 1975 as some industries have been adversely affected by the recession in the Philippines’ trading partners. Inflation related to high export prices and increased oil and food prices was a major problem in 1974, but abated markedly in 1975. Unequal income distribution and underemployment remain major economic problems.

2.02 Out of a total land area of some 30 million ha, more than half is in forests and about one-third under cultivation or in plantations. About 2.0 to 2.5 million ha of fairly level land is still available for growing crops, though some 1.0 million ha of this is cogon grassland which would be difficult to reclaim. Bringing this additional land under cultivation would be insufficient by itself to meet increasing food needs
or to improve rural income significantly. These goals call for increasing production from currently cultivated areas through yield improvements and increased cropping intensity where water is available.

The Agricultural Sector

2.03 Agriculture accounts for about one-third of net domestic product, over one-half of total employment and 70% of export earnings. During the 1960s the rate of growth of agricultural output accelerated gradually and averaged 4.7% per year for the 1965-70 period, stimulated by the spread of improved rice varieties. During the next five years, the spread of new varieties slowed; typhoons in 1972 and high fertilizer prices in 1974 further affected agricultural output, which grew by only 3.2% a year on average from 1970-74. The growth rate of rice production from 1970 to 1974 was only 1.4% a year. The failure of food supply to keep pace with demand caused the ratio of food prices to prices in general to increase by 37% over the period. This, combined with high world prices for sugar and coconut products, led to a substantial shift in the internal terms of trade in favor of agriculture, which encouraged rural people to stay on the farm. In the face of sluggish growth of manufacturing employment, much of the growth of the labor force in recent years has therefore taken place in agriculture. Although value added per worker in agriculture has increased in current prices, it has declined in real terms, implying growing rural underemployment.

2.04 There is considerable pressure of people on land in the Philippines, where the population density is 131 people/km² compared with the Asian average of 86. Lowland areas best suited for rice have been fully occupied for over a decade. Migration is heavy from the overcrowded regions of Central Luzon and the Visayas to the Cagayan Valley in north-eastern Luzon and Mindanao in the south.

2.05 Agricultural sector performance will be crucial in determining whether the drive towards a more rapid but more equitable income expansion succeeds. The major goals are self-sufficiency in cereals, particularly rice and corn; development of the livestock and fisheries sector; expansion of agricultural exports; intensification of agrarian reform; better conservation of natural resources; and strengthening of institutional support. Self-sufficiency in cereals is important not only to strengthen the balance of payments, but also to raise incomes for much of the rural population.

The Critical Role of Water Development

2.06 After allowance for increases in rainfed rice production, the Philippines cannot reach self-sufficiency in rice without substantial investment in irrigation expansion and improvement. Performance of irrigation systems in the country falls far short of their potential. The Sector Survey estimates that, out of a total of 960,000 ha which could be served by existing irrigation systems, only 630,000 ha are served in the rainy season and 254,000 ha in the dry season. Almost all of the irrigated area is devoted to rice.

The NIA's gravity systems are the main component. In addition, NIA has constructed and rehabilitated a substantial part of the small privately operated communal systems, averaging 250-300 ha. The Irrigation Services Unit, now under NIA's administrative supervision, is responsible for pump irrigation schemes. The 104 NIA gravity systems varying in size from 130 ha to 83,000 ha, are usually run-of-the-river schemes with insufficient control structures in the canals, inadequate drainage and little provision for access. Even when the systems are new, water distribution is uneven during the wet season and limited during the dry season. Maintenance has been minimal due to shortages of staff and funds and the lack of access roads for maintenance machinery. A vicious circle has developed by which lack of maintenance discourages farmers from paying operation and maintenance charges, which in turn precludes further maintenance.

2.07 This unsatisfactory situation began to change in the late 1960s. The NIA was reorganized, more advanced irrigation designs were introduced and much higher levels of water management aimed at. Simultaneously, the need for intensified agricultural supporting services on irrigation projects was realized. The Bank-assisted Upper Pampanga River Irrigation Project (UPRP) (Loan 637-PH) and the Magat River Multipurpose Project (MRMP); Stage I (Loan 1154-PH) and the Asia Development Bank (ADB) - assisted Angat-Magat Integrated Agricultural Development Project (AMIADP), typify the new approach. The pattern of rehabilitation, new construction and operation exemplified by these projects is essential for large-scale rice production. Indeed, to meet domestic rice demand in the 1970s, a program of rehabilitation and new construction in the rice lands of 50,000 ha per year will be needed for the remainder of the decade. The proposed project would thus be entirely compatible with Government objectives for water resources development.

Project Formulation

2.08 The 1975 Chico River Irrigation Project feasibility report prepared by NIA, proposed development of the irrigation potential in two stages, the first utilizing the unregulated flows of the Chico river and the second utilizing the dependable water supply provided by upstream multipurpose storage, the subject of a feasibility study by the National Power Corporation (NPC). Preliminary studies by NPC, with consultant assistance, indicated that four storage dams and hydroelectric generating plants could be constructed with a combined generating capacity of 1,000 MW. Development of the Chico river hydroelectric power potential is a priority item in NPC's planning to meet the rapidly growing national energy requirements and is scheduled for early implementation.

2.09 The Chico River Irrigation Project, adjacent to and practically an extension of the irrigated lands under the Magat project 1/, is scheduled for implementation over a nine-year period in the following stages:

1/ Magat River Multipurpose Project: Stage I (Loan 1154-PH).
(a) Stage I would consist of rehabilitation of several existing irrigation systems and construction of new facilities. The entire command area of 19,700 ha would be served by run-of-the-river diversion. Construction would be completed over a five-year period (1976-1980).

(b) Stage II, which would be constructed over a five-year period (1980-1984), is dependent on construction of a storage dam on the Chico river to augment the dry season flow of the river. It would consist of expanding the irrigation facilities to command an area of 49,000 ha.

(c) A Storage Dam and hydroelectric power generating facilities are scheduled to be constructed over a six-year period (1979-1984) following three years of feasibility study and preparatory work. Because of local opposition, focus of the study has been shifted from the Chico 2 to the Chico 4 site where only about 75 families live in the reservoir area. It is the Government’s intention to carry out resettlement of the families before starting construction of the dam.

Details on the development of irrigation in the Cagayan Valley, the role of the project and its phasing are at Annex 1. Stage I is an economically viable unit on its own (para. 7.03) and is not dependent on construction of Stage II irrigation facilities or on provision of storage on the Chico river.

III. THE PROJECT AREA

General

3.01 The project is located in Cagayan, Isabela and Kalinga - Apayao provinces in the Cagayan Valley of Northern Luzon, just north of the Siffin River Irrigation System being rehabilitated with Bank assistance under Stage I of the Magat project (Map No. 11944R). Aside from a small amount of irrigation, the project area is presently devoted to rainfed cultivation of rice during the wet season. Consequently, rice yields are low and adoption of high yielding varieties has been slow. On those lands now irrigated, systems are not completely developed, water distribution is poor and dry season water supply is limited.

3.02 There are a number of small towns with populations of less than 10,000 people scattered throughout the area. The larger towns, including Tuguegarao, the capital of Cagayan Province which lies just outside the project area, provide banking, storage, and processing facilities as well as supplies of inputs to the agricultural area. The Cagayan Valley is connected by national highway to Central Luzon and Manila to the south and the port of Aparri on the Babuyan Channel to the north.
Climate

3.03 The climate in the project area is tropical and monsoonal. Warm temperatures throughout the year allow a twelve-month growing season with irrigation. About 75% of the average annual rainfall of 1,800 mm falls in the six-month period of July through December, with the heaviest rain in November. The Cagayan Valley and Ilocos regions of Northern Luzon show the highest frequency of passing typhoon centers in the Philippines. Over a 25-year period between 1948 and 1972 the regions were hit by an average of 3 typhoons per year, with the highest frequency between July and November. The statistics are for the whole of Northern Luzon. This does not mean that all storms hit the project area and the statistics tell nothing of the extent or severity of the typhoons. These storms may cause flooding and damage to crops and the potential effects on project crop production is explained at Annex 14. The rainfall, together with river flows in the wet season, is generally adequate for a single rice crop. Dry season cropping, however, entails considerably more risk from rainfall deficiencies and irrigation is essential for an assured crop. Further climatic details are presented at Annex 2.

Topography, Drainage and Soils

3.04 The project area is located on flood plains and gently sloping tributary valleys of the Cagayan and Chico rivers. It is bounded on the south by the Mallig river, on the east by the Cagayan river and on the north and west by the Chico river and foothills of the Cordillera Range. The several areas comprising the project are separated by low and high hills. Large and small creeks traverse the areas serving as natural drainage ways. Because of high rainfall intensities and flat relief, drainage problems exist in some portions of the project area. Low areas are subject to short periods of flooding from overflowing streams. Water velocities are low and cause little damage to land, but there is some crop damage, depending on the stage of growth at time of flooding.

3.05 Soils in the project area are mostly of alluvial origin, are predominantly light brown or grey loams or silty loams, with granular structures, medium textures, slightly acidic reactions and fairly good internal drainage. They are generally high in organic matter. The soils are suited for rice, which has been grown in the project area for many years without problems.

Land Tenure and Farm Size

3.06 Since 1972 the Government has pursued a program of agrarian reform aimed at the transfer of land ownership to tenant farmers on rice and corn lands. Presidential Decree No. 27 (PD 27), the basic legislation of the new program, provides for the transfer to the tenant, whether sharecropper or leaseholder, of the land he tills up to 3 ha in an irrigated area and 5 ha in a rainfed area. According to PD 27, the landlord may retain up to 7 ha if he tills the land himself. Since there are some 2 million rice and corn farmers on about 4 million ha, of which less than 1 million ha are irrigated, there is
little prospect of achieving the 5 ha rainfed and 3 ha irrigated family farms nationwide. Furthermore, some 85% of the landlords have holdings of less than 7 ha and there are no plans at present for the transfer of lands in this category. The Department of Agrarian Reform (DAR) completed the issue of land transfer certificates to tenants of all land in holdings over 24 ha in 1975. In November 1974 the Government decided to proceed with the transfer of land in holdings between 24 and 7 ha.

3.07 DAR surveys show that some 8,000 farm families, averaging 5.5 members for a total of about 44,000 people, live in the project area. The average farm unit is 2.5 ha with about 84% of the farms, covering 83% of the area, falling between 1 and 5 ha. The farm size distribution is as follows:

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<td>2</td>
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<tr>
<td>1 - 3</td>
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<td>More than 7</td>
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<tr>
<td>Total</td>
<td>100</td>
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According to DAR data the 19,700 ha in the project area were owned by some 4,880 people, 95% of whom held less than 7 ha. However, this group accounted for only 70% of the land. The remaining 5% of the owners accounted for 5,850 ha or 30% of the area. There are about 4,100 tenant farmers on 8,470 ha in the project area. The transfer of landlord holdings larger than 7 ha will involve some 2,800 tenants on 5,850 ha. Including about 3,950 present owner-operators on 11,230 ha, when the land transfer is complete some 6,800 owner-operators or 85% of the farmers in the project area will cultivate 17,100 ha or 87% of the land. The remaining 1,300 tenant farmers on holdings under 7 ha would no longer be share-croppers, but would have written lease agreements providing for payments of fixed rents (Annex 3).

Existing Irrigation Facilities

3.08 The only national irrigation system in the project area is the Chico West system, originally planned for 2,000 ha which commands about 1,400 ha, but only irrigates about 1,100 ha because of lack of distribution facilities. This system, which diverts water from the Chico river, irrigates about 1,000 ha in the dry season. In addition there are some 3,200 ha irrigated by communal systems and a further 3,200 ha by privately owned pumps scattered throughout the project area. Due to the limited dry season water supply and the increasingly high cost of diesel fuel for pumping, dry season irrigation is restricted to about 2,700 ha in the communal systems and 1,600 ha in the pump systems.

Agricultural Production

3.09 Rice grown by transplanting is by far the most important crop in the area. A little corn is grown on the coarser textured and better draining soils immediately adjacent to the river banks but the area cropped is
not significant. On about 90% of the project area soil and drainage conditions are unsuitable for crops other than rice. The majority of farmers in the irrigated areas use improved rice varieties, while in the rainfed areas farmers rely mainly on the lower yielding, but hardier local varieties. In the irrigated areas the average paddy yield is 2.3 ton/ha in the wet season and 2.7 ton/ha in the dry season. The yield of rainfed paddy averages 1.5 ton/ha. The low yields are due to unsatisfactory water management, difficulties in getting the crop out of the fields because of lack of roads, and poor farming practices such as insufficient use of inputs and untimeliness of operations.

3.10 In rainfed areas most farmers rely entirely on animal power for land preparation, while in the irrigated areas mechanical land preparation is practiced on about 60% of the crop area. Mechanical cultivation is mostly done by four wheel tractors and rotary tillers. Threshing of the rainfed crop is almost entirely manual while mechanical thresher are used on close to two-thirds of the irrigated crop. Most of the equipment is operated by contractors.

Transportation

3.11 The Cagayan Valley is traversed by the Philippine-Japanese Friendship National Highway (No. 5) linking it with the port of Aparri on the Babuyan Channel to the north and to Central Luzon and Manila to the south. There is a limited network of largely unpaved provincial and municipal roads serving the project area and linking it to the national highways. Road improvements under the adjacent Magat project will improve regional access to the project area. The provincial government is engaged in a program of replacing existing wooden bridges with permanent concrete structures. There is no railroad service in the area. Under the project, access roads for construction and O&M roads for the irrigation facilities would also serve as feeder roads to handle the increased production.

IV. THE PROJECT

4.01 The project proposed for Bank financing would (i) upgrade existing irrigation systems and extend irrigation service to currently rainfed rice lands, a total of 19,700 ha, to standards adopted for the Magat project; and (ii) improve provincial roads, a total of 65.1 km, under the adjacent Magat project. The project would include:

(a) Irrigation Development

(i) construction of a diversion dam and intake works on the Chico river;

(ii) construction of a catch dam and intake works on Talaca creek;
(iii) rehabilitation and extension of an existing 1,400 ha NIA system and construction of a drainage system;

(iv) construction of an irrigation and drainage system for small local communal systems totaling 3,200 ha and for small pump irrigation systems totaling a further 3,200 ha;

(v) construction of new irrigation and drainage facilities for 11,900 ha of rainfed rice; and

(vi) procurement of vehicles and equipment.

(b) Provincial Road Program

(i) improvement of the Roxas-Gamu road, (35.2 km);

(ii) improvement of the Cabatuan-Cauayan road, (11.0 km); and

(iii) improvement of the San Mateo-Alicia road, (18.9 km).

The Project would also provide for preparation of a feasibility study by NIA for Stage II irrigation, and for technical assistance to NIA for an erosion control study of the Magat and Pampanga river catchments, and for an input-output monitoring system to monitor production inputs and the flow of project benefits for all Bank-assisted irrigation projects, covering some 210,000 ha and about 85,000 farm families.

Project Irrigation Works

4.02 The Chico diversion dam would be constructed on the Chico river with an intake for the main diversion canal, which would be sized for Stage I lands and for expansion under Stage II irrigation development to serve a total of 49,000 ha. The base cost of the excess intake and main canal capacity amounts to US$9.8 million. The diversion dam would also provide daily regulation of power releases from the Chico 4 storage dam to be constructed simultaneously with Stage II irrigation. Access roads would be built to facilitate construction and operation and maintenance.

4.03 The existing NIA Chico West System of 1,400 ha would be rehabilitated, upgraded and extended to serve a total of 2,000 ha by repairing existing canals and structures and by providing additional canals, control structures, drains and turnouts to manage water deliveries effectively.

4.04 Some 3,200 ha of small communal gravity irrigation systems and a further 3,200 ha of small pump irrigation systems scattered throughout the service area would be provided a new irrigation and drainage system and brought under the project. These lands are now incompletely developed, inadequately served, for the most part without on-farm facilities and are chronically short of water in the dry season. The remainder of the project comprises some 11,900 ha of presently rainfed rice lands. New irrigation
and drainage works would be constructed for these lands with adequate control structures and turnouts for efficient water control and delivery.

4.05 The project would be constructed to the same standards of on-farm water distribution and drainage as the adjacent Magat project (Annex 4). Rice has been grown in the project area for many years and the land is reasonably level and well laid out with little fragmentation of land holdings. Therefore, no land leveling, boundary realignment or land consolidation would be provided. The canal systems would have a turnout for each 10 ha from which farm ditches built as part of the project would provide direct delivery to about 80% of all holdings. Each 10 ha block would also be served by a collector drain. All canals would be unlined except for small sections of the main diversion canal in high fill. Small buildings would be provided for Water Management Technologists operating 500 ha of irrigated land apiece (para 5.04) and rice drying floors of 400 $m^2$ would be provided near or adjacent to the buildings. Some existing access roads would be improved and, where needed, new ones would be built. About 420 km of roads for operation and maintenance would be built along the major canals and laterals.

**Water Supply, Demand and Quality**

4.06 The project would derive its water supply from the unregulated flow of the Chico river. Stream flow records are available very near the diversion site and at several upstream locations since 1963 and at a downstream location from 1955-1964. Following analysis of inconsistencies between station records and comparisons with measured rainfall over the basin, an upstream station about midway in the catchment was considered the most reliable and was used as the base for estimating water supply at the diversion site. From these data a 10-year period including extremely low dry season flows was selected as representative of normal flow conditions and the variation that can be expected in a critical year. A separate analysis of stream flow at the downstream station nearest the diversion site and its extension over a 20 year period, without correction for inconsistencies with other stations and rainfall, gave essentially the same results for the low flow months which are critical to project water supply without storage.

4.07 Water requirements for the project were based on two rice crops per year. Taking into account the higher farm irrigation efficiencies expected after project development, anticipated conveyance and operational losses and effective rainfall, annual diversion requirements are estimated to total 2.4 m, of which 1.5 m would be required in the dry season. The proposed cropping calendar would maximize the use of rainfall for both wet and dry season crops.

4.08 Stage I of the project was formulated to utilize as nearly as possible the assured water supply from the Chico river for double crop irrigation without storage regulation. This resulted in the 19,700 ha selected for development, of which 17,000 ha would have a dry season water supply for a cropping intensity of 186%. When upstream storage is available, Stage II irrigation development would expand the area to a total of 49,000 ha with dry season water adequate for 45,000 ha. In selecting the dry season area which could be served, low flows expected one year in five were used.
together with a water deficiency criteria of not more than 20% in only one month. In four years out of five there would be ample water for the total command area. Furthermore, the critical month for water supply would be during land preparation for the dry season crop when there would be some flexibility in water deliveries in the previous month. There are no water rights on the Chico river that would interfere with either Stage I or II of the project. Although existing upstream uses of water are minor, assurances were obtained that the necessary water rights would be granted to NIA and no other water rights which could adversely affect the project water supply would be granted except by mutual agreement with the Bank.

4.09 Tests of water samples from the Chico river show good water quality with total dissolved solids under 300 ppm. The water is of low salinity, slightly alkaline and is free of toxic elements. The water is turbid during the wet season, but no adverse effects have been noted on the soils or crops irrigated with this water for nearly 20 years.

Status of Engineering

4.10 Project planning studies, designs and estimates of the irrigation and drainage systems and associated works were carried out by NIA. For the Chico West rehabilitation area, surveys were made of the existing main canals and cross sections were taken at 20 to 100 m intervals to determine excavation quantities. Rehabilitation costs of the remaining laterals, drainage and on-farm facilities were based on unit cost estimates obtained from a sample area for which detailed mapping and designs were prepared. Surveys were also made of the principal canals in extension areas to determine construction quantities. Existing 1:50,000 scale maps were used to determine lateral locations and costs were based on unit costs for a sample area within the Quezon-Malling service area. Farm ditch and drain requirements within the rotational areas were also determined by the sample area method. Canal structure requirements in the rehabilitation areas were determined in the field by NIA inspectors and costs were estimated for repair, replacement or additions. Structure requirements in the extension areas were determined according to basic irrigation design practices. Operation and maintenance roads were based on canal capacity and needs within the service area, and were checked in the field to ensure that adequate access to project works would be provided. Sufficient investigations have been made to assure that suitable materials are available for construction of canal embankments and maintenance roadways.

4.11 Enlarged rectified aerial photographs of the project irrigation service area at a scale of 1:10,000 were completed by contract in 1971 and these photographs were used in preparing the base maps for land classification. Detailed topographic mapping of the sample areas was carried out to a scale of 1:4,000 and for the diversion dam and catch dam at a scale of 1:2,000. NIA is extending the detailed topographic mapping on the service area at appropriate scale and this will be completed in conjunction with final designs and estimates for construction.

4.12 Construction of the irrigation and drainage system would start in 1977 with preconstruction activities starting in mid-1976 (see Chart 15355).
The provincial roads component would include preconstruction activities through 1976, start of construction in 1977 and completion by the end of calendar year 1978. All project works are expected to be completed by the end of calendar year 1980. The erosion control study would be carried out over a 30-month period, from mid-1976 through 1978. The input-output monitoring component would be carried out under the project throughout the implementation period and carried on thereafter by NIA.

**Provincial Road Program**

4.13 The Bank-assisted Magat project includes upgrading and construction of about 830 km of low standard roads, located on canal banks. The improvement of Cagayan Valley arterial roads that link the project area to the central and southwestern parts of Luzon Island was deferred for consideration under a later project to enable preparation work to be completed. As the preparation work for roads under the Magat project is now substantially done, it was decided to include those roads in the present project, except for the Tuguegarao - Santiago National Highway (130 km) which required further studies and was therefore deferred for further consideration under the proposed Fourth Highway Project scheduled for Bank appraisal in March 1977.

4.14 The 65 km provincial road component to be carried out by DPH comprises the following segments: Roxas-Gamu Road (35.2 km), Cabatuan-Cauayan Road (11.0 km) and San Mateo-Alicia Road (18.9 km). Although these roads directly serve only the Magat project area, the Roxas-Gamu Road also provides a less congested road outlet to the Chico project area as an alternative to the Philippines - Japanese Friendship National Highway (Map 11944R). The Tuguegarao - Quezon-Santiago National Highway is presently being studied by consultants and reconstruction of the road is expected to commence early in 1978 with road opening in 1981. Until the Magat river crossing on this national highway is improved, the Roxas-Gamu road will serve the dual role of a through road and as a local road serving the farmers under the Chico project. The Cabatuan-Cauayan and San Mateo-Alicia roads are principally local roads and their improvement will enable the transport of goods at lower costs. The benefits are likely to be shared by the farmers and by consumers in urban centers in Central and Southern Luzon.

4.15 All the roads are located in fairly flat country with good alignments. The improvements proposed consist of the widening of the three roads to DPH Class II standards (Annex 6). The roads would have 6.1 m wide pavements with double bituminous surface dressing and gravel shoulders 1.5 m wide. The roads are now subject to occasional flooding due to surface run-off and excessive irrigation water. The latter problem will be considerably eased by the Magat project but it would still be necessary to raise road embankments by about 0.5 m. Sub-grade consists mainly of silty or clayey soils and the existing roads have poorly maintained gravel surfaces except for short bituminous sections through urban areas. However, the existing bridges are in good condition and would be retained. No new bridges are needed but new culverts and drains are required. The detailed engineering is now being carried out by Region II, DPH and bidding documents are expected to be completed by June 1976.
Erosion Control Study

4.16 The erosion control study for Magat and Pampanga catchments (Annex 7) would assess erosion problems, quantify present damage to the catchments, evaluate remedial measures and propose a project comprising a plan of erosion control measures and land use to correct existing damage and prevent further damage. Assurances were obtained that NIA would engage a consulting firm satisfactory to the Bank for this work and under terms of reference to be approved by the Bank.

Input-Output Monitoring

4.17 The input-output monitoring program (Annex 8) would establish a system of monitoring production inputs and project benefits for the Chico project and all Bank-assisted irrigation projects covering some 210,000 ha and about 85,000 farm families. The system would provide warnings of input bottlenecks and indicate the size and direction of benefit flows. Assurances were obtained that NIA would engage consultants satisfactory to the Bank and under terms of reference to be approved by the Bank to assist with this work.

Feasibility Study Stage II Irrigation

4.18 The feasibility study for Stage II irrigation to expand the area irrigated under the project to about 49,000 ha would be carried out by NIA. They have demonstrated capability to do this by preparation of the feasibility study for Stage I irrigation. Consultant assistance would not be needed and costs, mostly local currency, would be borne by Government. Water supply for Stage II irrigation is dependent on upstream storage to regulate flow of the Chico river and construction of Stage II facilities would coincide with construction of the Chico 4 dam for hydroelectric power scheduled for completion by 1985. With a four-year construction program, preconstruction activities for Stage II irrigation should start early in 1980, which would require completion of the feasibility report by mid-1978. In carrying out the feasibility study, special attention should be paid to water requirements in the early months of the dry season crop and possible adjustments in the cropping calendar in relation to canal capacities. NIA has agreed that scheduling of the feasibility study would be coordinated with the feasibility study of the Chico 4 dam and the availability of a regulated water supply.

Cost Estimates

4.19 Total project costs are estimated at US$84.0 million, of which US$33.0 million or 39% is foreign exchange. Project costs are based on quantity estimates from feasibility designs and unit prices prevailing in the Central Luzon projects in mid-1975. Unit prices for equipment, materials and supplies are based on recent quotations received by NIA. Costs for design and construction supervision by NIA and DPH are included under engineering, while consultants' fees are included in the cost estimates for the erosion control study and the input-output monitoring program. All costs were
indexed to a common level, mid-1976, and this is the base cost level for the project. A physical contingency factor based on the degree of investigations completed to date was applied. It amounts to: 20% for the irrigation and drainage system and provincial road program; and 10% for the erosion control study and input-output monitoring. Costs due to expected price increases over the implementation period amount to about 26% of total project costs and assume the following annual inflation rates:

<table>
<thead>
<tr>
<th>Inflation Rate (%)</th>
<th>1976</th>
<th>1977-79</th>
<th>1980</th>
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<tr>
<td>Civil Works</td>
<td>14</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Equipment &amp; Services</td>
<td>10</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
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4.20 Details of project costs are presented in Annex 9 and are summarized below:

|                         | Local (Pesos M) | Foreign (US$ M) | Total (Pesos M) | Local (US$ M) | Foreign (US$ M) | Total (US$ M) | Exchange (%)
|-------------------------|-----------------|-----------------|----------------|--------------|----------------|----------------|---------------
| Irrigation              | 203.3           | 122.5           | 325.8          | 27.1         | 16.3           | 43.4           | 38            |
| Provincial Road Program | 30.0            | 17.2            | 47.2           | 4.0          | 2.3            | 6.3            | 41            |
| Erosion Control Study   | 5.4             | 6.2             | 11.6           | 0.8          | 0.8            | 1.6            | 55            |
| Input-Output Monitoring | 5.0             | 1.8             | 6.8            | 0.7          | 0.2            | 0.9            | 27            |
| Feasibility Study Stage II | 0.7           | 0.3             | 1.0            | 0.1          | -              | 0.1            | 30            |
| O & M Equipment         | 0.4             | 6.4             | 6.8            | -            | 0.9            | 0.9            | 95            |
| Base Cost Estimate      | 244.8           | 154.4           | 399.2          | 32.7         | 20.5           | 53.2           | 39            |
| Physical Contingencies  | 39.1            | 29.2            | 68.3           | 5.2          | 4.0            | 9.2            | 42            |
| Expected Price Increases| 98.7            | 63.8            | 162.5          | 13.1         | 8.5            | 21.6           | 39            |
| Total Project Cost      | 382.6           | 247.4           | 630.0          | 51.0         | 33.0           | 84.0           | 39            |

**Financing**

4.21 The proposed Bank loan of US$50 million would finance the full foreign exchange costs and about 33% of the local costs of the project. It would cover 60% of total project costs. The Government would provide the remaining P 255 million (US$34 million) out of annual budget appropriations to NIA and to DPH. To ensure the continuous and timely flow of funds, an assurance was obtained that the Government would cause NIA to
set up a special fund for the irrigation component of the project which would be replenished by the Government at monthly intervals to a level equivalent to the estimated requirements for the next two months. Establishment of the special fund would be a condition of effectiveness of the loan.

**Procurement**

4.22 Equipment and vehicles for force account construction, operation and maintenance, the erosion control study and the input-output monitoring program (all under NIA), costing about US$3.3 million, would be procured after international bidding in accordance with Bank Group Guidelines. A preference limited to 15% of the cif price of imported goods, or the custom duty, whichever is lower, would be extended to local manufacturers in the evaluation of bids. Local shopping is appropriate for off-the-shelf items costing less than US$10,000 each because the advantages of international competitive bidding would be clearly outweighed by the administrative costs involved. The total cost of such items would not exceed US$300,000. Bank staff have reviewed the local procedures and they are acceptable. There is adequate competition and foreign firms can participate. A detailed list of equipment requirements is given in Annex 10.

4.23 The three roads to be improved under the provincial roads component of the project would be advertised by DPH in one package (US$4.8 million), under international competitive bidding, with the option to bid on one or all of the three roads.

4.24 Work on the Chico diversion dam and main diversion canal (US$19.1 million) would be advertised by NIA subject to international competitive bidding. Works on the project service area would be scattered over five separate areas and include rehabilitation of a 1,400 ha system and construction of new systems for 11,900 ha of rainfed rice lands and a large number of individual communal and pump irrigation systems totaling some 6,400 ha. These have to be planned and executed to avoid so far as possible the growing season and bad weather. In the past NIA has experienced considerable difficulty in attracting bids for such works. Several steps have been taken on Bank-assisted projects to strengthen local contractors, including financing of reconditioned equipment and providing higher mobilization allowances. Even with these steps it is doubtful that all civil works could be done by contract and some of them would therefore have to be carried out on force account. NIA is presently carrying out the ADB's portion of the Magat project by force account and, together with force account work on other irrigation projects, considerable construction capability has been built up. Nevertheless, in light of NIA's large work program in the years ahead, it would not be desirable to expand its force account work too rapidly. Assurances were obtained that NIA would investigate ways of expanding the execution of civil works by contract, so that the amount of work done by force account would not exceed 40% of the total cost of the work not subject to international competitive bidding. Competitive bidding in accordance with local procedures is appropriate for the balance of the work. Bank staff have reviewed the local procedures and they are acceptable. There is potentially adequate competition and foreign firms can participate.
Disbursements

4.25 Disbursements would be made at the rate of 100% of the foreign exchange cost of directly imported equipment, 100% of the ex-factory price of locally manufactured equipment and 65% for imported equipment procured locally. For costs of consultants and technical assistance disbursements would be at the rate of 100% of the foreign exchange cost or 60% of total cost. Disbursements for both irrigation and provincial roads civil works would be 60% of certified monthly progress payments or expenditures. For civil works contractors' mobilization and equipment, disbursements would be at 100% of foreign exchange cost.

4.26 Disbursement of the Bank loan would be against import documentation, contracts and certified records of payment or expenditure. It is expected that disbursements would be completed by June 30, 1981, approximately one year after the end of construction. Upon completion of the project any undisbursed Bank funds would be cancelled. An estimated schedule of expenditures, a semi-annual disbursement schedule and a proposed allocation of loan proceeds are given in Annex 11.

Accounts and Audit

4.27 The NIA and DPH are Government agencies and their accounts are audited annually by the Government's Commission on Audit. Assurances were obtained that NIA and DPH would maintain separate accounts for their portions of the project and that after audit by the Commission on Audit, the project accounts, together with the auditor's comments, would be sent to the Bank within four months of the close of each financial year.

Environmental Effects

4.28 There is no schistosomiasis in the project area or in Northern Luzon generally. Malaria is effectively controlled by a Government program of house spraying with residual insecticides. The few cases reported are brought into the project area from the sparsely populated, mountainous forest regions bordering the Cagayan Valley. The principal public health problems in the area are protein deficiencies in preschool age children, enteric diseases and tuberculosis. The proposed project would have little direct impact on these.

V. ORGANIZATION AND MANAGEMENT

Project Management

5.01 NIA would be responsible for all components of the project except for the provincial road program which would be executed and maintained by DPH (para 5.05). Because of its relatively small size and proximity to the Magat project, the irrigation component would be executed and operated by the Special Projects Organization of NIA as a division of the Magat project (para 5.03).
5.02 NIA was created in 1964 and given responsibility for developing, operating and maintaining all national irrigation systems in the Philippines. The Government finances the NIA through the sale of bonds or from appropriations. A Board of Directors is responsible for the agency, and the Administrator, who is appointed by the President of the Philippines, handles management. NIA is in the process of being reorganized to meet the requirements of the Government's policy of accelerated irrigation development. The integration of the major foreign-assisted projects under a Special Projects Organization Office now headed by an Acting Assistant Administrator is one of the first results of the reorganization. The Special Projects Organization (Chart No. 9533) would also be responsible for execution and operation of the Chico project. Because of the large and increasing Bank-assisted program and the importance of the post, assurances were obtained that NIA would designate a full-time Assistant Administrator to head the Special Projects Organization, and that NIA would afford the Bank a reasonable opportunity to comment before making any designation to the post before completion of the project. Designation of an Assistant Administrator for Special Projects would be a condition of effectiveness of the proposed loans.

5.03 Day-to-day responsibility for construction of the irrigation facilities would rest with the Assistant Project Manager - Chico stationed in Tabuk who would report to the Magat Project Manager (Chart 15356). NIA would provide the additional support staff and facilities to allow him to carry out his responsibilities. There would be two construction divisions: the first located at Tabuk for building the Chico diversion dam, main diversion canal and Talaca catch dam; and the second located at Quezon for building the irrigation and drainage systems. NIA is in the process of selecting an Assistant Project Manager - Chico and arrangements for his appointment were confirmed during negotiations.

5.04 For O & M purposes the Chico irrigation project would comprise one district under the Magat project with support provided by the three Magat divisions dealing with administration, equipment and agricultural development. The proposed Chico district would be divided into two zones, one centered on Quezon and the other on Tabuk, each comprising about 10,000 ha. The zones would be divided into 50-ha irrigation units and a ditch tender would supervise two such units (100 ha). A Water Management Technologist (WMT) would control five ditch tenders (500 ha) while a Supervisor would be responsible for a water management division and five WMT’s (2,500 ha). (Annex 12).

5.05 DPH, through its Region II office, would be responsible for construction of the three provincial roads. It would prepare detailed designs and final engineering specifications and tender documents, award contracts and supervise construction. After construction the roads would be handed over to the Provincial Engineer, Isabela, for maintenance. Both DPH Region II, and the province have adequate staff and equipment to carry out this work.

5.06 The Special Projects Organization of NIA would be responsible for the Erosion Control Study and for Input-Output Monitoring. A consulting firm would assist NIA with the study which would be carried out by an Erosion Control Study Section established within the Dam and Reservoir divisions of UPRP and the Magat project. Consultants would assist NIA in setting up the Input-Output Monitoring program which would be carried out by the Agriculture
Department of the Special Projects Organization. The Project Development Division of NIA would prepare the feasibility study for Stage II irrigation.

Supporting Agricultural Services

5.07  An Agricultural Development Coordinating Council (ADCC) was established in the Upper Pampanga River Project (UPRP) to coordinate the work of the various agencies providing services to the farmers (Annex 13). The arrangement appears to be working well in UPRP and a similar organization is being established for the Tarlac Irrigation Systems Improvement Project, the Rural Development Project on Mindoro and the Magat project. As NIA would operate the Chico project as part of the Magat project, the Chico project should be included in the proposed Magat ADCC. While the Magat project falls within a single province, Isabela, the Chico project is in the three provinces of Cagayan, Isabela, and Kalinga-Apayao. To avoid having three ADCC's, and as the three provinces was within the same administration region (Cagayan Valley), an assurance was obtained that the Magat ADCC would be expanded to regional level to include the Chico project area.

5.08  A total of 26 agricultural graduates from a number of Government agencies provide extension services to farmers in the municipalities covering the project area. The Bureau of Agricultural Extension supplies the majority. The ratio of extension workers to farmers is about 1:600. Under the project the extension coverage would be strengthened by addition of the water management staff (para 5.04) and there would be better coordination through the ADCC (para 5.07).

5.09  Current fertilizer consumption in the project area amounts to less than 1,600 tons per year, 70% of which is accounted for in approximately equal proportions by sulphate of ammonia and ammonium phosphate. At full development the project area would require some 8,400 tons of fertilizer, on the basis of 60 kg/ha nitrogen and 30 kg/ha phosphate per crop season. Existing supply channels would handle the increased demand without difficulty. The certified rice seed requirement at full development would total 740 tons per year and no problems are expected in obtaining the amount.

5.10  The substantial increase in the irrigation area, higher cropping intensity and better farming practices resulting from the project would require a large increase in production credit. Under the agrarian reform and Masagana programs the Government has strengthened the credit institutions and eased credit to small farmers, previously dependent on the landlords for their requirements. A system of "supervised credit" is used which includes the provision of technical services to the borrower to ensure that recommended practices, such as variety, fertilizer and agrochemical inputs, are adopted. Under the system no collateral is required. During the 1974 wet season, agricultural loans granted to farmers of the three provinces in the project area by the Rural Banks and the Philippine National Bank
5.11 In the Bank-assisted Central Luzon projects the UPRP's Agricultural Development Division is responsible for monitoring the deployment of extension and water management personnel, pace of land reform, cropping patterns, use of inputs and credits, incidence of pests and diseases, etc. For the Magat project assurances were obtained that NIA would establish within six months of loan signature an Agricultural Development Division similar to the one for UPRP. The Chico project, as a division of Magat, would be provided the required support services.

Cost and Benefit Recovery

5.12 Republic Act No. 3601 establishing NIA gave it the authority to collect from users of irrigation systems, fees to finance operation of the systems and to reimburse construction costs. Collection of fees and the percentage rate of fees collected have been increased in the past few years. However, the 66% collection rate in 1974 is still low. Irrigation fees on the national irrigation systems have been recently raised to the equivalent of two cavans of paddy per ha in the wet season and three cavans in the dry season to be applied uniformly to all national irrigation systems. As an exception to the uniform rate policy, the Government has agreed to raise rates on the Bank-assisted Central Luzon projects and on the Magat project to the equivalent of 3.5 cavans of paddy/ha in the wet season and 4.4 cavans in the dry season. These rates would be reached gradually over a period of five years from completion of construction. Rates on the UPRP, where construction is due to end in mid-1976, have already been raised to the equivalent of 2.5 cavans of paddy/ha in the wet season and 3.5 cavans in the dry season.

5.13 In view of the problems encountered in collecting water fees in the past and the likelihood of greater difficulties in the future as a result of the recent increase in fees, NIA should put emphasis on improved collection. During the Magat project negotiations (Loan 1154-PH), NIA agreed to review the rate of collections for all national systems to identify the factors affecting collections. Because the Chico project would be operated as a division of the Magat project, the proposed fees for the Chico project users would be the same as those established for the other Magat divisions. Uniform fees for service to Magat and Chico projects users is technically consistent as at full development cropping intensities and farm incomes would be the same. For the Chico project, the proposed fee charges would result in a cost recovery index of 29%, a benefit recovery index of 11% and a rent recovery index of around 20%. Details are in Annex 18.

5.14 Because the level of fees charged for irrigation service is part of a broader problem, and not project-specific to Chico, it would be reviewed with Government within the context of its overall fiscal and irrigation sector policies. Assurances were obtained that the Government and the Bank would consult annually on the adequacy of water charges and the collection thereof.
5.15 To ensure sound operation and maintenance practices and an equitable contribution by beneficiaries toward recovery of project capital costs, assurances were obtained that:

(a) the NIA would make annual budgetary provisions to supply the funds necessary for operation and maintenance of the project;

(b) irrigation fees would be levied to provide NIA with sufficient funds to maintain and operate the project and to allow for the recovery of investment cost within a reasonable period, taking into account farmers' incentives and capacity to pay. A gradual increase in irrigation fees over a period of five years from completion of construction to a level equivalent to about 3.5 cavans of paddy per ha in the wet season and 4.4 cavans in the dry season would meet the requirement; and

(c) the NIA would take all necessary actions to ensure full and prompt collection of the irrigation fees.

VI. PRODUCTION, MARKET PROSPECTS, PRICES AND FARM INCOMES

Production

6.01 Implementation of the project would lead to a more intensive cropping pattern and higher yields. Upon completion, the irrigated area would increase to 19,700 ha, of which at present 7,500 ha are irrigated and 12,200 ha are rainfed during the wet season. Although Stage I would not provide storage for dry season irrigation water, diversion of unregulated river flows would allow the present dry season irrigated area of 5,300 ha to be expanded to 17,000 ha. Annual cropping intensity would increase from 127% to 186%. Better water control, improved extension services and expanded credit facilities would encourage increased plantings of high yielding rice varieties, heavier fertilizer applications, and greater use of crop protection chemicals. The use of machinery for land preparation and threshing would increase to meet more exacting crop calendars. At full agricultural development in 1986, most farmers would thresh their crops mechanically, and would use a combination of machinery and animal-drawn implements for land preparation.

6.02 At full development, estimated paddy yields for the wet and dry season crops would average 4.0 ton/ha per crop. The dry season yield reflects some damage from occasional typhoons. Farmers would achieve these yield levels five years after the introduction of water control. Future yields without the project assume about a 1.6% annual average increase from 1976 to 1986. At full development, total paddy production from the Stage I project area would be about 147,000 tons per year compared with 50,000 tons at present, and an estimated 57,000 tons in the future without the project (Annex 14).
Market Prospects

6.03 A major Government objective in the agricultural sector is self-sufficiency in basic foods, especially rice and corn. The deficit in rice, the main staple food crop, has been a persistent problem for the Philippines, and in recent years annual rice imports have averaged around 300,000 tons. The 1975 Basic Economic Report projects the 1985 Philippine demand for milled rice to be 5.0 million tons, equivalent to 8.5 million tons paddy including seed requirements. To meet this demand, local production would have to increase over the next decade by slightly more than 3.5% per year and the incremental paddy production from the project area would be marketed without difficulty. Traditionally, the project area has produced paddy surplus to its requirements, and has exported this surplus throughout the Cagayan Valley, to provinces in the Ilocos and northern Central Luzon regions, and occasionally to the Manila and Southern Tagalog regions. With the project, this pattern would continue, with buyers from Ilocos and northern Central Luzon purchasing most of the additional production.

Prices

6.04 In 1957 the Government introduced an annual farm gate support price for paddy to encourage production and to allow purchases of paddy by Government to build stocks. From 1965 to 1970 the support price was about 10% higher than the market price but since 1971 the market price has generally exceeded the support price. In December, 1975 the official farm gate support price for paddy was P 1,000/ton, which was considerably lower than the corresponding price of imported rice (P 2,650/ton cif Manila, which would correspond to a farm gate price for paddy of about P 1,500/ton). The low farm gate price is maintained by Government sales of imported rice on the domestic market below cost. In 1974 this subsidy cost the Government about US$20 million. With the expected decline of rice prices on the world market, it is reasonable to assume that the subsidy to consumers would be eliminated and that farm gate prices would generally correspond to world market prices. The Bank's latest price forecasts show the world market price of Thai 25%-35% broken rice to fall to around US$240 per ton by 1985 (in terms of 1976 constant dollars). These projections were used to estimate the present and future paddy farm gate prices for the farm budgets and the economic analysis.

6.05 The Government subsidizes fertilizers used to grow food crops for domestic consumption. For example, the November, 1975 price of urea used for food crops was P 1,780 per ton (US$237) on the farm, while the world market equivalent farm gate price was P 2,345 (US$313) per ton. Thus the Government compensates farmers to some extent for the low domestic price of rice. At full development the financial prices for paddy and urea are assumed to coincide at the Bank's forecasted world market prices (at mid-1976 constant prices). The corresponding farm gate prices would be P 1,220 (US$162) per ton of paddy and P 1,900 (US$253) per ton of urea. The use of a shadow exchange rate gives economic farm gate prices of P 1,350 and
P 2,100 per ton respectively (Annex 15). Under these price assumptions there would be ample incentive for farmers to participate in the project.

**Farm Incomes**

6.06 Farm models have been prepared for two typical farm sizes, presently operating under three conditions. These two models would account for 85% of the project's land area and nearly 95% of the farming population. Annex 16 presents the estimated present incomes and those projected at full development. Estimated and projected farm incomes (after payment of irrigation fees and before amortized land payments) are summarized as follows:

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<tr>
<th>Farm Size (ha)</th>
<th>Existing Farm Type</th>
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<tr>
<td></td>
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<td>Present (%)</td>
<td>Future</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>Gravity Irrigated</td>
<td>186</td>
<td>186</td>
</tr>
</tbody>
</table>

a/ Rounded to nearest P 100 and US$10.

6.07 Present net farm incomes vary from P 2,200 (US$290) on 2 ha rainfed farms to P 10,300 (US$1,370) on 4.0 ha gravity irrigated farms. At full development, all farms would be gravity irrigated and are expected to have identical cropping intensities. Net farm income would be P 11,900 (US$1,590) on 2.0 ha, and P 22,000 (US$2,930) on 4.0 ha. Present rainfed farmers would make the greatest relative gains, and present gravity irrigated farmers the least.

6.08 Little information is available on off-farm income in the project area, but observations and interviews in the field indicate that it is small relative to returns from farm work. Although comparisons of farm incomes based on farm budgets with income data based on national accounts aggregates must be interpreted with caution, they do present a rough picture of the relative position of project beneficiaries. With an estimated 5.5 persons per family, present per capita farm income varies from P 400 (US$55) to P 1,870 (US$259), about 20%-80% of the 1976 per capita GNP of US$300. About 84% of the project’s farm families accounting for 75% of the area are presently at or below the Bank's estimated absolute per capita poverty level of US$140 (expressed in mid-1976 constant price levels). At full project development in 1986, the projected per capita farm income would be be P 2,200 (US$290) for a 2 ha farm and P 4,000 (US$535) for a 4.0 ha farm, or some 65-115% of the 1986 projected per capita GNP of US$465. These comparisons indicate that the project would considerably narrow the income gap between the project area and other parts of the country for the many small farmers (2 ha or
less), while for the larger farmers (4 ha or more) per capita farm income would be slightly above the projected national average per capita GNP.

VII. BENEFITS AND JUSTIFICATION

7.01 The project's irrigation component would directly benefit some 8,000 farm families and 2,000 landless laborer families, a total of 55,000 people. The proposed irrigation would increase yields and production on 19,700 ha, by providing better water control, improved drainage and the necessary agricultural supporting services. By considerably increasing dry season irrigation from 5,300 ha at present to 17,000 at full project development, it would also create a demand for an additional 1.17 million man-days of farm labor per year, equivalent to some 4,700 full time additional jobs. The road component would improve access links between the 75,000 ha Stage I irrigation service area of the Magat project and existing national highways. It would also provide an alternative road outlet for the southern portion of the Chico project irrigation service area to the national highways linking the Cagayan Valley to Manila.

7.02 The proposed road improvements would reduce transport costs of farm inputs and outputs. Project area farmers and rice consumers in the Cagayan Valley, northern Central Luzon and Ilocos regions would share the benefits. Assuming a 15-year project life, the economic rate of return is 20% for the Roxas - Gamu road, 18% for the Cabatuan - Cauayan road and 15% for the San Mateo - Alicia road. The Government intends to improve the Tuguegarao - Santiago National Highway via Quezon with an improved crossing over the Magat river which is presently serviced by a ferry to carry light vehicles only during the low river season. The Government has appointed consultants to carry out feasibility studies of this national highway and if the improvements are found feasible, there will be some diversion of traffic from the Roxas - Gamu road and its economic rate of return will decrease to 15%. (Annex 6).

7.03 For the irrigation development, the full costs of the diversion weir and the main canals, sized to serve both Stages I and II, were charged to Stage I in the economic analysis. Assuming a 50-year project life, full agricultural benefits being attained in 1986, farm gate prices for rice and fertilizer based on the Bank's commodity price forecasts for 1985, a shadow foreign exchange rate of US$1.00 = P 8.30, and a seasonably variable shadow wage rate for unskilled labor, the economic rate of return would be 15%. Details for the proposed project and for second phase development are in Annex 19.

7.04 The rate of return showed little sensitivity to the estimates of project costs or assumptions made concerning the timing of agricultural benefits or the opportunity cost of farm labor. It showed most sensitivity to a reduction in the level of benefits, emphasizing the importance of effective agricultural extension and the timely availability of adequate farm inputs. In none of the cases tested, however, did the rate of
return fall below 12%. On the other hand, if the world market price for rice turns out to be 25% higher than forecast, the rate of return would be 19%. Similarly, if 50% of the diversion weir cost was allocated to the proposed power project, the remaining weir costs shared between Stages I and II on a service area basis and US$9.2 million of the main canal, representing the cost of excess capacity charged to Stage II, the rate of return would be 21%.

7.05 At full agricultural development the project would result in rice import savings of ₱177.6 (US$23.7) million per year at the forecasted world market prices (para 6.04). After deducting the incremental cost of imported fertilizers, chemicals, fuel and other farm inputs, annual net foreign exchange savings would amount to about US$20 million.

VIII. AGREEMENTS REACHED AND RECOMMENDATION

8.01 During negotiations, agreement with the Government was reached on the following principal points:

(a) the necessary water rights would be granted to the NIA and no private water rights which would adversely affect the project's water supply would be granted except by mutual agreement with the Bank (para 4.08);

(b) the Government and the Bank would consult annually on the adequacy of water charges and the collection thereof (para 5.14); and

(c) NIA would make annual budgetary provisions to supply the funds necessary for operation and maintenance of the project; would take all necessary action to ensure full and prompt collection of irrigation fees; and would gradually increase irrigation fees over a period of five years from completion of construction to a level equivalent to about 3.5 cavans of paddy/ha in the wet season and 4.4 cavans in the dry season (para 5.15).

8.02 Conditions of effectiveness of the loan would be:

(a) establishment by NIA of a special fund for the irrigation component of the project; the Government has agreed to cause NIA to establish the fund which would be replenished by the Government at monthly intervals to a level equivalent to the estimated requirements for the next two months (para 4.21); and

(b) the designation by NIA of a full-time Assistant Administrator to head the Special Projects Organization;
NIA would afford the Bank a reasonable opportunity to comment before making any designation to the post (para 5.02).

8.03 The proposed project would be suitable for a Bank loan of US$50.0 million, with a 25 year maturity including a grace period of six years. The borrower would be the Republic of the Philippines.
APPENDIX A
Page 1

PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Cagayan Basin Development

General

1. The Cagayan river basin in Northern Luzon is one of the largest of the nine major basins in the Philippines. It covers some 28,000 km² and is bounded on the north by the Babuyan Channel, on the south by the Caraballo mountains, on the east by the Sierra Madre mountains and on the west by the Cordillera Central range. The basin encompasses parts of the provinces of Isabela, Cagayan, Mountain, Kalinga-Apayao, Ifugao, Nueva Vizcaya, Quezon and Quirino. The Cagayan River traverses the entire length of the valley, from its source near the Nueva Vizcaya – Quezon boundary to its mouth on the Babuyan Channel. The two most important tributaries are the Magat and Chico rivers. The Magat is located in the south western part of the basin and the Chico in the north western portion. The Magat is about 150 km long from its upper reaches in Nueva Vizcaya to its confluence with the Cagayan in Isabela province. The Chico rises in the Cordillera Central mountains, is about 140 km in length and joins the Cagayan downstream of Alcala in Cagayan province. The estimated average annual stream flow at the point of confluence for the Magat amounts to 5,680 Mm³ and for the Chico 6,930 Mm³, equivalent to 12% and 14% respectively of the Cagayan basin run-off.

2. Land is one of the major resources in the basin. Of the total area of 2.8 million ha about 1.0 million ha are cultivated, of which 40% are in Isabela, 30% in Cagayan and the balance equally divided between Nueva Vizcaya and Mountain provinces. The main problem confronting basin agriculture is insufficient dependable water for year-round irrigation. While rainfall may be deficient for short periods during the rainy season, it is usually enough for wet season cropping, but is patchy, erratic and inadequate in the dry season. In rainfed areas cropping is limited to the wet season and the land is unproductive during the dry months. Even on the 46,000 ha of land served by national gravity irrigation systems in the basin during the wet season, only about 30 to 40% are irrigated during the dry season.

3. Mean annual rainfall in the basin varies from 1,000 mm to 3,000 mm. The four-month period, January through April, is dry and accounts for less than 9% of annual rainfall, while some 75% of the precipitation occurs during July through December. The estimated annual runoff in the basin amounts to 49,000 Mm³.
Magat River Development

4. The Government recognized the importance of irrigation in the basin and began developing national gravity irrigation projects in the mid-1950's. The first stage of the Magat River Irrigation System (MARIS) was completed in 1957 and the Siffu River Irrigation System (SIFRIS) in 1960. The MARIS was further extended in 1966. In the same year a Water Resources Survey Team from the U.S. Bureau of Reclamation (USBR) submitted a report on the potentials of the Cagayan basin in terms of land and water resources. The report concluded that both the Magat and Chico sub-basins appeared to have good potential for water resource exploitation and should be given priority for development.

5. As a result of the Basin Report recommendations the Government engaged consultants to prepare a provisional planning report on the Magat river project. The report, submitted in 1967, proposed building a rockfill dam on the Magat river to provide storage for year-round irrigation of 75,000 ha of land as well as generation of 100 MW of hydroelectric power. In 1973 the National Irrigation Administration (NIA) with assistance from the USBR completed a feasibility survey of the Magat project. The survey concluded that development of a multipurpose project on the Magat river was technically feasible and economically viable. The project was envisaged to provide storage by building a high dam on the river to allow year-round irrigation of 104,000 ha and installation of a hydroelectric plant with a capacity of 300 MW.

6. Because of the physical size, large estimated cost and long construction period NIA proposes a 10-year implementation schedule (1975-1986) for the Magat project, divided into two stages. Stage I consists of the rehabilitation of existing irrigation systems and construction of new facilities for a total of 75,000 ha that can be served by run-of-the river diversion in the wet season. The Asian Development Bank (ADB) is assisting NIA to rehabilitate 40,000 ha of Stage I under the Angat-Magat Integrated Agricultural Development Project (AMIADP). The remaining 35,000 ha of Stage I are being developed with Bank assistance under Loan 1154-PH. Stage II would include construction of additional irrigation facilities to increase the command area to 104,000 ha and construction of the storage dam, power station and the provision and installation of generating and transmission facilities.

Chico River Development

7. The National Power Corporation (NPC) completed a technical prefeasibility study of the hydro-electric development potential of the Chico sub-basin in 1973. The study proposed construction of a series of four storage dams with a total installed capacity of 1000 MW and a total average annual energy production of about 2,000 Gwh. NPC, with consultant assistance, began a feasibility grade study on the Chico 2 damsite, but had to stop work due to opposition of the people in the proposed reservoir site. The focus of the study has been shifted to the Chico 4 site where
problems of reservoir resettlement are expected to be less difficult because only about 75 families are involved. Resettlement would be carried out after suitable sites have been selected in consultation with tribal representatives and before commencing construction of the dam.

8. An NIA study of the feasibility of irrigation development from the Chico river completed in 1975 concluded that year-round irrigation of at least 40,000 ha of rice land would be technically feasible and economically viable. Further analysis at appraisal indicates that with the additional storage provided at the Chico 4 site, irrigation could be expanded to about 49,000 ha with sufficient water to irrigate about 45,000 ha during the dry season.

Phasing of the Project

9. Because of the need to coordinate the full development of the irrigation potential with the development of hydro-power and storage on the river it is proposed to implement the Chico River Irrigation Project in two stages. The first stage would be limited to 19,700 ha that could be served by run-of-the river diversion in the wet season. The second stage would provide service to an additional 29,300 ha in the wet season for a total of 49,000 ha. The second stage would be dependent on the provision of storage on the river through the construction of the proposed Chico 4 hydro-dam. A feasibility study for the dam is to be prepared by NPC with consultant assistance.

10. **Stage I** would consist of the construction of a diversion dam on the Chico River, the rehabilitation and upgrading of about 7,800 ha of existing irrigation systems and their expansion by a further 11,900 ha. The diversion dam would be designed to function as an afterbay regulator for the storage dam of Stage II. Construction of Stage I would take five years (1976-1980). At completion irrigation would be available to 19,700 ha of rice in the wet season and 17,000 ha in the dry season for a cropping intensity of 186%.

11. **Stage II** would take five years (1980-1984) for implementation and would consist of construction of irrigation facilities to service an additional 29,300 ha. The timing of Stage II would be dependent on the construction of the Chico 4 storage dam scheduled to be completed over the 1979-1984 period. Construction of Stage II irrigation facilities would overlap Stage I construction by one year and be completed in 1984, at completion of Chico 4 storage dam. Such phasing would permit the earliest possible introduction of 190% cropping intensity to the entire 49,000 ha of the combined Stages I & II of the irrigation project.
## PHILIPPINES

### CHICO RIVER IRRIGATION PROJECT: STAGE I

#### Climatological Data

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<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
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3/** " " 1949-1973
4/** " " 1903-1939, 1947-1972
5/** " " 1957-1968
6/** " " 1958-1970
7/** " " 1948-1972
Background

1. Since 1972, the Government has pursued an agrarian reform program aimed at the transfer of land ownership to tenant farmers on rice and corn lands. Presidential Decree No. 27 (PD 27), the basic legislation of the new program, provides for the transfer to the tenant, whether sharecropper or leaseholder, of the land he tills up to a total of 3 ha in an irrigated area and 5 ha in a rainfed area. The landlord is allowed to retain up to 7 ha providing he cultivates the land himself. The Decree lays down a system of valuing the land and provides for the tenant to pay for it in 15 equal annual installments at an interest rate of 6% per annum.

2. It is estimated that the total number of rice and corn tenants is about 1.0 million on some 1.5 million ha owned by about 430,000 landlords. Some 85% of these landlords have holdings of less than 7 ha. In addition, the total number of rice and corn farmers probably exceeds 2 million, while the total area of rice and corn lands is not much more than 4 million ha, of which less than 1 million ha are irrigated. There is, therefore, little prospect of achieving the objective of 5 ha rainfed or 3 ha irrigated family farms nationwide.

3. A recent survey by the Department of Agrarian Reform (DAR) reports that 55% of the tenants on 45% of the tenanted area are under landlords with holdings smaller than 7 ha. The Government is anxious not to antagonize the small landowners, and is looking for a solution equitable to both tenants and landlords. For holdings under 7 ha the Government has announced its intention to enforce leasehold with security of tenure. To prevent abuses pending the issue of rules and regulations under the various decrees, the Government has forbidden evictions, and has declared sharecropping illegal. DAR is proceeding with the transfer of land in holdings over 24 ha, and by December 1975, had issued land transfer certificates to 208,000 tenants covering 366,000 ha in 64 provinces but valuation and payment has been slow. DAR reports that landlords and tenants have submitted to the DAR valuations of 50,000 ha, involving 930 landlords and 37,200 tenants in 36 provinces. The Land Bank has paid compensation to 590 landlords for 25,700 ha, involving 16,400 former tenants.

4. In November 1974 the Government decided to proceed with the transfer of land in holdings between 24 and 7 ha. This work began in January 1975 and is targeted to be finished by the end of 1977. To
expedite land transfer and resolve land valuation disputes, barrio (hamlet) land valuation committees began functioning in April, 1975. The committees consist of the barrio captain, four tenant farmers, two owner cultivators, two landowners, a representative from the DAR and one from the samahang nayon (pre-cooperative organization).

Situation in the Project Area

5. DAR has identified all corn and rice holdings subject to land reform in the three project area provinces of Isabela, Cagayan and Kalinga-Apayao. As of October 1975 land transfer certificates were issued to some 18,400 tenants on about 34,000 ha out of a total of about 32,000 tenants on holdings over 7 ha. There are about 46,000 tenants on holdings below 7 ha.

6. According to DAR and NIA data, an estimated 4,880 people own the 19,700 ha in the Stage I project area. Some 95% of the owners have properties of less than 7 ha, and account for 70% of the area. The remaining 5% of holdings larger than 7 ha, the existing operational limit for land transfer, comprise 30% of the area (5,850 ha), which will be transferred to the former tenants. The land ownership pattern in the project area by size of holding in January 1975 was as follows:

<table>
<thead>
<tr>
<th>Size of Holding (ha)</th>
<th>Owners</th>
<th>Area Owned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Less than 3</td>
<td>3,290</td>
<td>67</td>
</tr>
<tr>
<td>3 - 7</td>
<td>1,380</td>
<td>28</td>
</tr>
<tr>
<td>7 - 12</td>
<td>151</td>
<td>3</td>
</tr>
<tr>
<td>12 - 24</td>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>24 - 50</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>50 - 100</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>More than 100</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Total 4,880 100 19,700 100

7. The average project farm unit is 2.5 ha. Most farms (84%) are between 1 and 5 ha, and cover 83% of the project area. The farm size distribution is as follows:

<table>
<thead>
<tr>
<th>Farm Size (ha)</th>
<th>Farm Cultivated Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>Less than 1</td>
<td>841</td>
</tr>
<tr>
<td>1 - 3</td>
<td>5,471</td>
</tr>
<tr>
<td>3 - 5</td>
<td>1,318</td>
</tr>
<tr>
<td>5 - 7</td>
<td>328</td>
</tr>
<tr>
<td>More than 7</td>
<td>92</td>
</tr>
</tbody>
</table>

Total 8,050 100 19,700 100
8. There are substantial differences in mean farm size and farm size distribution between some of the five sections of the proposed project. The mean farm size varies from a low of 1.1 ha in Chico West to a high of 3.3 in Quezon-Mallig. Farm size distribution in the five sections is as follows:

<table>
<thead>
<tr>
<th>Section</th>
<th>Chico West</th>
<th>Tuga-Gobgob</th>
<th>Tabuk</th>
<th>Agbannawag</th>
<th>Quezon-Mallig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha):</td>
<td>2,000</td>
<td>1,250</td>
<td>3,400</td>
<td>2,950</td>
<td>10,100</td>
</tr>
<tr>
<td>No. Farms:</td>
<td>1,820</td>
<td>520</td>
<td>1,420</td>
<td>1,230</td>
<td>3,060</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farm Size: (ha)</th>
<th>Farms</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1</td>
<td>42</td>
<td>22</td>
</tr>
<tr>
<td>1 - 3</td>
<td>57</td>
<td>71</td>
</tr>
<tr>
<td>3 - 5</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>5 - 7</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>More than 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Mean Farm Size: (ha) 1.1 2.4 2.4 2.4 3.3

The Chico West section with a long history of irrigation is characterized by small farms and little variation from the mean. Until recently the Quezon-Mallig section had relatively little irrigated land and still shows traces of a land settlement initiated before World War II, when the land was divided into 10 ha holdings.

9. In January, 1975, the project area tenure situation was as follows:

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Farmers</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Owner-Operator</td>
<td>3,945</td>
<td>49</td>
</tr>
<tr>
<td>Leaseholder</td>
<td>2,898</td>
<td>36</td>
</tr>
<tr>
<td>Sharecropper</td>
<td>1,207</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>8,050</td>
<td>100</td>
</tr>
</tbody>
</table>

The proportion of owner-operators was high, being 20% greater than in the neighboring Magat project and between two and three times higher than in the Bank-assisted Central Luzon projects. The highest proportion of owner-operators (56%) was in the Chico West section, the lowest (12%) was in the Agbannawag section, while there was little difference between the other three sections. Tenants accounted for 51% of the farmers, but only
some 30% of these were sharecroppers, compared to 90% in Magat. In the Quezon-Mallig section sharecroppers accounted for only 7% of the tenant farmers. The average owner-operator unit was some 2.9 ha compared to an average tenant unit of 2.1 ha.

10. The mean farm size in the project area is smaller than in the Magat project, but larger than in Central Luzon projects, where the range is from 1.5 to 2 ha. Central Luzon is more intensively developed than the relatively newly settled areas of Cagayan Valley. Population density in the valley is among the lowest in the Philippines despite considerable internal migration during the last decade. Development of the Magat and Chico projects is expected to attract more people to the area and the farm size will probably decrease as irrigation increases productivity.

11. The transfer by DAR of landlord holdings larger than 7 ha would involve an estimated 5,850 ha and 2,800 tenants. The transfer would result in some 17,100 ha or 87% of the project area being cultivated by around 6,800 owner-operators, the equivalent of 85% of the farmers. The 1,300 tenant farmers on holdings of less than 7 ha would operate under a leasehold contract.
CHICO RIVER IRRIGATION PROJECT: STAGE I

Project Irrigation Works

1. Stage I would provide irrigation service to 19,700 ha of rice land and diversion and main canal capacity for expansion under Stage II development to irrigate a total of 49,000 ha. Stage I would divert unregulated flows of the Chico River while Stage II development would depend on construction of a storage dam on the Chico River to firm up wet season water supply and augment dry season flows of the river. Stage I project works would consist of:

   (a) Construction of a diversion dam and intake on the Chico river;

   (b) Construction of a catch dam and intake on Talaca creek;

   (c) Rehabilitation and extension of an existing 1,400 ha NIA irrigation system and construction of drainage facilities;

   (d) Construction of new irrigation and drainage facilities for 3,200 ha of communal irrigation systems and a further 3,200 ha of privately-owned pump irrigation systems scattered over the project area; and

   (e) Construction of new irrigation and drainage facilities for 11,900 ha of currently rainfed rice lands.

Chico Diversion Dam

2. The Chico diversion dam would consist of a concrete overflow section having a crest length of 480 m and an earth and rockfill section with a 300 m crest length. The maximum height of the dam above streambed would be about 12.0 m. The dam would function as a diversion structure and also as an afterbay regulator when upstream storage and power generating facilities are constructed. The water requirements of the downstream Chico West system (2,000 ha) would be released through the dam's sluiceway, which would be equipped with two 5.5 m x 5.0 m radial gates. Water for other areas would be diverted through a three-bay, reinforced concrete canal intake structure equipped with three 4.5 m x 3.0 m radial gates. These gates would limit water diversions to about 29.6 m³/sec.
for the principal Stage I area of 17,700 ha. After service is extended by 29,300 ha in Stage II development, water diversions through the canal intake would be increased to its design capacity of 76.9 m³/sec. The dam would impound about 6.3 M m³, allowing it to re-regulate the daily water releases for peak power generation from the proposed hydroelectric power plant at the Chico 4 damsite.

Main Diversion Canal and Diversion Canal No. 1

3. The Main Diversion Canal, 25 km long, would start at the Chico diversion dam intake on the left bank, cross the Chico river in a siphon at about station 3.5 km and empty into Talaca creek, which would convey project irrigation water about 4 km to Talaca catch dam. Bed rock is exposed over this entire 4 km length of Talaca creek and no particular problems are anticipated in carrying project irrigation water. The Tuga Gobgob (1,250 ha), Tabuk (3,400 ha) and Agbannawag (2,950 ha) Stage I areas would be served by primary canals taking off from the Main Diversion Canal. Diversion Canal No. 1 (at about 11 km on the Main Diversion Canal) would serve 1,000 ha of the Tabuk area in Stage I and a further 9,000 ha area under Stage II development. Both the Main Diversion Canal (capacity 76.9 m³/sec) and Diversion Canal No. 1 (capacity 16.7 m³/sec) would be oversized to serve Stage II lands. For Stage I lands only, the initial capacities would need to be 29.6 and 1.8 m³/sec, respectively.

4. For much of the upper reach the Main Diversion Canal traverses rather rough terrain with numerous small streams and ridges requiring cuts and fill, some in excess of 10 m. Canal sections on fills higher than 10 m would be concrete lined. Other than these short lengths, all canals would be unlined. Detailed engineering prior to construction may determine that some of the high fills should be eliminated by siphons and the basic cost estimate for the Main Diversion Canal was increased by 10% to cover this possibility.

Talaca Catch Dam

5. Water discharged into Talaca creek from the Main Diversion Canal would be impounded by the Talaca catch dam and diverted to the Quezon-Mallig area of Stage I through a reinforced concrete canal intake structure located on the left bank. The intake structure would also serve Stage II lands at a later date. The catch dam would be of the concrete overflow type with a crest length of 60 m and a maximum height above streambed of about 14.0 m. The dam's sluiceway would be equipped with two 2.5 m x 2.5 m radial gates. Water diversions through the canal intake would be regulated by three 2.95 m x 3.54 m radial gates.
Service Area

6. The layout of the irrigation system and principal works are shown on Map 11944R. The 19,700 ha Stage I comprises the following:

<table>
<thead>
<tr>
<th>Area</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chico West</td>
<td></td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>1,400</td>
</tr>
<tr>
<td>Extension</td>
<td>600</td>
</tr>
<tr>
<td>Sub-total</td>
<td>2,000</td>
</tr>
<tr>
<td>Tuga Gobgob</td>
<td>1,250</td>
</tr>
<tr>
<td>Tabuk</td>
<td>3,400</td>
</tr>
<tr>
<td>Agbannawag</td>
<td>2,950</td>
</tr>
<tr>
<td>Quezon-Mallig</td>
<td>10,100</td>
</tr>
<tr>
<td>Total</td>
<td>19,700</td>
</tr>
</tbody>
</table>

Table 1 summarizes the principal project works and the density of on-farm facilities is in Table 4. Aside from the existing Chico West system which would be upgraded and provided a drainage system through rehabilitation, all lands would require new systems, even though some 6,400 ha are presently served in some manner by small communal systems and pump systems. Additional details and location of these small systems are at Annex 14. The communal systems are small, scattered, inadequately developed and, other than those diverting from the Chico river, are chronically short of water. The pump systems generally involve only a few hectares each and are only partially developed and inadequately served. Part of the pump lands are served from shallow wells and part from small streams which, in the dry season, carry very little water. In addition to the shortage of water for pump lands, diesel fuel is increasingly more costly and pumping costs are particularly high during the dry season when water requirements are greater.

7. General features of the irrigation systems would include canal structures, such as checks, control structures and turnouts to provide water efficiently to each field as needed. Constant head orifice turnouts would be provided to each rotational area of about 50 ha. Turnouts would be provided to each 10-ha unit from which farm ditches constructed by the project would distribute water to most farmers. Farm drains would convey excess water from each 10-ha unit to main outlet drains. A few farmers would receive water through their neighbors' fields. Canals would be unlined. Working stations for Water Management Technologists (WMT) would be provided for each 500 ha of irrigated land as well as concrete drying floors.

9. Gravel surfaced operation and maintenance (O&M) roads would be constructed on the canal banks according to the following criteria:
for canals with a design capacity greater than 5.0 m³/sec, roadways 5 m wide would be provided on both banks; for canals with capacities between 2.0 and 5.0 m³/sec, a 3.5 m wide road would be provided on one bank; and no roadway would be provided along waterways with capacities less than 2.0 m³/sec. These roads would also serve as farm-to-market access roads. Some existing roads in the project area would be improved by widening and gravel surfacing to connect O&M roads to the main road system. The surfacing of new and upgraded roads would be 20 cm thick for 5.0 m roadways and 15 cm thick for 3.5 m roadways.

9. The proposed level of on-farm water distribution and drainage is similar to that being implemented on the Magat project (Table 4) and would be a substantial improvement over existing systems in the general area. Rice has been grown in the project area for many years and the land is reasonably level and well laid out with little fragmentation of land holdings. Therefore, no land levelling, boundary realignment or land consolidation would be provided at this stage. The NIA has built a 1,000-ha pilot scheme on the Upper Pampanga River Project to test the feasibility, costs and local acceptability of full on-farm development, including land consolidation, land levelling and individual farm access to irrigation and drainage. The pilot scheme will determine the effects of full on-farm development on yields, ease of operations and efficiency of water use and the findings would be applicable to the proposed project.
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CHICO RIVER IRRIGATION PROJECT: STAGE I

Summary of Irrigation Facilities to be Provided or Rehabilitated

**Chico West RIS Rehabilitation (1,400 ha)**

<table>
<thead>
<tr>
<th>Facility</th>
<th>Rehabilitation</th>
<th>Enlargement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Canal (km)</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Laterals (km)</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>Drains (km)</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>Farm Ditches (km)</td>
<td>88</td>
<td>0</td>
</tr>
<tr>
<td>Farm Drains (km)</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>O &amp; M Roads w/ Project (km)</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

**New Irrigation Area (18,300 ha)**

<table>
<thead>
<tr>
<th>Facility</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canals and Laterals (km)</td>
<td></td>
</tr>
<tr>
<td>1. Canals</td>
<td></td>
</tr>
<tr>
<td>a) Main Diversion Canal</td>
<td>25</td>
</tr>
<tr>
<td>b) Tuga-Gobgob Canal</td>
<td>13</td>
</tr>
<tr>
<td>c) Diversion Canal No. 1</td>
<td>5</td>
</tr>
<tr>
<td>d) Agbannawag Canal</td>
<td>11</td>
</tr>
<tr>
<td>e) Quezon-Mallig West Canal</td>
<td>14</td>
</tr>
<tr>
<td>f) Quezon-Mallig East Canal</td>
<td>12</td>
</tr>
<tr>
<td>2. Laterals (km)</td>
<td>315</td>
</tr>
<tr>
<td>Drains (km)</td>
<td>329</td>
</tr>
<tr>
<td>Farm Ditches (km)</td>
<td>1,080</td>
</tr>
<tr>
<td>Farm Drains (km)</td>
<td>732</td>
</tr>
<tr>
<td>O &amp; M Roads (km)</td>
<td>395</td>
</tr>
<tr>
<td><strong>Total Area (19,700 ha)</strong></td>
<td></td>
</tr>
</tbody>
</table>
### PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

#### Irrigation Facilities Cost

<table>
<thead>
<tr>
<th>Category</th>
<th>Area (ha)</th>
<th>US$/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. REHABILITATION AREA (1,400 ha)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Canal System</td>
<td></td>
<td>115</td>
</tr>
<tr>
<td>(b) Drainage System</td>
<td></td>
<td>114</td>
</tr>
<tr>
<td>(c) Road System</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>(d) On Farm Distribution and Drainage</td>
<td></td>
<td>210</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td></td>
<td>546</td>
</tr>
<tr>
<td><strong>II. NEW IRRIGATION (18,300 ha)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Canal System</td>
<td></td>
<td>1,000</td>
</tr>
<tr>
<td>(b) Drainage System</td>
<td></td>
<td>114</td>
</tr>
<tr>
<td>(c) Road System</td>
<td></td>
<td>175</td>
</tr>
<tr>
<td>(d) On Farm Distribution and Drainage</td>
<td></td>
<td>210</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td></td>
<td>1,530</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>1,480</td>
</tr>
</tbody>
</table>

1/ Not including contingencies (20%) and engineering, supervision and administration (10%).

2/ Includes Water Management Technologist stations.

3/ Includes main canal capacity for Stage II development.
### PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

Estimated Length of New Canals Required in Stages I and II

<table>
<thead>
<tr>
<th>Name of Canal</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Diversion Canal</td>
<td>25</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>Tuga-Gobgob Canal</td>
<td>13</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>Diversion Canal No. 1</td>
<td>5</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Agbannawag Canal</td>
<td>11</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Quezon-Mallig West Canal</td>
<td>14</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>Quezon-Mallig East Canal</td>
<td>12</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Diversion Canal No. 2</td>
<td>-</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Liwan-Gadu West Canal</td>
<td>-</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Liwan-Gadu East Canal</td>
<td>-</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Magsaysay Canal</td>
<td>-</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Enrile Canal</td>
<td>-</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Chico East-East Canal</td>
<td>-</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Chico East-West Canal</td>
<td>-</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

**TOTAL** 80 160 240
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Density of Terminal On-Farm Facilities on IBRD Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>On-Farm Facility</th>
<th>0 &amp; M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Irrigation (m/ha)</td>
<td>Drainage (m/ha)</td>
</tr>
<tr>
<td>UPRP</td>
<td>57</td>
<td>12</td>
</tr>
<tr>
<td>Tarlac</td>
<td>55</td>
<td>40</td>
</tr>
<tr>
<td>Magat</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Chico</td>
<td>59</td>
<td>40</td>
</tr>
</tbody>
</table>
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Water Supply, Demand and Quality

Water Supply

1. The project would derive its supply from the unregulated flow of the Chico river at the diversion dam site, where the catchment area is approximately 1,930 km². The average annual rainfall over the catchment is about 2,780 mm while the average annual runoff is 1,480 mm, or approximately 2,860 Mm³. The annual runoff expected to be exceeded in 4 out of 5 years would be about 1,540 Mm³. There is presently no regulatory storage on the catchment and none would be available until the first of four proposed hydropower storage dams is constructed upstream of the project.

2. The water supply of the Chico river at the diversion dam site was correlated by drainage area proportion with the recorded discharge at a station upstream of the diversion site about mid-way in the catchment, as that record is considered the most reliable of the records at several measuring points after a rather comprehensive analysis by both NIA and NPC. A separate analysis of stream flow at the downstream station nearest the diversion site, and its extension over a 20-year period, gave essentially the same results for the low flow months, which are critical to project water supply without storage.

Water Demand

3. Although some corn and cassava are grown in the project area, rice would continue to be the major crop and more land would be planted to paddy in the dry season when irrigation water is available. It was considered that transplanted paddy of the 120-day, non-photosensitive varieties would be the main crop in both the wet and dry seasons. Water requirements were based on the following cropping calendar:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wet Season</td>
</tr>
<tr>
<td>Land Preparation</td>
<td>July 15-Nov. 15</td>
</tr>
<tr>
<td>&amp; Nursery</td>
<td></td>
</tr>
<tr>
<td>Transplanting</td>
<td>Sept 15-Nov. 15</td>
</tr>
<tr>
<td>Harvesting</td>
<td>Dec. 15-Feb. 15</td>
</tr>
</tbody>
</table>
4. Land preparation and nursery were estimated to take 30 days. Water requirements for soil saturation and replacement of water lost through evaporation and deep percolation during this period were determined to be 310 mm in the wet season and 335 mm in the dry season. Flooding immediately after transplanting was estimated to be 20 mm followed by another application of 50 mm about two weeks later. Subsequent water applications to compensate for evapotranspiration and deep percolation losses were based on a percolation loss of 2.0 mm/day and evapotranspiration rates estimated to be equal to the average Class A pan evaporation rates recorded at Tuguegarao, Cagayan between 1957 and 1972. The effective rainfall was determined from observed daily rainfall at Tuguegarao allowing the pondage in the field to fluctuate with the growth of crops to a maximum depth of 50 mm in the first month and 150 mm in the succeeding months.

5. The overall irrigation efficiency at full development was estimated to be 43% in the wet season and 50% in the dry season. This is based on farm irrigation losses of 40% in the wet season and 30% in the dry season, conveyance losses of 20% and system operation losses of 10%. Monthly water requirements and supply expected to be exceeded in 4 out of 5 years are presented in Table 1. Seasonal and total annual diversion requirements are developed in Table 2.

6. The area that could be irrigated in Stage I in both the wet and dry seasons was determined from estimated unregulated river flow at the diversion dam and the estimated water requirements for paddy. Return flow from about 7,600 ha of Stage I irrigated lands would accrue to the river above the Chico West diversion site and was calculated in the available water supply in exceptionally dry years when natural flow of the river would be low. The water supply analysis shows that the Stage I system could serve 19,700 ha in the wet season and 17,000 ha in the dry season. A shortage of 19% could be expected in one out of five years during one month of land preparation or the early stage of dry season crop growth. In all other years there would be no water shortages and in fact during the wet season the water supply would be sufficient for a somewhat larger area.

Water Quality

7. Tests of water samples from the Chico river indicate good water quality with total dissolved solids under 300 ppm. The waters are of low salinity, only slightly alkaline and free of toxic elements. The water is turbid during the wet season but no adverse effects have been noted on soils or crops irrigated with this water for nearly 20 years.
# PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

## Estimated Water Requirement and Supply

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
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<th>Sept</th>
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<tr>
<td><strong>Wet Season Paddy (19,700 ha)</strong></td>
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<tr>
<td><strong>Dry Season Paddy (17,000 ha)</strong></td>
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<tr>
<td><strong>Rainfall, Tuguegarao (mm)</strong></td>
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<td>14</td>
<td>23</td>
<td>39</td>
<td>88</td>
<td>100</td>
<td>116</td>
<td>129</td>
<td>136</td>
<td>118</td>
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<tr>
<td><strong>Land Prep &amp; Nursery</strong> (mm)</td>
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<tr>
<td><strong>Flooding for Cultivation</strong> (mm)</td>
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<td></td>
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<tr>
<td><strong>Evapotranspiration</strong> (mm)</td>
<td>37</td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Deep Percolation</strong> (mm)</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>60</td>
<td>60</td>
<td>15</td>
<td>6</td>
<td>30</td>
<td>60</td>
<td>54</td>
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<tr>
<td><strong>Field Requirement</strong></td>
<td>67</td>
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<td>115</td>
<td>213</td>
<td>357</td>
<td>241</td>
<td>165</td>
<td>132</td>
<td>154</td>
<td>204</td>
<td>202</td>
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<tr>
<td><strong>Effective Rainfall</strong> (mm)</td>
<td>18</td>
<td>0</td>
<td>23</td>
<td>39</td>
<td>79</td>
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<td>117</td>
<td>103</td>
<td>109</td>
<td>118</td>
<td>142</td>
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<tr>
<td><strong>Farm Requirement</strong> (mm)</td>
<td>49</td>
<td>0</td>
<td>92</td>
<td>171</td>
<td>278</td>
<td>151</td>
<td>68</td>
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<td>15</td>
<td>86</td>
<td>59</td>
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<tr>
<td><strong>Overall Efficiency (%)</strong></td>
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<td>0</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>48</td>
<td>45</td>
<td>43</td>
<td>43</td>
<td>55</td>
<td>55</td>
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<tr>
<td><strong>Diversion Requirement (mm)</strong></td>
<td>111</td>
<td>0</td>
<td>184</td>
<td>318</td>
<td>556</td>
<td>308</td>
<td>142</td>
<td>65</td>
<td>105</td>
<td>200</td>
<td>137</td>
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<tr>
<td><strong>Cropped Area (1000 ha)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Dry Season</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Diversion Requirement (mm)</strong></td>
<td>22.5</td>
<td>0</td>
<td>31.3</td>
<td>59.2</td>
<td>91.4</td>
<td>58.8</td>
<td>25.3</td>
<td>12.1</td>
<td>20.7</td>
<td>39.4</td>
<td>33.4</td>
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<tr>
<td><strong>Water Supply (m³)</strong></td>
<td></td>
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<tr>
<td><strong>Average Year</strong></td>
<td>87.0</td>
<td>56.0</td>
<td>56.4</td>
<td>60.2</td>
<td>157.6</td>
<td>230.5</td>
<td>233.0</td>
<td>397.0</td>
<td>377.0</td>
<td>428.0</td>
<td>194.0</td>
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<td><strong>Critical Year</strong></td>
<td>61.0</td>
<td>40.5</td>
<td>44.5</td>
<td>42.5</td>
<td>102.0</td>
<td>166.0</td>
<td>285.0</td>
<td>207.0</td>
<td>205.0</td>
<td>115.0</td>
<td>79.0</td>
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<td><strong>Usable Return Flow</strong></td>
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<td>5.4</td>
<td>8.0</td>
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<td>2.3</td>
<td>0.2</td>
<td>1.2</td>
<td>3.6</td>
<td>1.8</td>
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<tr>
<td><strong>Total Critical Year Supply</strong></td>
<td>65.1</td>
<td>40.5</td>
<td>47.0</td>
<td>47.9</td>
<td>110.0</td>
<td>170.0</td>
<td>186.3</td>
<td>285.2</td>
<td>208.2</td>
<td>208.6</td>
<td>116.8</td>
</tr>
</tbody>
</table>

---

1/ Annual rainfall at Tuguegarao exceeded in 4 out of 5 years (1903-1973).
2/ Monthly flows with 50% probability of occurrence (once in two years).
3/ Monthly flows with 80% probability of occurrence (four out of five years).
4/ From 7,600 ha above Chico West system.
5/ 19% shortage one year out of five.

LP = Land Preparation, N = Nursery, T = Transplanting, M = Management, H = Harvest
### PHILIPPINES

#### CHICO RIVER IRRIGATION PROJECT: STAGE I

**Project Water Requirements**

<table>
<thead>
<tr>
<th>Land Preparation</th>
<th>Wet Season</th>
<th>Annual</th>
<th>Dry Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturation</td>
<td>75</td>
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<td>50</td>
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<tr>
<td>Evaporation</td>
<td>175</td>
<td></td>
<td>225</td>
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<tr>
<td>Percolation</td>
<td>60</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Sub-total</td>
<td>310</td>
<td>645</td>
<td>335</td>
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<tr>
<td>Flooding for Cultivation</td>
<td>70</td>
<td>140</td>
<td>70</td>
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</table>

**Crop Water Requirements**

<table>
<thead>
<tr>
<th></th>
<th>Wet Season</th>
<th></th>
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<tbody>
<tr>
<td>Evapotranspiration</td>
<td>376</td>
<td>887</td>
<td>511</td>
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<tr>
<td>Deep Percolation</td>
<td>180</td>
<td>360</td>
<td>180</td>
</tr>
<tr>
<td>Sub-total</td>
<td>556</td>
<td>1,247</td>
<td>691</td>
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**Total Field Water Requirement**

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<tbody>
<tr>
<td>936</td>
<td>2,032</td>
<td>1,086</td>
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**Less Effective Rainfall**

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<tbody>
<tr>
<td>570</td>
<td>912</td>
<td>312</td>
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</table>

**Net Farm Irrigation Requirement**

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<tbody>
<tr>
<td>366</td>
<td>1,120</td>
<td>751</td>
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</table>

**Farm Irrigation Efficiency (%)**

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<tr>
<td>60</td>
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**Farm Irrigation Requirement (Turnout)**

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<tbody>
<tr>
<td>610</td>
<td>1,687</td>
<td>1,077</td>
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</table>

**Conveyance Efficiency (%)**

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<tr>
<td>80</td>
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**Diversion Requirement (Main Canal)**

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<tbody>
<tr>
<td>763</td>
<td>2,109</td>
<td>1,346</td>
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**System Operation Efficiency (%)**

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<tr>
<td>90</td>
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**Diversion Requirement (Headworks)**

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<tr>
<td>851</td>
<td>2,359</td>
<td>1,508</td>
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**Overall Irrigation Efficiency (%)**

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<tbody>
<tr>
<td>43</td>
<td>47</td>
<td>50</td>
</tr>
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PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Provincial Road Program

Background

1. The roads proposed for construction and improvement under the project are located in Isabela province in the Cagayan Valley. The valley is served by the Magat and Cagayan rivers to its South and East and the Chico river to its North. The potential for agricultural development in the valley is large and the Government plans to invest heavily to achieve this.

2. The Magat River Multipurpose Project: Stage I (Loan 1154-PH) includes the upgrading and construction of about 830 km of low standard roads located on irrigation canal banks and intended primarily for access to the canals for purposes of operation and maintenance. The improvement of Cagayan Valley arterial roads that link the Magat project area to the marketing centers in Central Luzon was deferred for consideration under a later project to enable preparation work to be completed. The road component of the Chico project consists of three of these roads.

3. The project roads, totalling about 65 km of provincial roads are a part of 260 km of one national highway and several provincial roads in the Cagayan Valley recommended for improvement by a mission that visited the Philippines in December, 1974 under the FAO/IBRD Cooperative Program. The Tuguegarao-Quezon-Santiago National Highway (130 km) was omitted from present consideration because of the need for in-depth feasibility studies and detailed engineering by consultants. Roads serving other areas were also excluded as they were found to be not feasible for development at the present time.

Description

4. The road component, which is described in detail in Appendix A, would comprise:

(a) the construction and improvement of the following provincial roads (Map 11944R):

   (i) Roxas - Gamu Road - 35.2 km
   (ii) Cabatuan - Cauayan Road - 11.0 km
   (iii) San Mateo - Alicia Road - 18.9 km

   Total 65.1 km
and

(b) the detailed engineering and construction supervision of roads in (a).

Cost Estimates

5. The total cost of the road program including physical contingencies (20%) and right-of-way costs (US$0.8 million) is estimated to be about US$7.4 million of which US$2.8 million would be foreign exchange. This cost amounts to about US$100,000 per km including engineering and supervision costs. Details of the cost estimates are given in Annex 9, Table 5.

Preparation

6. The Provincial Governments are responsible for the planning, construction and maintenance of provincial roads. The Department of Public Highways (DPH), which is a Central Government agency, provides technical assistance through its Regional Offices as required by the Provincial Governments. Where local staff and facilities are inadequate, DPH undertakes the construction and rehabilitation of provincial roads that have been identified as having high priority.

7. The road component of the project was prepared by Region II, DPH. Preparation consisted of economic and technical feasibility studies including sufficient preliminary engineering to produce cost estimates to within ±20%. The Director of the DPH Planning Services and his staff assisted in the conduct of the studies and generally supervised the work. The studies were carried out in accordance with guidelines given by a Bank preparatory mission in May, 1975.

8. Detailed engineering and preparation of contract documents would be carried out by Region II, DPH which would establish a Special Projects Office for this purpose. The proposed design standards are shown in Table 1. They follow the standards adopted by DPH after two UNDP-financed studies: Transport Survey (1968-70) by consultants, Metra/Sauti (France/Italy) and Road Feasibility Studies I (1971-72) by consultants, Norconsult (Norway). The roads would be built to Class 2 standards with a 6.10 m pavement width (2 lanes) and double bituminous surface dressing.

Execution

9. Region II, DPH would be responsible for the execution of the works through its Special Projects Office. The construction works will be executed by contract with supervision by DPH. The implementation schedule is given in Chart 15355, which shows that construction would commence in January, 1977. The road works are expected to take about 2 years and would be completed by the end of calendar year 1978. The arrangements are satisfactory and DPH has the organization, management and staff to implement the road program.
Road Maintenance

10. For maintenance the roads would be handed over to the Isabela Provincial Government which is responsible for the maintenance of all provincial roads within its boundaries. The Provincial Government has an engineering department headed by a qualified Provincial Engineer who has the staff and equipment to maintain the roads. His office is in Cauayan where a new workshop is under construction. Road maintenance costs, including periodic maintenance costs, are estimated to be about US$1,200 per km per annum. Two thirds of maintenance funds are contributed by the Central Government and the balance by the Provincial Government.

Economic Analysis

11. Traffic Surveys. Traffic counts are normally taken by DPH twice a year. They were suspended in 1971 but have now been resumed. For the purposes of the project additional counts were taken in April, 1975 for 24 hour per day for one week. Consultants (Valentine, Laurie and Davies - Australia) are presently studying the feasibility of improving the Tuguegarao - Santiago National Highway. If the study finds that, in addition to improvements to the national highway, it is feasible to construct a bridge or otherwise improve the crossing over the Magat river, some diversion of through traffic from the project roads will take place especially in the case of the Roxas-Gamu road. At present there is a ferry crossing to carry light vehicles only when river levels are low. In order to determine the amount of such diversion, origin and destination interviews were also conducted at appropriate stations.

12. The traffic counts were adjusted to take into account seasonal fluctuations to arrive at the annual average daily traffic (AADT) and traffic forecasts were made for the following two cases:

   Case A - with the Tuguegarao-Quezon-Santiago National Highway in its existing condition and without an improved crossing over the Magat river; and

   Case B - when the improved Tuguegarao-Quezon-Santiago National Highway is opened in 1981 with an improved crossing over the Magat river.

The AADT for the years 1975-1993 are given in Table 2 which shows a significant traffic diversion (about 40%) from the Roxas-Gamu Road for Case B. Traffic growth rates range from 8 to 10% per annum until 1985 and drop to 6% thereafter.

13. Benefits. The construction and improvement of the roads would primarily reduce vehicle operating costs. Transportation costs would be less and the benefits would be shared by the farmers. The roads are expected to produce some development benefits but they are difficult to measure and are not quantified.
14. **Economic Rates of Return.** Discounting benefits and costs over a 15 year evaluation period, the economic rates of return for the project roads are as follows:

<table>
<thead>
<tr>
<th>Road</th>
<th>Case A</th>
<th>Case B</th>
<th>Cases A &amp; B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roxas-Gamu Road</td>
<td>20%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Cabatuan-Cauayan Road</td>
<td>18%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Mateo-Alicia Road</td>
<td>15%</td>
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<td></td>
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</tbody>
</table>

15. The economic costs and benefits streams are shown in Tables 3, 4 and 5. Improvements to the Roxas-Gamu Road are based on Case B. Improvements to the national highway are to be included in the proposed Fourth Highway Project scheduled for appraisal in early 1977 with construction works commencing later in the same year. If a better crossing over the Magat river is not found feasible the Roxas-Gamu road would need strengthening in about ten years. The economic rates of return for the other two roads are essentially the same for Cases A and B.
**ANNEX 6**

**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**Proposed Geometric Standards for Class 2 Roads**

<table>
<thead>
<tr>
<th>Terrain</th>
<th>Flat</th>
<th>Rolling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Speed (km/hr)</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Pavement Width (m)</td>
<td>6.10</td>
<td>6.10</td>
</tr>
<tr>
<td>Shoulder Width (m)</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Min. Hor. Radius (m)</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>Max. Gradient (%)</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Stop Sight Distance (m)</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>Pass Sight Distance (m)</td>
<td>350</td>
<td>250</td>
</tr>
<tr>
<td>Right-of-Way Width (m)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Pavement Design</td>
<td>AASHO method, using an 8,000 Kg single axle load.</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** DPH
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Traffic Volumes

<table>
<thead>
<tr>
<th>Provincial Road</th>
<th>Length (km)</th>
<th>Traffic Counts (vpd)</th>
<th>Estimated Traffic Growth (% p.a.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Roxas-Gamu Road</td>
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<td>446</td>
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Case A - With existing Tuguegarao - Quezon - Santiago National Highway and without improved crossing over the Magat river.

Case B - When improved Tuguegarao - Quezon - Santiago National Highway is opened with an improved crossing over the Magat river at Cabatuan.

Source: DPH
## Economic Costs & Benefits

### Roxas-Genu Road

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<tr>
<th>Year</th>
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### Economic Rate of Return:

- **Case A** = 20%
- **Case B** = 15%

**Case A** - With existing Tuguegarao – Quezon – Santiago National Highway and without improved crossing over the Magat river.

**Case B** - When improved Tuguegarao – Quezon – Santiago National Highway is opened in 1981 with improved crossing over the Magat river at Cabatuan.
PHILIPPINES
CHICO RIVER IRRIGATION PROJECT: STAGE I
Economic Costs & Benefits
Cabatuan-Cauayan Road

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Economic Rate of Return: 18%

Case A and Case B essentially the same.
**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**Economic Costs & Benefits**

San Mateo-Alicia Road

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Economic Rate of Return: 15%

Case A and Case B essentially the same.
CHICO RIVER IRRIGATION PROJECT: STAGE I

Description of Project Roads

Roxas-Gamu Road (35.2 km)

1. The road starts at the junction with the Tuguegarao-Quezon-Santiago National Highway in Roxas town (population 27,000). It traverses flat terrain for about 18 km and then gently rolling country passing the town of Burgos (pop. 12,000), until it reaches Gamu town (pop. 15,000). The road extends beyond the town proper over an existing bridge across the Cagayan river to join the Philippines-Japanese Friendship National Highway. The area served by the road is agricultural, mainly devoted to rice growing.

2. The horizontal alignment of most of the road is good. However, the grades especially of the stretch of the road on flat terrain are low and almost level with the adjoining rice fields. Occasional flooding of the roadway to a shallow depth occurs during continuous heavy rains or high floods. The existing width of the carriageway is about 4.00 m with shoulder widths varying from 1.00-1.50 m.

3. The subgrade consists for the great part of clayey and silty soils but some gravelly and sandy soils are also present. The road generally has a gravel surface which is fair during the dry season but poor during the wet season. There are short asphalt sections through Roxas and Gamu towns but they have deteriorated except for some parts in Gamu town which are fair.

4. There are four bridges which are all in good condition and no new bridges are required. Some of the existing pipe culverts are clogged and some are broken. None have head walls or any protection around the inlet to prevent erosion of the road embankment.

5. The improvements proposed are to widen the road to Class 2 standards with a 6.10 m carriageway and double bituminous surface dressing. The grades along some stretches would be raised by a maximum of about one meter. Existing pipe culverts would be cleared and extended with headwalls and protection works at the inlets and additional culverts would be installed as needed.

Cabatuan-Cauayan Road (11.0 km)

6. The road starts at Cabatuan town (pop. 19,000) situated on the banks of the Magat river. A light vehicle ferry crossing serves the national
highway running north and south from Cabatuan but little traffic from the national highway is diverted to the project road. The situation is expected to be the same when the national highway with the river crossing is improved.

7. The road runs in a southeasterly direction over a relatively flat terrain planted with rice. It terminates in Cauayan town (pop. 47,000) at the junction with the Philippines-Japanese Friendship National Highway.

8. The horizontal alignment of the whole stretch of the road is good but the grade for about 10 km from Cabatuan is low and subject to occasional flooding. The existing width of the carriageway is 4.00 m with shoulder widths varying from 1.00-1.50 m.

9. The subgrade consists mostly of clayey and silty soils but some clayey gravels and sands are also present. The road generally has a gravel surface which is fair during the dry season but poor when the rains come. There are short stretches of asphalt sections in Cabatuan and Cauayan town but they have deteriorated.

10. There is only one bridge along the road and it is in good condition. No new bridges are required. The existing drainage facilities are similar to the Roxas-Gamu road and have to be improved.

11. The improvements proposed are to widen the road to Class 2 standards with a 6.10 m carriage and double bituminous surface dressing. Almost the whole road would be raised by the average height of about 0.5 m. Existing pipe culverts would be cleared and extended with headwalls and protection works at the inlets. Additional culverts would also be installed.

San Mateo-Alicia Road (18.9 km)

12. The road starts at the junction with the Tuguegarao-Quezon-Santiago National Highway in San Mateo town (pop. 34,000) and runs in a southeasterly direction traversing generally flat terrain planted with rice all the way. It terminates at the junction with the Philippines-Japanese Friendship National Highway in Alicia town (pop. 28,000).

13. The subgrade consists of clayey and silty soils. The road has a gravel surface throughout with many sections where the surfacing is inadequate. There are three bridges and all are in good condition. No new bridges are proposed. Most of the existing pipe culverts are clogged and many are broken. None have headwalls or any protection round the inlets.

14. The improvements proposed are to widen the road to Class 2 standards with a 6.10 m carriageway and double bituminous surface dressing.
The road would generally be raised by an average height of about 0.5 m. Existing pipe culverts would be cleared and extended with headwalls and protection works at the inlets. Broken culverts would be removed and new culverts installed.
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Erosion Control Study

General

1. In 1974, the Pantabangan dam and appurtenant structures of the Upper Pampanga River Project were completed. The Diayo and Canili dams and reservoirs of the Aurora-Penaranda Irrigation Project (APIP), as an adjunct to UPRP, are currently under construction and construction of a storage dam on the Magat river as a part of Stage II of the Magat project is scheduled to begin in 1979. The watershed areas above the aforementioned reservoirs are partially denuded, land management practices in the watershed areas are poor, erosion control practices are nearly non-existent and sediment loads carried by many of the streams are exceptionally high. Both the quality and quantity of water impounded in these reservoirs and the amount of sediment deposited in them are dependent on watershed protection and management. Improvements are needed to reduce erosion rates and the amount of sediment deposited in the reservoirs to prolong reservoir life and to ensure economic returns from the watersheds and from the irrigation projects which depend on them as a source of water supply.

2. The Pampanga watershed covers an area of about 84,500 ha of which 40,000 ha are open land. Ten thousand persons displaced by the reservoir are resettled within the watershed and may pose major problems through intensified use of the area. The Canili-Diayo watershed covers 6,400 ha of which 4,300 ha are forest land and 2,100 ha are open land. The Magat watershed covers some 414,300 ha, about 60% of which are open land that need some conservation treatment. The breakdown of forest and open areas in the three watersheds is:

<table>
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<th>Watershed</th>
<th>Pampanga</th>
<th>Canili-Diayo</th>
<th>Magat</th>
</tr>
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<td>of which:</td>
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Forest cover is being further reduced by cutting of commercial timber, and grass lands are regularly burned over at the end of the dry season exposing the steep slopes to erosion during the rainy season.

3. The proposed erosion study would provide technical assistance to NIA in assessing the erosion problems, evaluating remedial measures and preparing a plan for control to correct existing damage and prevent further damage to the watersheds.
Objectives

4. The objectives of the study would be to:

(a) conduct a benchmark inventory of the watershed areas including land use, soils, vegetative cover, erosion problems and sediment rates;

(b) establish systematic data collection programs to provide additional data on sediment rates and their sources;

(c) identify problem areas, quantify present damage to the watersheds and estimate future damage if remedial measures are not taken;

(d) evaluate vegetative and mechanical erosion control methods at selected sites in the watersheds with respect to suitability, effectiveness and costs;

(e) develop standards for land use and watershed management that would result in reduced sediment loads entering downstream reservoirs. These would include management of upland agriculture and shifting cultivation, range management, timber resource management, fire protection and transportation planning; and

(f) propose an erosion control project comprising a plan of erosion control measures and land use to correct existing damage and prevent further damage, together with estimated costs and a time schedule for implementation.

Implementation

5. The study would be carried out over a 30-month period, from July, 1976 through calendar year 1978, by the Special Projects Organization of NIA with consultant assistance (about 65 man-months). An Erosion Control Study Section would be established within the dam and reservoir divisions of UPRP and Magat project to carry out the erosion control study. NIA would select consultants to assist them with the study. Among other things the consultants would be responsible for training NIA staff in erosion control and watershed management work.

Costs

6. The study is expected to cost a total of US$1.7 million including a foreign exchange component of US$900,000 for aerial photography, consultant services and purchase of vehicles, equipment, materials and supplies. Details of the cost estimate are at Annex 9 and a list and cost of the proposed equipment to be purchased is shown in Annex 10.
CHICO RIVER IRRIGATION PROJECT: STAGE I

Input-Output Monitoring Program

General

1. The National Irrigation Administration (NIA), with assistance from the Bank Group, is currently constructing and/or rehabilitating the Pampanga, Aurora-Penaranda, Tarlac, Rural Development (Mindoro) and Magat projects. These total some 190,000 ha and 77,000 farm families, and if the proposed Chico Stage I project is included, about 210,000 ha and 85,000 farm families. Additionally, landless laborers living in the project areas would equal around 10%-20% of the farm family population.

2. If these projects are to be successful when NIA has completed their construction, besides attaining the projected cropping intensities, farmers must reach the projected paddy yields of around 4.0 ton/ha in the wet and dry seasons. To do this, farmers must receive a sufficient and timely supply of farm inputs, such as credit, seed, fertilizer, pesticide, labor, water, threshing and drying facilities, and transport and marketing services. If these inputs do not reach the farmers in time and in sufficient quantities, the success of the entire NIA irrigation program could be threatened.

3. At present NIA cannot check the build-up and flow of farm inputs in and to the project areas before the cropping season commences. NIA can only react once the crop season starts, and input shortfalls are discovered. Thus NIA requires a program which will monitor the flow of sufficient inputs into each project area, and will allow it to rectify in time any shortfall that may occur. Additionally, since crop production data is only collected on a provincial basis with few details after the cropping season finishes, NIA requires another program that will indicate the success or otherwise of that crop season in each project area, that is, data on crop yields, farm incomes and costs, changes in off-farm income, farming practices, changes in landless laborers' incomes, and any other benefit flows from the individual projects.

Objectives

4. The objectives of the input-output monitoring programs would be to:

   (a) monitor the flow and build-up of farm inputs in each project area before and during each crop season, and give NIA sufficient warning of any likely shortfall so that it may take appropriate action; and
(b) monitor the size and the recipients of benefit flows in each project area.

Implementation

5. NIA would monitor inputs and outputs under separate programs, and would give primary responsibility for implementing and operating the programs to the Agricultural Department of the Special Projects Organization.

6. As NIA does not have the necessary expertise to set up the programs, it would engage a firm of consultants to advise on the implementation of the input monitoring, and an individual project benefit monitoring specialist to advise on the output monitoring.

7. For the input monitoring, NIA would hire the consultant firm for a total of about 20 man-months, distributed over the project’s five year life. They would assist NIA to formulate and implement the program.

8. NIA would hire the project benefit monitoring specialist for a total of about 10 man-months over the project’s five year life. He would advise NIA on a survey program to monitor project benefits, and assist in its implementation. Specifically, the consultant would advise on survey sample size; questionnaire composition; data processing methods; computer services; and survey cost estimates.

Cost

9. The input monitoring program is estimated to cost US$370,000, of which US$26,000 would be foreign exchange for the purchase of equipment, vehicles, materials and consultant services. The output monitoring program is estimated to cost US$630,000, of which US$244,000 would be foreign exchange for similar type purchases.

10. The total cost estimate for both programs is US$1.0 million, of which US$270,000 is foreign exchange. Annex 9 gives details of the cost estimates, and Annex 10 lists the proposed equipment to be purchased and its cost.
# CHICO RIVER IRRIGATION PROJECT: STAGE I

## Cost Estimate

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<th>Foreign (US$ '000)</th>
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<td><strong>Sub-Total</strong></td>
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1/ Based on Annex 9, Table 7.
## PHILIPPINES

### CHICO RIVER IRRIGATION PROJECT: STAGE I

#### Cost Estimate

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<td><strong>Cost Estimate</strong></td>
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<td>Drainage System</td>
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<td>Drainage System</td>
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<td>Road System</td>
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## PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**EROSION CONTROL STUDY**

### Cost Estimate

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<td>b) Imported equipment</td>
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<td>ii) Hydromet and soil investigation equipment</td>
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**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**INPUT-OUTPUT MONITORING**

**Cost Estimate**

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### PHILIPPINES

#### CHICO RIVER IRRIGATION PROJECT: STAGE I

#### PROVINCIAL ROAD PROGRAM

Cost Estimate

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<tr>
<td>Construction Supervision (15%)</td>
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<td><strong>Right-of-Way</strong></td>
<td></td>
<td>800</td>
<td>-</td>
<td>800</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>4,600</td>
<td>2,800</td>
<td>7,400</td>
</tr>
</tbody>
</table>
## PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**FEASIBILITY STUDY STAGE II IRRIGATION**

### Cost Estimate

<table>
<thead>
<tr>
<th>Item</th>
<th>Local (US$'000)</th>
<th>Foreign (US$'000)</th>
<th>Total (US$'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Project Personnel</td>
<td>75.0</td>
<td>0</td>
<td>75.0</td>
</tr>
<tr>
<td>2. Equipment &amp; Vehicles</td>
<td>5.0</td>
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<tr>
<td>3. Supplies and Materials</td>
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<td>14.0</td>
<td>20.0</td>
</tr>
<tr>
<td>4. Contingencies</td>
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<td>6.0</td>
<td>15.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>95.0</strong></td>
<td><strong>45.0</strong></td>
<td><strong>140.0</strong></td>
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### Expected Price Increases

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<tr>
<th>Calendar Year</th>
<th>1976</th>
<th>1977</th>
<th>1978</th>
<th>1979</th>
<th>1980</th>
<th>Total</th>
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<tbody>
<tr>
<td>1. Irrigation System</td>
<td>730</td>
<td>2,040</td>
<td>16,830</td>
<td>19,400</td>
<td>12,200</td>
<td>51,200</td>
</tr>
<tr>
<td>Provincial Road Program</td>
<td>1,220</td>
<td>3,090</td>
<td>3,090</td>
<td>-</td>
<td>-</td>
<td>7,400</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>1,950</td>
<td>5,130</td>
<td>19,920</td>
<td>19,400</td>
<td>12,200</td>
<td>58,600</td>
</tr>
<tr>
<td>Annual Inflation Rate (%)</td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Expected Price Increases</td>
<td>65</td>
<td>690</td>
<td>5,280</td>
<td>8,100</td>
<td>6,955</td>
<td>21,090</td>
</tr>
<tr>
<td>2. Erosion Control Study</td>
<td>340</td>
<td>680</td>
<td>680</td>
<td>-</td>
<td>-</td>
<td>1,700</td>
</tr>
<tr>
<td>Input-Output Monitoring</td>
<td>200</td>
<td>50</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>1,400</td>
</tr>
<tr>
<td>Feasibility Study Stage II Irrigation</td>
<td>-</td>
<td>-</td>
<td>90</td>
<td>-</td>
<td>-</td>
<td>900</td>
</tr>
<tr>
<td>Operation and Maintenance Equipment</td>
<td>-</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>-</td>
<td>900</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>540</td>
<td>1,230</td>
<td>1,230</td>
<td>540</td>
<td>200</td>
<td>3,740</td>
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<tr>
<td>Annual Inflation Rate (%)</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Expected Price Increases</td>
<td>15</td>
<td>110</td>
<td>220</td>
<td>150</td>
<td>75</td>
<td>570</td>
</tr>
<tr>
<td>Total Without Price Increases</td>
<td>2,490</td>
<td>6,360</td>
<td>21,150</td>
<td>19,940</td>
<td>12,400</td>
<td>62,340</td>
</tr>
<tr>
<td>Expected Price Increases</td>
<td>80</td>
<td>800</td>
<td>5,500</td>
<td>8,250</td>
<td>7,030</td>
<td>21,660</td>
</tr>
<tr>
<td>Total with Price Increases</td>
<td>2,570</td>
<td>7,160</td>
<td>26,650</td>
<td>28,190</td>
<td>19,430</td>
<td>84,000</td>
</tr>
</tbody>
</table>

1/ Calculated by compounding the estimated rate of price increase in prior year and one-half the rate of increase in the year concerned.
## PHILIPPINES

### CHICO RIVER IRRIGATION PROJECT: STAGE I

**Equipment for Irrigation Force Account Work**

<table>
<thead>
<tr>
<th>Items</th>
<th>Quantity</th>
<th>Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor, crawler 180 HP</td>
<td>2</td>
<td>80</td>
<td>$1,600</td>
</tr>
<tr>
<td>Tractor, crawler 175 HP</td>
<td>2</td>
<td>70</td>
<td>$1,400</td>
</tr>
<tr>
<td>Tractor, crawler 90 HP</td>
<td>2</td>
<td>45</td>
<td>$90</td>
</tr>
<tr>
<td>Crane, crawler, dragline 3/4 cu. yd.</td>
<td>2</td>
<td>80</td>
<td>$1,600</td>
</tr>
<tr>
<td>Motor grader, 125 HP</td>
<td>2</td>
<td>46</td>
<td>$92</td>
</tr>
<tr>
<td>Front end loader, wheeled 1.5 cu. yd.</td>
<td>3</td>
<td>32</td>
<td>$96</td>
</tr>
<tr>
<td>Truck, tractor w/25T trailer</td>
<td>2</td>
<td>49</td>
<td>$98</td>
</tr>
<tr>
<td>Truck, forklift</td>
<td>2</td>
<td>20</td>
<td>$40</td>
</tr>
<tr>
<td>Truck, pickup 3/4T lxl4</td>
<td>3</td>
<td>9</td>
<td>$27</td>
</tr>
<tr>
<td>Truck, dump 6-8 cu. yd.</td>
<td>6</td>
<td>22</td>
<td>$132</td>
</tr>
<tr>
<td>Truck, flatbed 6T</td>
<td>4</td>
<td>20</td>
<td>$80</td>
</tr>
<tr>
<td>Truck, water</td>
<td>1</td>
<td>18</td>
<td>$18</td>
</tr>
<tr>
<td>Poller, 3 wheel steel 12T</td>
<td>2</td>
<td>28</td>
<td>$56</td>
</tr>
<tr>
<td>Mobile repair shop, truck mtd.</td>
<td>1</td>
<td>67</td>
<td>$67</td>
</tr>
<tr>
<td>Truck, fuel and lube service</td>
<td>1</td>
<td>39</td>
<td>$39</td>
</tr>
<tr>
<td>Station wagon lx4</td>
<td>3</td>
<td>9</td>
<td>$27</td>
</tr>
<tr>
<td>Jeep, utility vehicle lx4</td>
<td>6</td>
<td>8</td>
<td>$48</td>
</tr>
<tr>
<td>Mixer, concrete 1 cu. yd.</td>
<td>4</td>
<td>11</td>
<td>$44</td>
</tr>
<tr>
<td>Vibrator, concrete</td>
<td>2</td>
<td>2</td>
<td>$4</td>
</tr>
<tr>
<td>Generator, 10KW</td>
<td>4</td>
<td>8</td>
<td>$32</td>
</tr>
<tr>
<td>Water pump 2&quot;Ø to 6&quot;Ø</td>
<td>6</td>
<td>1</td>
<td>$6</td>
</tr>
<tr>
<td>Tractor, industrial w/ backhoe loader</td>
<td>3</td>
<td>28</td>
<td>$84</td>
</tr>
<tr>
<td>Radio transceiver, single sb.</td>
<td>4</td>
<td>3</td>
<td>$12</td>
</tr>
<tr>
<td>Miscellaneous tools and equipment</td>
<td></td>
<td></td>
<td>$80</td>
</tr>
</tbody>
</table>

**Subtotal** 1,632

**Spare parts (10%)** 168

**TOTAL** 1,800
# PHILIPPINES

## CHICO RIVER IRRIGATION PROJECT: STAGE I

### Equipment for Irrigation Operation and Maintenance

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor, crawler 9C HP</td>
<td>2</td>
<td>45</td>
<td>90</td>
</tr>
<tr>
<td>Crane, crawler, dragline 3/4 cu. yd.</td>
<td>1</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Tractor, industrial w/backhoe loader</td>
<td>1</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Front end loader, wheeled 1.5 cu. yd.</td>
<td>1</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Motor grader, 125 HP</td>
<td>1</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Roller, 3 wheel steel 12T</td>
<td>1</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Truck, tractor w/25T trailer</td>
<td>1</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Truck, water</td>
<td>1</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Truck, dump 6-8 cu. yd.</td>
<td>2</td>
<td>22</td>
<td>44</td>
</tr>
<tr>
<td>Truck, flatbed 6T</td>
<td>2</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Truck, fuel and lube service</td>
<td>1</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>Station wagon 4x4</td>
<td>1</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Jeep, utility vehicle 4x4</td>
<td>2</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Mixer concrete 1 cu. yd.</td>
<td>2</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Compactor, 19 x 24 in. plate w/generator</td>
<td>1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Water pump 2&quot; to 6&quot;</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Motor bike</td>
<td>1</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Weed cutter</td>
<td>250</td>
<td>0.3</td>
<td>75</td>
</tr>
<tr>
<td>Radio transceiver, single s.b.</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mobile repair truck</td>
<td>1</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>Miscellaneous tools and equipment (lump sum)</td>
<td></td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

| Sub-total                                                           | 805      |
| Spare parts (10%)                                                   | 95       |

| TOTAL                                                               | 900      |
## PHILIPPINES

### CHICO RIVER IRRIGATION PROJECT: STAGE I

#### EROSION CONTROL STUDY

List of Equipment, Vehicles and Supplies

<table>
<thead>
<tr>
<th>Items</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Office Equipment, Field Supplies and Materials</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90.0</td>
<td></td>
<td>90.0</td>
<td></td>
</tr>
<tr>
<td><strong>2. Vehicles and Equipment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jeeps, 4 x 4</td>
<td>6</td>
<td>8.0</td>
<td>48.0</td>
</tr>
<tr>
<td>Pickups, 4 x 4</td>
<td>6</td>
<td>9.0</td>
<td>54.0</td>
</tr>
<tr>
<td>Mobile radios</td>
<td>6</td>
<td>1.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Spare parts</td>
<td></td>
<td></td>
<td>9.0</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td></td>
<td></td>
<td>120.0</td>
</tr>
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<td><strong>3. Hydromet and Soil Equipment</strong></td>
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<td></td>
</tr>
<tr>
<td>Water stage recorders</td>
<td>10</td>
<td>1.5</td>
<td>15.0</td>
</tr>
<tr>
<td>Rainfall recorders, weighing types</td>
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<td>0.6</td>
<td>12.0</td>
</tr>
<tr>
<td>Standard rain gages</td>
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<td>0.2</td>
<td>4.0</td>
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<tr>
<td>Current meters and accessories</td>
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<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>DH-48 sediment samplers</td>
<td>2</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>DH-59 sediment samplers</td>
<td>2</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Engineer levels and accessories</td>
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<td>1.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Weather stations with equipment</td>
<td>3</td>
<td>3.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Soil investigation equipment</td>
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<td></td>
<td>19.0</td>
</tr>
<tr>
<td>Miscellaneous unlisted</td>
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<tr>
<td><strong>Sub-Total</strong></td>
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<td></td>
<td>85.0</td>
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<tr>
<td><strong>4. Sediment and Water Quality Laboratory Equipment</strong></td>
<td></td>
<td></td>
<td>50.0</td>
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<tr>
<td><strong>5. Office Supplies</strong></td>
<td></td>
<td></td>
<td>30.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>375.0</td>
</tr>
</tbody>
</table>
### PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**INPUT-OUTPUT MONITORING**

**List of Equipment, Vehicles and Supplies**

<table>
<thead>
<tr>
<th>Items</th>
<th>Quantity</th>
<th>Unit Cost (US$'000)</th>
<th>Total Cost (US$'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Office Equipment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desk program calculator</td>
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<td>25.0</td>
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<tr>
<td>Desk calculators</td>
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<td>8.0</td>
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<tr>
<td>Pocket calculators</td>
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<td>0.17</td>
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<td>Typewriters</td>
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<td>4.5</td>
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<tr>
<td>Electric typewriters</td>
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<td>1.75</td>
<td>3.5</td>
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<tr>
<td>Mineograph machines</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Tape recorders</td>
<td>12</td>
<td>0.2</td>
<td>2.5</td>
</tr>
<tr>
<td>Miscellaneous office equipment</td>
<td>-</td>
<td></td>
<td>9.0</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td></td>
<td></td>
<td>62.0</td>
</tr>
<tr>
<td><strong>2. Vehicles</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Motorcycles</td>
<td>24</td>
<td>1.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Jeeps, 4 x 4</td>
<td>8</td>
<td>8.0</td>
<td>64.0</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
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<td></td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>150.0</td>
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</tbody>
</table>
## PHILIPPINES

### CHICO RIVER IRRIGATION PROJECT: STAGE I

#### Estimated Schedule of Expenditures

<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Total</th>
<th>FY77/ FY78</th>
<th>FY79</th>
<th>FY80</th>
<th>FY81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation System</td>
<td>51,200</td>
<td>1,750</td>
<td>9,450</td>
<td>18,100</td>
<td>15,800</td>
</tr>
<tr>
<td>Provincial Road Program</td>
<td>7,400</td>
<td>2,700</td>
<td>3,100</td>
<td>1,600</td>
<td>-</td>
</tr>
<tr>
<td>Erosion Control Study</td>
<td>1,700</td>
<td>680</td>
<td>680</td>
<td>340</td>
<td>-</td>
</tr>
<tr>
<td>Input-Output Monitoring</td>
<td>1,000</td>
<td>250</td>
<td>250</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Feasibility Study Stage II Irrigation</td>
<td>140</td>
<td>-</td>
<td>90</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>Irrigation O &amp; M Equipment</td>
<td>900</td>
<td>150</td>
<td>300</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>62,340</td>
<td>5,530</td>
<td>13,870</td>
<td>20,590</td>
<td>16,150</td>
</tr>
<tr>
<td>Expected Price Increases</td>
<td>21,660</td>
<td>700</td>
<td>2,930</td>
<td>6,880</td>
<td>7,650</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td>84,000</td>
<td>6,230</td>
<td>16,800</td>
<td>27,470</td>
<td>23,800</td>
</tr>
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</table>

1/ IBRD Fiscal Years.
### Table 2: Estimated Schedule of Disbursements

<table>
<thead>
<tr>
<th>IBRD Fiscal Year and Semester</th>
<th>Accumulated Disbursements US$'000 Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fiscal Year 1977</strong></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>0</td>
</tr>
<tr>
<td>2nd</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>Fiscal Year 1978</strong></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>1,000</td>
</tr>
<tr>
<td>2nd</td>
<td>5,500</td>
</tr>
<tr>
<td><strong>Fiscal Year 1979</strong></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>14,500</td>
</tr>
<tr>
<td>2nd</td>
<td>20,500</td>
</tr>
<tr>
<td><strong>Fiscal Year 1980</strong></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>31,000</td>
</tr>
<tr>
<td>2nd</td>
<td>37,500</td>
</tr>
<tr>
<td><strong>Fiscal Year 1981</strong></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>45,000</td>
</tr>
<tr>
<td>2nd</td>
<td>49,000</td>
</tr>
<tr>
<td><strong>Fiscal Year 1982</strong></td>
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</tr>
<tr>
<td>1st</td>
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</tr>
</tbody>
</table>

**PHILIPPINES**

CHICO RIVER IRRIGATION PROJECT: STAGE I
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Proposed Allocation of Proceeds of Loan

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Foreign Loan</th>
<th>Proposed Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>______</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>I. Civil Works:</td>
<td>______</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Irrigation System 1/</td>
<td>37.08</td>
<td>14.64</td>
<td></td>
</tr>
<tr>
<td>Provincial Road Program</td>
<td>5.60</td>
<td>2.30</td>
<td></td>
</tr>
<tr>
<td>Expected Price Increases</td>
<td>20.91</td>
<td>8.12</td>
<td>40.7</td>
</tr>
<tr>
<td>Sub-total</td>
<td>63.59</td>
<td>25.06</td>
<td></td>
</tr>
<tr>
<td>Of which (a) US$6.5 million for contractors' mobilization &amp; equipment on the irrigation system and (b) US$34.2 million for other civil works. Disbursement for (a) will be 100% of foreign expenditures and for (b) 60% of total expenditures.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II. Equipment: 2/

| Expected Price Increases | 0.33 | 0.31 | 3.4 |
| Sub-total                | 3.48 | 3.09 |

Disbursement will be 100% of foreign expenditures for directly imported equipment, 100% of expenditure (ex-factory) for locally manufactured equipment and 65% of total expenditure for imported equipment procured locally.

III. Technical Assistance: 2/

| Erosion Control Study          | 1.11 | 0.46 |
| Input-Output Monitoring        | 0.56 | 0.07 |
| Expected Price Increases       | 0.42 | 0.08 |
| Sub-total                      | 2.09 | 0.67 |

Disbursement will be 100% of foreign expenditure or 60% of total expenditures.

IV. Unallocated

| Physical Contingencies          | 9.13 | 3.89 | 4.7 |
| (Feasibility Study Stage II)    | 9.13 | 3.89 | 4.7 |
| (Administration & Engineering)  | 5.24 | -    |     |
| TOTAL                          | 14.37 | 33.00 | 50.0 |

1/ Force account equipment (US$1.8 million) excluded and transferred to Category II.

2/ Includes equipment for force account (US$1.8 million), O&M (US$0.9 million), Erosion Control Study (US$0.43 million) and Input-Output Monitoring (US$0.35 million).

3/ Other than equipment in Category II.

4/ No loan disbursement for feasibility study to be prepared by NIA without consultant assistance.
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CHICO RIVER IRRIGATION PROJECT: STAGE I

Organization and Management

1. This annex covers organization aspects of the irrigation component of the project. Annex 6 presents details of execution and maintenance of the provincial road component, which would be carried out by DPH. Since 1964, the overall responsibility for the national irrigation systems in the Philippines has been vested in the National Irrigation Administration (NIA). The NIA was set up under Republic Act NO. 3601 to investigate, study, improve, construct and administer all national irrigation systems. It was given the power to carry out investigations into all available water resources in the country in order to utilize them for irrigation and to collect water rates from the beneficiaries of the national irrigation systems. Presidential Decree No. 552 of September 11, 1974 has further widened NIA's scope by giving it "broader powers and authority to undertake concomitant projects such as flood control, drainage, land reclamation, hydraulic power development, domestic water supply, road or highway construction, reforestation and projects to maintain ecological balance, in coordination with the agencies concerned." The NIA is financed by the Government through the sale of bonds or from appropriations.

2. The governing body of the NIA is the Board of Directors, composed of a Chairman and five members, who are all ex-officio except for one member appointed by the President of the Philippines on the recommendation of rice and corn growers. Management of the NIA is vested in an Administrator appointed by the President. The Administrator is also Vice Chairman of the Board. Directly below the Administrator, there are three Assistant Administrators, respectively, responsible for Special Projects, Engineering and Operation, and Finance and Administration. Field services are managed by eight regional and two sub-regional offices, together with a number of special project offices.

3. The NIA is in the process of being reorganized and expanded to meet the wider responsibilities imposed on it by PD No. 552 and by the Government's policy of accelerating irrigation development. The integration of the major foreign-assisted projects under a Sepcial Projects Organization office to avoid duplication and to increase transfer of experience between projects is one of the first results of the reorganization. The Special Projects Organization has been given responsibility for the Bank-assisted Central Luzon projects, for the Asian Development Bank (ADB)-assisted Angat-Magat and Davao del Norte projects and the Bank-assisted Magat project (Chart 9533 (2R). The NIA would make the Special Projects Organization responsible for executing and operating the Chico project. Because of its small size and proximity to Magat, the Chico project would be executed and operated as a division of the Magat project.
4. The NIA would appoint an Assistant Project Manager, Chico, responsible for executing the project, and reporting to the Magat Project Manager. The Magat divisions for engineering, agriculture, equipment and administration would provide the required services to the Chico project. The proposed organization is shown in Chart 1. The Engineering Division would be responsible for the preparation of plans, programs, designs, estimates, specifications and construction work surveys. The Construction Division would undertake contract administration work, including inspection and supervision of works. It would also be responsible for force account construction. The Administrative Division would be responsible for personnel and records management, accounting, property procurement and other services. For Chico project construction there would be two divisions: one located at Tabuk to build the diversion dam and main diversion canal and the other located at Agbannawag to build the irrigation and drainage systems.

5. The Operation and Maintenance Division would take charge of all new and existing systems in the project area. The Agricultural Development Division would be responsible for introducing new water management techniques and farming methods, and ensuring that necessary agricultural support services are established in the area. For operation and maintenance purposes the project area would be divided into two zones, each of about 10,000 hectares. Each zone would be under the supervision of an Irrigation Superintendent having field offices in the service area. Each zone would be divided into four water management divisions, each under a Supervisor. Each water management division would be divided into 500-hectare units, each the responsibility of a Water Management Technologist. Ten 50-hectare rotation areas, the basic unit of the irrigation system, comprise the 500-hectare unit. Two 50-hectare units would be the basic organization entity and would be supervised by a ditch tender. The boundaries of each division and subdivision would be determined by the location of supply canals. The estimated annual cost of operation and maintenance is ₱130 (US$17) per ha as shown in Table 1.
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CHICO RIVER IRRIGATION PROJECT: STAGE I

Cost of Irrigation Operation and Maintenance

<table>
<thead>
<tr>
<th>Item</th>
<th>Annual Cost (P/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and Wages</td>
<td>73</td>
</tr>
<tr>
<td>Equipment Costs</td>
<td>39</td>
</tr>
<tr>
<td>Materials and Supplies</td>
<td>3</td>
</tr>
<tr>
<td>Administrative and General Expenses</td>
<td>15</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>130</strong></td>
</tr>
</tbody>
</table>

1/ From detailed NIA estimates of personnel and equipment requirements, based on experience in UPRP.
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CHICO RIVER IRRIGATION PROJECT: STAGE I

Supporting Agricultural Services

Extension

1. Many Government organizations currently have dealings with the farmers. The principal agencies are:

(a) Bureau of Agricultural Extension (BAE);
(b) Bureau of Plant Industry (BPI);
(c) Department of Agrarian Reform (DAR);
(d) Agricultural Credit Administration (ACA);
(e) Department of Local Government and Community Development (DLGCD);
(f) National Grains Authority (NGA); and
(g) National Irrigation Administration (NIA).

In addition, there are non-Government Rural Banks (RB).

2. In the Upper Pampanga River Project (UPRP) the need for coordinating the various agencies providing services to the farmers was clearly felt. An Agricultural Development Coordinating Council (ADCC) was established for the project to provide day-to-day control and coordination of the activities of the various agencies within the project area. The ADCC consisted of the Provincial Heads of all the participating agencies. The arrangement is working well in UPRP and similar organizations are being set up for the Tarlac Irrigation Systems Improvement Project, the Rural Development Project on Mindoro and the Magat project. As NIA would operate the Chico project as a part of the Magat, the Chico project should be included in the proposed Magat ADCC. However, this raises a difficulty. While Magat falls within a single province, Isabela, the Chico project is in the three provinces of Cagayan, Isabela, and Kalinga-Apayao. To avoid having three ADCC's, and as the three provinces are within the same administrative region (Cagayan Valley), a regional level ADCC would be established for the Magat and Chico project areas.

4. The project would be organized on the basis of irrigation units of 50 ha in the same manner as the Pampanga, Tarlac and Magat Projects.
The 20 to 25 farmers in such a unit would be given every incentive to work together as a group. The NIA would schedule irrigation on a rotational basis thus promoting a uniformity of operations within each unit at any given time. The rotational area would also be the basic unit for the provision of credit and the building block for the eventual organization of irrigation associations and cooperatives. In the Bank-assisted irrigation projects, the NIA is assigning a Water Management Technologist to every 10 units. The same staffing pattern would be applied to the Chico project (see Annex 12). The water management staff would supplement the existing extension personnel provided by the various Government agencies and would help to increase extension coverage in the project area.

5. New extension work items to be emphasized would include improved irrigation and drainage practices; the importance of scheduling operations; the use of good quality seed and even planting; proper fertilizer application; weed and pest control; and the use of tillage and threshing machinery.

Research

6. There are four BPI research stations in or near the project area: the Cagayan Valley station at San Mateo, the Ilagan station, the Luna station, and the Abulog station. The first two are in Isabela province and the others in Kalinga-Apayao and Cagayan provinces respectively. The Cagayan Valley station deals principally with rice and the others with upland crops. The work on rice is focused on varietal screening, foundation seed production and pure seed certification. In addition to the four BPI stations, there is a Bureau of Soils unit, based at Ilagan, working on fertilizers, soil fertility and soil erosion. NIA has good working relations with the Central Luzon State University, the Agricultural College of the University of the Philippines and the International Rice Research Institute. The project would be able to draw on research backup from all these sources.

Fertilizer

7. Annual consumption of fertilizer in the project area currently amounts to about 1,600 tons, 70% of which is accounted for in approximately equal proportions by sulphate of ammonia and ammonium phosphate. Application rates of all fertilizers run at a low level of about 50 kg/ha in the wet season and 105 kg/ha in the irrigated dry season crop. At full development the project would require some 8,400 tons of fertilizer annually, of which 35% would be urea and the balance ammonium phosphate. In terms of nutrients the average rate of application per crop season would be 60 kg/ha nitrogen and 30 kg/ha phosphoric acid. There are three commercial distributors in the project area and existing supply channels would handle the increased demand without difficulty.

Seed

8. Just under 1,400 tons of rice seed per annum are currently used in the project area. About 95% of the seed is obtained by retention from
the farmers' commercial production and only 5% from seed-growers. The Cagayan Valley station produces foundation and registered seed for bulking by seed-growing cooperatives or selected individual farmers. At full development the project would use approximately 1,800 tons of rice seed per annum. There would be a decrease in the existing 55 kg/ha seed rate to 50 kg/ha. On the assumption that rice seed would be renewed every five crop seasons, the estimated annual requirement of quality seed for the project area at full development would amount to 740 tons. No difficulties are foreseen in supplying this amount.

Farmers' Organization

9. As part of the Agrarian Reform program, the Government, through the DLGCD, is promoting the formation of pre-cooperative farmers organizations, based on the barrio or hamlet. The organizations would serve as channels for the inflow of technical services, credit and inputs and as assembly points for produce intended for market. It is hoped that at a future date the organizations would grow into full-fledged, formally constituted cooperatives. This approach to cooperative organization fits in well with the 50-ha irrigation unit approach adopted by NIA on Bank-assisted irrigation projects.

10. The NIA is committed to the creation of irrigation associations among the farmers which would eventually assume a large part of the responsibility for the operation and maintenance of the national irrigation systems. Without losing sight of the ultimate objective, the main thrust of NIA's efforts in UPRP and the other Central Luzon projects has been to organize the farmers within the 50-ha units, primarily for production and water management. The immediate aim is to demonstrate to the farmers that working together and using water efficiently is possible and profitable. Once this has been established, a realistic framework for setting up irrigation associations would exist. The project area would be expected to follow this example and gain from the experience of the Central Luzon projects.

Credit

11. Some 15-20% of the farmers in the project area finance their requirement of farm inputs and hired labor from their own resources. The remainder use some form of credit. The principal sources are:

(a) banks, notably the Rural Banks (RB), the Philippine National Bank (PNB), the Development Bank of the Philippines (DBP) and private banks;

(b) the Agricultural Credit Administration (ACA);

(c) input dealers, marketing organizations and millers; and

(d) money lenders.
Six of the 26 RBs in Cagayan, Isabela and Kalinga-Apayao provinces are within reach of the project area farmers.

12. To ensure the success of the Agrarian Reform program (Annex 3), the Government has proceeded to strengthen the credit institutions and to facilitate the granting of production credit to small farmers who previously depended on the landlords for their requirements. RBs have been authorized rediscounting privileges of 100%, Government guarantees of up to 85% of the loans made and low-cost money is available from the Central Bank. The easier credit thus made available is employed under a system of "supervised credit," which includes the provision of technical services to the borrower to ensure that recommended practices, including variety, fertilizer and agrochemical inputs, are adopted. Loans granted under supervised credit are not secured by collateral, but are covered by a Government guarantee; the interest is at 12% per annum and the loan is for a period of six months. During the 1974 wet season crop, a total of about ₱ 51.9 million (US$6.8 million) was issued as production credit to rice farmers in the three project area provinces. The PNB accounted for about 60% of the total, the RBs for 38% and the ACA for the balance. The area covered by the credit amounted to 64,500 ha.

13. Under the "Masagana 99" program, production credit was given up to ₱ 800/ha, consisting of ₱ 430 for inputs and ₱ 370 for labor and subsistence. The Government has since raised the rate to ₱ 1,200/ha, made up of ₱ 680 for the inputs and ₱ 520 for labor and subsistence. The increased rate is a little below the production costs estimated at full development. Assuming that at full project development about 10% of the farmers in the project area would find their requirements of inputs and hired labor from their own resources, some 7,200 farmers would need credit from institutional sources. At a loan level of ₱ 1,200/ha the total annual credit requirement at full development would amount to ₱ 22.0 million (US$2.9 million). The existing credit institutions would be able to meet the requirement.
Present and Projected Cropping Patterns and Production

Present Cropping Pattern

1. Some 19,700 ha in the project area are currently cultivated to rice in the wet season. Of these about 7,500 ha are irrigated and the remaining 12,200 are rainfed. Of the presently irrigated area, 1,100 ha are in the existing Chico West system operated by the NIA, 3,200 ha are in communal systems and 3,200 ha in privately owned and operated pumping systems. The communal and pump systems are distributed as follows:

<table>
<thead>
<tr>
<th>Section</th>
<th>Communal Systems (ha)</th>
<th>Pump Systems (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuga Gobgob</td>
<td>1,250</td>
<td>-</td>
</tr>
<tr>
<td>Tabuk</td>
<td>1,000</td>
<td>200</td>
</tr>
<tr>
<td>Agbanawag</td>
<td>250</td>
<td>-</td>
</tr>
<tr>
<td>Quezon-Mallig</td>
<td>700</td>
<td>3,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,200</strong></td>
<td><strong>3,200</strong></td>
</tr>
</tbody>
</table>

In the irrigated areas some 5,300 ha are cultivated during the dry season for a cropping intensity of 171%. However, for the project area as a whole the present cropping intensity is only 127%.

2. Wet season irrigated rice is grown between July and February. Transplanting is spread over a 14 week period between July and October and harvesting takes place over a 12 week period in December and February. The dry season crop is grown between February and September, with most of the transplanting in March-May and the harvest in July-September. The rainfed wet season crop tends to be about one month earlier than the irrigated crop. While a majority of the farmers adhere to the above time tables, there is considerable slippage, which is particularly noticeable in the irrigated areas. All rice is transplanted from field nurseries onto previously puddled land.

3. On the presently irrigated land 70% of the area is planted to improved varieties in the wet season crop and 95% in dry season crop, compared to only 27% in the rainfed areas. In the absence of irrigation, farmers prefer the lower yielding, but hardier local varieties. The average paddy yield in the rainfed areas is about 1.5 ton/ha, on the
irrigated areas the yield in the wet season is about 2.3 ton/ha and 2.7 ton/ha in the dry season. The low yields are due to inadequate water supply, to unsatisfactory water management, and poor farming practices. The latter are exemplified by uneven transplanting, high weed infestations, inadequate use of agro-chemicals and untimeliness of operations.

Future Cropping Pattern

4. In the absence of the project the rate of increase in yield in the rainfed areas is estimated at about 1.5% per annum and would probably be due to a slow increase in the area under high yielding varieties. In the irrigated areas the yields in both wet and dry season crops are estimated to increase by some 1.7% per annum as a result of gradual improvement in crop management. The use of inputs would be expected to increase with the availability of greater supplies of credit and more extension efforts as part of the Government's campaign for national self-sufficiency in rice. The average yield increase throughout the project area is projected to increase by 1.6% per year from 1976 to 1986. Existing cropping intensities would remain unchanged in the absence of additional water supplies and improvement of the system.

5. The expected changes in the cropping pattern and in crop production under the project are shown in Table 1. Some 19,700 ha would be provided with wet season irrigation, of which 12,200 ha are currently rainfed. Project facilities and better water management would allow dry season cropping to increase from 5,300 ha by 11,700 to 17,000 ha. Overall cropping intensity in the project area would rise from the present 127% to 186%. The proposed cropping pattern based solely on rice is consistent with soils and topography and with the customs of the local people.

Future Yields

6. With good water control, adequate supplies of credit and inputs and a strengthened extension service, future paddy yields under irrigation are expected to be 4.0 ton/ha for both the wet and dry season crops. The projected yields would be reached five years after the introduction of water. Although Chart 9536 (R) shows high typhoon frequencies, these refer to all Northern Luzon, and not to a particular spot such as the project area. The proposed cropping calendar should minimize typhoon damage. Nevertheless, dry season yields with the project have been reduced to allow for some losses.

7. The improved yields would be obtained from the use of high yielding varieties throughout the project area, better land preparation through greater use of machinery, certified seed, row planting, heavier fertilizer input and greater expenditure on crop protection and weed control. The improved road network envisaged under the project would allow better access to the farms, thus facilitating the inflow of inputs and outflow of produce.
Development Constraints

8. The project would bring a change in the cropping calendar, a 47% increase in labor requirement, a greater degree of mechanization of both land preparation and harvesting, and a demand for additional drying and storage facilities. The most important issues are examined briefly.

9. **Cropping Calendar.** To ensure efficient utilization of resources and the avoidance of technical and organizational bottlenecks, cropping calendars must be prepared as a basis for extension and water management activities. Chart No. 9536 (R) shows a provisional calendar. The main difference between the proposed and existing practice is the tightening of the dry season crop schedule to avoid harvesting in September, a wet month with a high probability of being struck by a typhoon. The proposed calendar allows for a 30-day period for system maintenance in February, the driest month in the year. There would be little change in the wet season crop, except for some acceleration of operations to take advantage of peak rainfall and to ensure that harvesting and threshing take place in the dryest conditions available.

10. **Labor Availability.** The supply and demand for labor with and without the project are examined in detail in Annex 17.

11. **Mechanization.** At present just under 80% of the rainfed area relies entirely on animal drawn equipment for land preparation. In the irrigated areas, machinery is used for land preparation on a little less than 60% of the area cultivated in both wet and dry season crops. With improved water management, better access to the fields, the need for tighter scheduling of operations to maximize water use and increased cropping intensities, it is estimated that the use of machinery would increase to the point that 80% of land preparation in the wet season crop and 90% in the dry season crop would be mechanical. It is anticipated that the machinery, mostly four-wheel tractors and rotary tillers, would be operated mainly by contractors, as is currently the practice.

12. **Harvesting.** The rice is harvested by sickle and the bundles may be left for a few days in the field to dry, depending on the weather. Threshing is either carried out manually by beating the panicles on a slatted table or by mechanical threshers. The latter are fairly large machines and need firm ground conditions. At present only some 20% of the rainfed area is threshed mechanically, while machinery is used on about 60% of the irrigated area in the wet season crop and on 55% in the dry season crop. Under project conditions of much better access to the fields and improved field drainage, it is assumed that some 90% of the cropped area would be threshed mechanically. This would not present any difficulties as existing contractors are enterprising and can be expected to meet the requirements.

13. **Drying and Storage.** The bulk of the threshed paddy is currently sun-dried on whatever suitable surfaces are available. Some of the rice
mills have concrete drying floors. The National Grains Authority (NGA) plans to erect a number of artificial dryers throughout the rice producing areas of the Cagayan Valley. Existing arrangements appear to be adequate for the present paddy crop of 50,000 tons. At full development the annual production from the project would total 147,000 tons. Production from the wet season crop would increase by 120%, while the dry season crop would increase by 375%. The wet season crop harvest should not present problems as it would take place mainly in January and February, the two driest months in the year. Some expansion in drying facilities, both solar and mechanical, would be needed to deal with the increased output of the dry season crop harvested in the wetter July-August period. The project would provide additional solar drying facilities attached to the Water Management Technologist Stations. The DLGCD is currently engaged in a program to provide every barrio with a paved area to be used for sport, recreation and crop drying. Millers are also aware of the need for drying and can be expected to provide whatever additional facilities are required. Storage capacity within the project area is just enough for present production, but would need to be expanded to meet the increased yields. In addition to on-farm storage, there are public and private sector storage facilities. The NGA is building additional storage and the private sector is expected to follow suit to meet rising paddy production from the project area.

14. Processing. There are 105 privately owned rice mills and hullers in the project area municipalities. Assuming a 12-hour working day and a 200-day milling season, the mills have an annual capacity of 50,000 tons of paddy compared to the current area production of 63,000 tons. There are no difficulties in processing the existing crop as there is ample spare milling capacity in the neighboring Magat project area. However, additional milling capacity would be needed at full development. No difficulties are expected in providing the required extra milling capacity as the private sector is enterprising and has access to capital.

Marketing

15. The farmer may sell his surplus paddy to a middleman, store it in a private or Government-owned warehouse in the hope of obtaining a better price, have it milled and sell the rice to a trader, or sell the paddy to the NGA at the Government support price. While the Government is involved in the marketing sector, there is no authority with specific responsibility for marketing. The part played by Government agencies and farmers' marketing cooperatives is remarkably small. With the emphasis currently being placed on the development of cooperatives as an essential support to agrarian reform, it is likely that at full project development, cooperatives would play a larger role in marketing paddy.
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CHICO RIVER IRRIGATION PROJECT: STAGE I

Summary of Cropping Pattern and Production

<table>
<thead>
<tr>
<th>Season</th>
<th>Cropped Area (ha)</th>
<th>Paddy Production ('000 tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present</td>
<td>Future</td>
</tr>
<tr>
<td>Wet Season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated Rice</td>
<td>7,500</td>
<td>19,700</td>
</tr>
<tr>
<td>Rainfed Rice</td>
<td>12,200</td>
<td>18.3</td>
</tr>
<tr>
<td>Sub-total</td>
<td>19,700</td>
<td>19,700</td>
</tr>
<tr>
<td>Dry Season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated Rice</td>
<td>5,300</td>
<td>17,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25,000</td>
<td>36,700</td>
</tr>
</tbody>
</table>

Cropping Intensity: 127% 186%

1/ At full development 1986.
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CHICO RIVER IRRIGATION PROJECT: STAGE I

Market Prospects and Prices

Market Prospects

1. One of the Philippines Government's main policy goals is self-sufficiency in basic foods, especially rice and corn. A deficit in rice, the main staple food crop, has been a persistent problem. Official figures show that for 1963-1967 the Philippines imported an average of about 300,000 tons of rice annually. Although the Government did not import rice in 1969 or 1970, stocks declined in those years. Rice imports were again over 300,000 tons in 1971, 1972 and 1973, reaching 456,000 tons in 1972 because of disastrous floods that year. Good domestic crops allowed smaller rice imports of 170,000 tons in 1974, and 142,000 tons to October 31, 1975. To sufficiently maintain stocks, imports in 1975 could still total 200,000 tons.

2. For the second year running, the Philippines produced a record rice crop in 1975. For the crop year ending June 30, 1975, official paddy production was 5.7 million tons harvested from 3.5 million ha, yielding some 1.6 ton/ha. This was slightly larger (by 1%) than the record 1973/74 crop. Despite these good harvests, rice self-sufficiency is not imminent. With a population of 42 million, converting paddy to milled rice at a 63% recovery rate, and adding 200,000 tons consumed from imports, per capita consumption of milled rice in 1974/75 was 90 kg. Based on population forecast of 55 million in 1985 (Philippines Basic Economic Report, 1975), and the annual per capita consumption of milled rice remaining at 90 kg, total Philippine rice demand in 1985 would be some 5.0 million tons. At a 63% recovery rate, this is equivalent to 7.9 million tons of paddy. To meet this demand, paddy output would have to increase by 3% to 4% yearly between 1975 and 1985. This rough demand computation is in line with the Basic Economic Report, 1975, which suggests rice production will have to expand by 3.5% per year if domestic demand is to be met and imports eliminated. Although from 1965 to 1970, paddy production increased by some 5% per year, from 1970 to 1975 production increased only 0.8% yearly. The 5% growth rate resulted from the introduction of high yielding varieties to the Philippines in the late 1960's. Since then production growth has been small despite the Government's Masagana 99 program to increase rice production launched in May 1973. The project would help increase the current growth rate, and farmers should have no difficulties in marketing the additional rice from the project area. The project area has traditionally supplied rice for consumption in the Cagayan Valley, in the provinces of the Ilocos and the Central Luzon regions, and occasionally in the Manila and Southern Tagalog regions. With the project, this pattern would mainly continue, with buyers from Ilocos and northern Central Luzon purchasing
most of the additional rice, and little, if any, going to Manila or farther south.

Prices

3. Since 1957 the Government has set an annual farm gate support price for paddy to encourage production and to allow some purchases of paddy by Government to build stabilization stocks. Responsibility for operating the system rested with an independent body, the Rice and Corn Administration, which operated unsatisfactorily. On September 28, 1972, the responsibility for rice and corn was transferred to a National Grains Authority (NGA).

4. During the late 1950's and early 1960's the support price remained virtually unchanged and was P 9.5 per cavan 1/ (P 216/ton) in 1961. Thereafter, it was gradually increased and by 1971 it reached P 20.0 per cavan (P 454/ton). Although no precise figures are available to compare the annual average market and support prices for paddy before 1965, the Sector Survey 2/ shows the market price about 10% higher in 1965, and the support price about 10% higher from 1966 to 1970. Since 1971 the market price has generally exceeded the support price, except in areas where the NGA has not operated. The NGA only commenced buying in the project area in April 1975. Before then, unofficial figures suggest the market price was considerably below the support price in the project area. The poor road system in the area also contributed to the lower prices.

5. The behavior of market prices in relation to the support price is consistent with the record of domestic paddy output during the past decade. In the early 1960's, domestic production was unable to meet the growing demand for rice and this tended to raise market prices above the support price. After the mid-1960's, increased production as a result of the spread of high yielding varieties improved the balance between domestic production and consumption and tended to depress market prices. During the last three to four years the trend has reversed and the market and support prices are practically the same. As a result of continuing inflation and to encourage farmers to increase paddy production, the Government has continued to raise the official support price for paddy, which in December, 1975 was P 50 per cavan (P 1,000/ton). In the project area, the market farm gate price was P 47 per cavan (P 940/ton).

6. Through 1972, the farm gate support price for paddy and the domestic consumer price for rice kept pace with changes in the world market

---

1/ Before 1974 a "cavan" or sack of paddy was equivalent to 44 kg. Since 1974 the official weight of a cavan of paddy is set at 50 kg.

price for rice. Since then however, to keep domestic prices down in the face of record high world market prices for rice, the Government has subsidized consumers by maintaining a low official ceiling price for rice and a correspondingly low farm gate price for paddy by sales of imported rice on the domestic market below cost. This subsidy cost the Government about US$20 million in 1974.

7. The Bank projects the world market price of Thai 25%-35% broken rice to fall (at constant mid-1976 prices) from US$330 per ton fob Bangkok in 1976 to around US$240 per ton in 1985. These projections have been used to estimate the present and future farm gate prices of paddy for the farm budgets and the economic analysis. In the farm budgets, using the official exchange rate (US$1.00 = P 7.50), the corresponding farm gate prices fall from P 1,650 per ton (P 83 per cavan) in 1976 to P 1,220 per ton (P 61 per cavan) in 1985. For the economic analysis, using a shadow priced foreign exchange rate (US$1.00 = P 8.30), farm gate paddy prices fall from P 1,820 per ton (P 91 per cavan) to P 1,350 per ton (P 68 per cavan). Over the same period the current paddy support price of P 50 per cavan is is expected to rise to P 61 per cavan at constant mid-1976 prices. This implies that by 1985 the subsidy to consumers would fall to zero, and the market farm gate price and the support price for paddy would be equal.

8. Table I shows the present and projected price structure for rice and urea as used in the economic analysis. In the project area, rice ex-mill has been valued at the cif price Manila of imported rice. Unloading plus distribution costs of rice imported through Manila have been assumed equal to rice transport costs from the project area to rice deficit areas. Some rice may be imported into the Philippines through San Fernando in the Ilocos region, but higher unloading and storing charges here are likely to offset any cheaper distribution costs compared to Manila.
**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

Rice and Urea Price Structure, 1976 and 1985  
(P or US$/ton at Constant Mid-1976 Prices)*

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<tr>
<th></th>
<th>1976</th>
<th>1985</th>
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<tr>
<td></td>
<td>P/ton</td>
<td>US$/ton</td>
</tr>
<tr>
<td><strong>Rice</strong></td>
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<tr>
<td>Export price Thai 25%-35% brokens fob Bangkok</td>
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<td>Import price cif Manila</td>
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<tr>
<td>Rice price ex-mill, project area</td>
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<tr>
<td>Paddy equivalent price (63% rice recovery)</td>
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<tr>
<td>Milling costs less value of by-products</td>
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<td>-</td>
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<td>Handling and transport costs, farm to mill</td>
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<tr>
<td>Farm gate paddy price</td>
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<td>(Financial farm gate price)²/</td>
<td>(940)</td>
<td>(125)</td>
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<td><strong>Economic</strong></td>
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<tr>
<td>(Financial)²/</td>
<td>91</td>
<td>68</td>
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<tr>
<td><strong>Urea</strong></td>
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<td>Export price fob Europe, bagged</td>
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<td>Ocean freight and insurance to Philippine ports</td>
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<td>Handling and retail distribution costs</td>
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<td>Transport cost retailer to farm</td>
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<td>Urea farm gate price</td>
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<tr>
<td>(Financial farm gate price)²/</td>
<td>(1,780)</td>
<td>(237)</td>
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1/ At shadow-priced exchange rate of US$1.00 = P 8.3

2/ At official exchange rate of US$1.00 = P 7.5
CHICO RIVER IRRIGATION PROJECT: STAGE I

Crop and Farm Budgets

1. Annex 14 contains the existing and proposed cropping patterns. This annex shows:

(a) Production costs for irrigated and rainfed rice at present and in the future "with" and "without" the project (Table 1). Present production costs are based on the results of a survey conducted by NIA, and interviews in the area during appraisal. In the future without the project, input levels would change little in rainfed areas, but crop husbandry would improve in the irrigated areas. Future input levels for "with project" conditions are based on recommendations by the Bureau of Soils and the Bureau of Plant Industry, and expected increases in mechanized cultivation and threshing;

(b) Monthly labor requirements for the wet and dry season crops per hectare, based on present and proposed cropping calendars (Table 2). Under project conditions, the labor requirements for land preparation and harvesting would be reduced by the use of machinery, while the labor requirements would increase for crop management, including such activities as weeding, fertilizer and pesticide application, and irrigation;

(c) Crop budgets for the present and for the future "with" and "without" the project (Table 3); and

(d) Farm budgets for typical family farms of 2.0 ha and 4.0 ha (Table 4). The budgets are calculated according to cash flows. Labor costs include only hired labor and not farm family labor. Monthly hired labor requirements are determined by comparing total monthly labor requirements with a maximum availability of 40 man-days of family labor per farm per month. Hired farm labor is costed at P 6 per day, except during harvest when hand cutting of the crop is costed at 7% of the crop value, and hand threshing at 5.5%. Future water charges are similar to those for the Magat project, that is 3.5 cavans of paddy per ha in the wet season and 4.4 cavans in the dry season. Assuming that the majority of farmers would be amortizing owners under the Agrarian Reform, land payments are calculated on actual payments made by the Land Bank to former landlords in the provinces of Isabela, Kalinga-Apayao and Cagayan for rainfed and irrigated land. Separate budgets are shown for farms presently irrigated by gravity and by pumps.
**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**Rice Crop Production Costs**

<table>
<thead>
<tr>
<th></th>
<th>Present Wet Season</th>
<th>Present Dry Season</th>
<th>Future Without Project Wet Season</th>
<th>Future Without Project Dry Season</th>
<th>Future With Project Wet Season</th>
<th>Future With Project Dry Season</th>
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<tbody>
<tr>
<td><strong>Cash Inputs ($/ha)</strong></td>
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<td></td>
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</tr>
<tr>
<td>Cultivation</td>
<td>110 (55)</td>
<td>150</td>
<td>155</td>
<td>135 (70)</td>
<td>180 (80)</td>
<td>180 (80)</td>
</tr>
<tr>
<td>Seed</td>
<td>120 (65)</td>
<td>180 (115)</td>
<td>225 (135)</td>
<td>120 (110)</td>
<td>360 (325)</td>
<td>470 (425)</td>
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<tr>
<td>Fertilizer</td>
<td>35 (30)</td>
<td>45 (40)</td>
<td>55 (50)</td>
<td>65 (60)</td>
<td>80 (75)</td>
<td>250 (230)</td>
</tr>
<tr>
<td>Harvesting</td>
<td>75 (40)</td>
<td>175 (90)</td>
<td>190 (100)</td>
<td>80 (75)</td>
<td>315 (285)</td>
<td>340 (305)</td>
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<tr>
<td>Interest</td>
<td>20</td>
<td>25</td>
<td>25</td>
<td>30 (35)</td>
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<td>60</td>
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<tr>
<td>Total Cash Inputs</td>
<td>420 (330)</td>
<td>685 (520)</td>
<td>750 (565)</td>
<td>505 (520)</td>
<td>880 (875)</td>
<td>1,390 (1,380)</td>
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<td>135 (70)</td>
<td>180 (80)</td>
</tr>
<tr>
<td>Seed</td>
<td>75 (70)</td>
<td>70 (60)</td>
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<td>Fertilizer</td>
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<td>Harvesting</td>
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<td>220 (200)</td>
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<tr>
<td>Interest</td>
<td>30 (35)</td>
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<tr>
<td>Total Cash Inputs</td>
<td>505 (520)</td>
<td>880 (875)</td>
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<td>Total Cash Inputs</td>
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**Labor Inputs (man-days/ha)**

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<tr>
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<td>Planting</td>
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<tr>
<td>Total Labor Inputs</td>
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1/ Economic prices, based on world market rice and fertilizer prices, for use in economic analysis. Figures in parentheses are financial prices prevailing at appraisal for use in farm budgets. Unit costs for rice (seed) and fertilizer are now higher than in the future as world market prices for them are projected to fall (at mid-1976 constant prices).

2/ Based on the following assumptions at full development:
   (a) Cultivation - Mechanical 90% @ $200/ha
       Animal 10% @ $90/ha
   (b) Seeding rate - 50 kg/ha @ average $1.60/kg
   (c) Fertilizer - Urea 80 kg/ha @ $2.1/kg
   (d) Agro-Chemicals - Lump sum
   (e) Harvesting - Mechanical threshing 80% of crop @ 7% of yield value.
   (f) Interest -- @ 12%/year on production credit for 9 months on 90% of cash inputs

3/ Excluding labor handling farm machinery, the cost of which is included under cash inputs.
### Monthly Labor Requirements for Various Rice Crops (man-days/ha)\(^1\) / \(^2\) /

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<th>Feb</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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1/ P = Present  
W = Future without project  
W = Future with project  

2/ Excluding labor handling farm machinery.
**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**Rice Crop Budgets**

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Future Without Project</th>
<th>Future With Project</th>
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<tbody>
<tr>
<td></td>
<td>Wet Season</td>
<td>Dry Season</td>
<td>Wet Season</td>
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<tr>
<td></td>
<td>Rainfed</td>
<td>Irrigated</td>
<td>Rainfed</td>
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<tr>
<td><strong>Yield (ton/ha)</strong></td>
<td>1.5</td>
<td>2.3</td>
<td>2.7</td>
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<tr>
<td><strong>Farm-gate Price (P/ton)</strong></td>
<td>940</td>
<td>940</td>
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<tr>
<td><strong>Gross Value of Production (P/ha)</strong></td>
<td>1,410</td>
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<td>2,540</td>
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<tr>
<td><strong>Production Costs, Excluding Labor (P/ha)</strong></td>
<td>330</td>
<td>520</td>
<td>565</td>
</tr>
<tr>
<td><strong>Net Value of Production, Excluding Labor (P/ha)</strong></td>
<td>1,080</td>
<td>1,640</td>
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<tr>
<td><strong>Labor Requirements (man-days/ha)</strong></td>
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1/ Financial costs and prices are used, based on Table I.
**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

**Farm Budgets**

<table>
<thead>
<tr>
<th>Unit</th>
<th>2.0 ha Farm</th>
<th>4.0 ha Farm</th>
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<tr>
<td></td>
<td>Present</td>
<td>Future w/Proi.</td>
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<tr>
<td>Transplanted Rice</td>
<td>(ha)</td>
<td>(ha)</td>
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<tr>
<td>Total Cropped Area</td>
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<tr>
<td>Cropping Intensity</td>
<td>(%)</td>
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<td></td>
<td>100</td>
<td>186</td>
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<tr>
<td>Total Paddy Production</td>
<td>(ton)</td>
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<td></td>
<td>3.0</td>
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<tr>
<td>Gross Value of Production</td>
<td>(P)</td>
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<td>Production Costs</td>
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<td>Costs of Hired Farm Labor</td>
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<td>Net Value of Production</td>
<td>(P)</td>
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<tr>
<td>(Before Water Charges)</td>
<td>(P)</td>
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<tr>
<td>Water Charges</td>
<td>(P)</td>
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<tr>
<td>Net Value of Production</td>
<td>(After Water Charges)</td>
<td>(P)</td>
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<td>Net Crop Income</td>
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<td>Farm Labor Requirements</td>
<td>(man-days)</td>
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</table>

1/ Based on Tables 1 and 3.
2/ Based on a maximum of 40 man-days/month and a total of 480 man-days/year of family labor.
3/ Based on present charges of P100/ha in the wet season and P150/ha in the dry season; an average pumping cost of P350/ha; and proposed future charges of P175/ha and P220/ha in the wet and dry seasons.
4/ Based on an amortizing owner with annual payments over 15 years @ 6% interest on the unpaid balance.
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Farm Labor Analysis

Labor Supply

1. According to an NIA survey, data from the 1970 Census of Population and Housing, the 1971 Agricultural Census and the Department of Agrarian Reform, the present rural population of the project area is 55,000. This consists of about 8,050 farm families, and some 1,950 landless families occupied principally or entirely in agricultural production. The average farm family is 5.5 persons, from which two full-time workers are available for farm work, giving a total family labor supply of 16,100 workers. Assuming each of the other 1,950 families also supplies two workers, the total estimated project area rural labor force is 20,000. Assuming 240 days per worker per year, a monthly average of 20 days, the total annual labor supply is 4.8 million man-days, or 0.4 million man-days per month.

2. From 1960 to 1970, while the total Philippine population grew 3.0% per year, the population in the project area municipalities grew at 3.5% per annum due to migration from other regions. Assuming that migration continues in the future, and the rural work force in the project area grows at 3.5% per year (versus the 1975 Basic Economic Report's average 3.0% growth projection for the Philippine work force over the same period), rural labor would total some 28,000 at full project development in 1986. This would give a total annual labor supply of 6.72 million man-days, and a monthly average supply of 0.56 million man-days.

Labor Demand

3. Annex 16, Table 2 gives estimates of average monthly and annual labor requirements per ha for different rice crops. Mechanization of land preparation and paddy threshing is already widespread, particularly on land with some existing irrigation. In future, without the project, some additional mechanization of land preparation and threshing is assumed, thereby slightly reducing labor requirements per ha. The timing of cropping operations throughout the project area varies widely. This diversity contributes to the difficulties of water management in present irrigated areas, and of scheduling inputs and supporting services. With the project, strict scheduling of operations would be essential to permit adequate irrigation of the whole area. This in turn would require further mechanization of land preparation, particularly for the dry season crop. At the same time practically all threshing would be done by hired mechanical threshers. Notwithstanding this additional mechanization, average labor requirements per ha at full project development are estimated to be similar to present levels because of higher crop management requirements.
4. Table 1 gives estimates of total monthly labor requirements in the project area. The present annual requirement is some 2.5 million man-days, or 52% of the estimated rural labor supply. Yearly labor demand has a pronounced seasonal pattern. Peak monthly demand occurs in August and half of total yearly labor is needed during the four month period July through October. Present dry season labor demand is much less than that of the wet season, beginning at 55% of available labor supply in February and falling during consecutive months to a low of 12% in June. In future without the project, increased mechanization would slightly lower the annual labor requirements to 2.4 million man-days. Except for small monthly variations, the seasonal employment pattern would remain as now. The project would greatly increase dry season irrigation and the dry season labor demand which would increase yearly labor demand and even out seasonal labor requirements. At full development annual labor requirements would be 3.7 million man-days, 55% or 1.2 million man-days greater than without the project. Tighter scheduling of cropping operations and a later planting of the wet season crop would concentrate the wet season peak labor demand, and shift it to the period October through January; it would also make better use of the available rainfall and avoid harvesting during the high rainfall month of November. NIA would maintain the system during the dry conditions of February and farmers would grow their dry season crop from March through August. At 1.7 million man-days, total dry season labor demand would be 86% of the total wet season labor demand of 1.97 million man-days.

Economic Cost of Farm Labor

5. Detailed information on wages actually paid in the project area is limited. Most work is done by unpaid family labor and traditional "exchange" labor. Information on off-farm employment is even less reliable. The wage for hired labor in peak agricultural seasons is around ₱ 6 per man-day, which is assumed to reflect the opportunity cost of labor to the economy at such times. In months of high rural unemployment, which characterize most of the year, the opportunity cost of labor would be much lower. The economic cost of farm labor in the project area was therefore estimated by taking account of the generally prevailing rural unemployment and extreme seasonal fluctuations in labor demand.

6. It is postulated that the marginal opportunity cost of farm labor in the project area can be approximated by an S-shaped curve (Chart 15379). The marginal opportunity cost is positive at all levels of labor demand and increases as more labor is employed in farm work. The increase is slow initially, reflecting the scarcity of alternative productive employment, but becomes more rapid as the labor supply becomes fully used. At full employment in the project area, the opportunity cost is assumed equal to the market wage of ₱ 6 per man-day. As labor demand increases beyond this point, the market wage rate continues to rise until it reaches ₱ 7 per man-day, at which level it remains constant for subsequent demand increases. This reflects the mobility of the Philippines rural labor force, and indicates that large numbers of laborers would be attracted to the project area from surrounding areas at that market wage.
7. It is reasonable to approximate the S-shaped curve by three straight line segments. Three points determine the position of the curve. Point A represents the minimum opportunity cost of farm labor which is estimated to be $2 per man-day, equal to $1.5 as the economic value of alternative employment (casual non-farm labor, fishing, house repairs, etc.) plus $0.5 to supply the additional food requirements of more strenuous farm work with the project. Point B indicates that at full employment of rural labor the opportunity cost would equal the market wage of $6 per man-day. The horizontal segment to the right of Point C indicates that at $7 per man-day as many laborers as needed would be available for farm work in the project area.

8. The monthly marginal opportunity cost may be read directly from the curve at the corresponding level of labor demand. With the project, it varies from $2.3 per man-day in a month of high unemployment to $5.3 per man-day in the month of May. The total economic cost of farm labor is then the area under the curve up to the level of employment. Computed this way, the future economic cost of farm labor would be $10.2 million with the project at full development and $5.9 million without the project, or an incremental cost of $4.3 million. This would be equivalent to pricing the incremental employment of 1.2 million man-days per year at a shadow wage rate of $3.3 per man-day. The corresponding shadow wage rate for the total labor demand of 3.7 million man-days at full development would be $2.8 per man-day.
PHILIPPINES
CHICO RIVER IRRIGATION PROJECT: STAGE I
Estimated Opportunity Cost Curve for Farm Labor

MARGINAL OPPORTUNITY COST ($/Man-Day)

FARM LABOR DEMAND (Million Man-Days/Month)
### PHILIPPINES

#### CHICO RIVER IRRIGATION PROJECT: STAGE I

Total Monthly Labor Requirements ('000 man-days)\(^1\)

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<thead>
<tr>
<th>Area (ha)</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td><strong>Wet Season</strong></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Irrigated Rice</td>
<td>P</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>143</td>
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<td>150</td>
<td>60</td>
<td>82</td>
<td>90</td>
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<tr>
<td></td>
<td>W</td>
<td>7,500</td>
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<td>-</td>
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<td>-</td>
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<td>150</td>
<td>82</td>
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<td></td>
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<td>256</td>
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<td>W</td>
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<tr>
<td><strong>Dry Season</strong></td>
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<td>64</td>
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<td>453</td>
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<td>236</td>
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\(^1\) P = Present  
W = Future without project  
F = Future with project.
### Economic Cost of Farm Labor at Full Project Development

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<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(Million man-days)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>0.09</td>
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<td>2.5</td>
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<tr>
<td><strong>Economic Cost of Farm Labor</strong></td>
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<tr>
<td>(P Million)</td>
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<tr>
<td>W</td>
<td>0.8</td>
<td>0.4</td>
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<td>1.6</td>
<td>0.5</td>
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<td>0.8</td>
<td>0.6</td>
<td>1.4</td>
<td>1.2</td>
<td>0.6</td>
<td>10.2</td>
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<tr>
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<td>0.6</td>
<td>0.5</td>
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<td>0.1</td>
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<td>0.9</td>
<td>0.6</td>
<td>0.7</td>
<td>0.4</td>
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<td>5.9</td>
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<tr>
<td><strong>Incremental Economic Cost of Farm Labor</strong></td>
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</tr>
<tr>
<td>W-W</td>
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<td>-0.1</td>
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<td>0.4</td>
<td>0.1</td>
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<td>-0.3</td>
<td>0.8</td>
<td>0.5</td>
<td>0.2</td>
<td>4.3</td>
</tr>
</tbody>
</table>

1/ **W** = Future with project.  
W = Future without project.
1. This Annex examines the implications for public revenues and project beneficiary incomes of proposed water charges for the Chico project equal to those in the Bank-assisted Central Luzon and Magui projects. In determining the extent of cost recovery and the relation of water charges to benefits, three indices have been used which are defined as follows for the present project:

   (a) **Cost Recovery Index:** the ratio of incremental water charges paid by all project beneficiaries to incremental project construction and operation and maintenance costs.

   (b) **Benefit Recovery Index:** the ratio of incremental water charges paid by a typical farm family to incremental income accruing to the family before paying water charges.

   The Benefit Recovery Index as defined above gives no feeling for how much of the incremental income due to the project it would be feasible or equitable to recover, since it ignores the value of family labor, management costs and uncertainty associated with farmers' effort to achieve these incomes. Therefore the analysis also considers the

   (c) **Rent Recovery Index:** the ratio of incremental water charges paid by a typical farm family to incremental "project rent" accruing to the family before paying water charges, where "project rent" is defined as incremental income as in (b) less the value of family labor, management costs and allowances for uncertainty.

   The upper limit of the Rent Recovery Index is 100% but it would normally be less than that because of political difficulties, tax disincentives and costs of collecting taxes. Rent is a difficult concept to measure in practice, but an attempt is made to determine reasonable quantitative estimates of its various components based on qualitative considerations.

2. All water charges, costs and benefits are measured at present values discounted at 10% annual rate of interest over the 50 year life of the project and in terms of 1976 constant prices. Costs represent financial flows from the public sector and are net of taxes and other transfer payments. It is assumed that there would be no incremental payments of general taxes due to the project.
3. Construction costs charged to Stage I in the cost recovery analysis amount to US$34.0 million. They exclude 50% of diversion dam costs (US$4.6 million) which are attributed to the proposed power project and US$12.6 million representing the proportion of diversion dam and main canal costs which are allocated to the proposed Stage II. The present value of the remaining construction and O&M costs, discounted at 10%, is $189 million. Water charges would be the equivalent of 3.5 cavans of paddy/ha in the wet season and 4.4 cavans in the dry season. This would be equivalent to $215 and $270/ha in the wet and dry seasons, respectively, at the forecast farm gate price for paddy (Annex 15), or a weighted average of $445/ha for a cropping intensity of 186%. Such a rate would be reached gradually over a period of five years from completion of construction. At a discount rate of 10% the present value of such a charge on the entire project area over the 50-year life of the project would be $54 million, indicating a cost recovery index of about 29%.

4. As in the farm budget analysis (Annex 16), two representatives farm sizes of 2.0 and 4.0 ha are considered for benefit and rent recovery analysis. Only the case of farms now under rainfed conditions is analyzed. Such farms represent about two-thirds of all project beneficiaries, and it would be impracticable to levy and collect different water charges in the future on the basis of whether farms are now rainfed or served by gravity or pump irrigation. Because the irrigated farms presently enjoy a higher income level than the rainfed farms, their incremental income under the project would be smaller and consequently the benefit and rent recovery indices on these farms would be higher than the levels indicated below.

5. As shown in Table 1, incremental net farm income from the project at full development, before water charges and payments for land, would be $8,810 for the 2.0 ha farm model and $16,050 for the 4.0 ha model. Water charges of $445/ha (para 3) would give a benefit ratio of 10-11%. In computing project rent, incremental family labor was valued at full market price of $6.0/man-day (Annex 17). The value of farm management was assumed to be 15% of incremental net farm income at full development for the 2.0 ha farm and 25% for the 4.0 ha farm to reflect the greater management needs of the larger farm. An uncertainty allowance of 20% of incremental net farm income was assumed for both models. The resulting rent recovery indices are 20% for the 2.0 ha farm and 24% for the 4.0 ha farm, indicating the slightly progressive effect of uniform water charges in the face of higher imputed farm management costs for larger farms.

6. Table 2 summarizes the numerical results. The proposed water charges give a cost recovery index of 29%, benefit recovery indices around 10% and slightly progressive rent recovery indices in the 20% range. These indices are low (for comparison, the cost recovery index for the Magat project was 34% and the benefit recovery index was in the 12%-17% range).
for two major reasons. First, since Chico Stage I is primarily a new project with little rehabilitation, the cost per ha is high and water charges the same as in the previous projects would therefore give a lower recovery index. Secondly, since farmers in the Chico project area are now poorer than beneficiaries under other Bank-assisted NIA systems before project improvements, their incremental incomes and project rents would be larger and therefore, with the same water charges, the recovery indices would again be lower. The question therefore is whether higher rates should be charged for Chico in view of these facts.

7. For the following reasons it would not be practicable or desirable to recommend higher rates for the Chico Stage I project at this time.

(a) After construction, when the water charges would become effective, the Chico area would be operated as part of the Magat system. It would be difficult to levy and collect different rates from beneficiaries under such conditions. Furthermore, at full development of both projects, including proposed Stage II storage and full double cropping, incomes of all farmers on similar size farms would be identical. It would be unfair to charge the original Chico farmers more than their Magat counterparts solely because they were poorer to begin with;

(b) Although the Government has recently increased the water charges on all national irrigation systems, and has agreed to even higher rates on Bank-assisted projects, there has not yet been any experience with collecting these rates. While the overall collection rate has shown a marked improvement from 50% of fees charged in FY1969 to 66% in FY1974, there is still much room for improvement. In conjunction with the Magat project, the Government has recently agreed to discuss with the Bank ways of improving collection of water charges, based on the results of the National Irrigation Systems Improvement Study (NISIS) financed under the Tarlac project. For the present, it would be more appropriate to continue this emphasis on improving collections rather than insist on higher levies; and

(c) The question of water charges is part of the much broader issue of overall tax, subsidy and pricing policy both within agriculture and between agriculture and other sectors, and should be viewed in a broader sectoral or national economic context.

For the foregoing reasons, the proposed water charges, although implying low cost, benefit and rent recovery indices in the case of the Chico Stage I project are acceptable.
### PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: Stage I**

**Benefit and Rent Recovery**

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (ha)</td>
<td>Number</td>
<td>% of Area (%)</td>
<td>(ha)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0-3</td>
<td>6,312</td>
<td>57</td>
<td>2.0</td>
<td>8,810</td>
<td>1,350</td>
<td>1,320</td>
<td>1,760</td>
<td>4,380</td>
<td>890</td>
</tr>
<tr>
<td>3 and over</td>
<td>1,738</td>
<td>43</td>
<td>4.0</td>
<td>16,050</td>
<td>1,430</td>
<td>4,010</td>
<td>3,210</td>
<td>7,400</td>
<td>1,770</td>
</tr>
</tbody>
</table>

1/ At full market price of P 6.0/man-day.
2/ 15% of incremental net farm income at full development for the 2.0 ha model and 25% for the 4.0 ha model.
3/ 20% of incremental net farm income.
4/ P215/ha in the wet season and P270/ha in the dry season with a cropping intensity of 186%.
5/ It is assumed that incremental farm incomes, project rent and water charges would build up to full development levels with similar time streams and would remain at full development levels for the life of the project so that the ratios at full development would equal the ratios of discounted present values.
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Cost and Benefit Recovery Summary

<table>
<thead>
<tr>
<th>Size of Model Farm (ha)</th>
<th>Cost Recovery Index</th>
<th>Benefit Recovery Index</th>
<th>Rent Recovery Index</th>
<th>Average Per Capita Income Present With the Project (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>29</td>
<td>10</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>4.0</td>
<td>29</td>
<td>11</td>
<td>22</td>
<td>50</td>
</tr>
</tbody>
</table>

GNP per capita (1974): US$300
absolute poverty level (1974): US$140

1/ Net value of production after water charges and payments for land, rounded to nearest US$10

2/ IBRD estimate
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Economic Analysis

Stage I

1. The following assumptions were made in evaluating the Stage I economic rate of return:

(a) Benefits - The expected paddy yields, prices, gross returns, production costs, net returns (without accounting for labor costs) and labor requirements per ha are shown in Annex 16. Chart 9536(R) shows the proposed cropping calendar. Annex 15 gives the calculations for the farm gate prices of paddy, which are based on the Bank's world market price projections for milled rice. Table 1 shows the expected project benefits at full agricultural development of Stage I.

(b) Foreign Exchange - Because of import taxes and quantitative restrictions, the official exchange rate understates the value to the economy of foreign exchange used in carrying out the project and saved by reducing rice imports. In the absence of detailed information needed to compute specific conversion factors and using the Squire-van der Tak approach 1/, the estimated standard conversion factor (SCF) for the Philippines was about 0.905 for the three years 1972-74. This ratio implies a shadow exchange rate of US$1.00 = ₱ 8.30, which was used in the economic analysis.

(c) Investment Costs - The total investment cost, expressed in mid-1976 prices, is US$48.2 million. This includes US$9.2 million to size the main canals so that they can serve the proposed Stage II. Annual O&M costs of US$16 per ha include the incremental cost of the Water Management Technologists. All costs include physical contingencies but exclude costs due to price increases.

(d) Development Period - According to the project implementation schedule, the Chico West section (2,000 ha) would be completed in mid-1978 and the 1978-79 wet season crop (harvested in 1979) would be the first crop grown here under improved conditions; the Quezon-Mallig (10,100 ha) and the Tuga Cobgob (1,250 ha)

sections would be completed in mid-1980 and the 1980-81 wet season crop would be the first crop under improved conditions; and the Tabuk (3,400 ha) and Agbannawag (2,950 ha) sections would be completed at the end of 1980 with the 1981 dry season crop the first crop under improved conditions. Beginning with the first crop grown under upgraded conditions, farmers would achieve the projected yield levels over five years in equal installments. Stage I would reach full development in 1986.

(2) **Labor Pricing** - Farm labor was evaluated at a shadow wage rate, which varies seasonally and averages P 2.8 per man-day over the year under "with" project conditions at full development, compared to a full employment market wage of P 6.0 per man-day. Annex 17 presents a detailed analysis. The use of unskilled labor in construction and development works is limited and all labor employed in such works is valued at the market wage rate.

2. Using the foregoing assumptions and discounting Stage I benefits and costs over 50 years, the economic rate of return is 15% (Table 4).

**Sensitivity Analysis**

3. Sensitivity of the rate of return was tested to cost overruns; reduction and delays in benefits; a higher opportunity cost of farm labor; a 25% increase in the world market rice price; and the allocation of a portion of the capital cost to Stage II. The effects of these changes in assumptions were as follows:

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Rate of Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) A two-year delay in reaching full project benefits because of construction slowdowns.</td>
<td>14</td>
</tr>
<tr>
<td>(b) A 20% increase in construction costs.</td>
<td>13</td>
</tr>
<tr>
<td>(c) A combination of a two-year delay in reaching full project benefits and a 20% cost overrun.</td>
<td>12</td>
</tr>
<tr>
<td>(d) A 25% decrease in project benefits because farmers failed to attain projected yields and/or cropping intensity.</td>
<td>12</td>
</tr>
<tr>
<td>(e) The valuing of farm labor at the market wage rate of P 6 per man-day throughout the year.</td>
<td>15</td>
</tr>
</tbody>
</table>
ANNEX 19

Alternative Rate of Return

(f) A 25% increase in the world market rice price. 19

(g) The allocation of 50% of diversion weir costs to power project, the remaining weir costs shared between Stages I and II on a service area basis and US$9.2 million of main canal costs to Stage II. 21

(h) The valuing of foreign exchange costs and returns at the official exchange rate 14

Costs to Borrower of Delays in Project Implementation

4. Two costs to the Government, resulting from delays in implementing Stage I Irrigation, have been calculated. One cost is a reduction in the real net benefits that could be attained from the project; the other, a reduction in the real grant element in the Bank’s loan.

5. The loss in net benefits has been calculated using a 12% discount rate by comparing the discounted time-stream of Stage I net benefits with two other similarly discounted time-streams where:

(a) the original time-stream is delayed by two years (that is, a two-year delay before implementation begins); and

(b) the project proceeds as planned for two years, followed by a two-year delay during which net benefits if any (benefits minus O&M costs) remain stationary, after which the project proceeds as originally planned.

6. The calculations show that the project, in mid-1976 prices, is worth US$8.14 million if the loan is committed in mid-1976.

(a) With a two-year initiation delay the project is worth US$6.08 million, a US$2.06 million delay-cost, which is 25% of the project’s original net present value in real terms.

(b) With a two-year delay after two years of project implementation, Stage I is worth US$5.62 million, a US$2.52 million delay-cost, which is some 30% of the project’s original net present value in real terms.

7. The difference between the grant element in a Bank Loan and the commitment charges is a financial benefit to the Government. If the grant element is around 10% for a Bank Loan at 8.5% interest, with a 25 year term and seven year grace period, the discounted real present value of the grant element less the commitment charges is US$1.25 million.
With a two year delay in project initiation, this is reduced to US$0.65 million, while a two year delay after two years of implementation reduces the financial benefit to US$0.69 million. The cost to the Philippines, because of delayed Bank disbursements, is US$0.60 million in the first case and US$0.56 million in the second.

8. Adding these two types of losses together, the total cost to the Philippines of a two year delay at the commencement of Stage I Irrigation is US$2.66 million. The cost of a two-year delay after two years of implementation is US$3.08 million.

Stage II

9. Construction of the project's proposed Stage II is dependent on the building of a dam for hydro-power generation on the Chico river. Stage II's size and construction timing has yet to be finally determined. A preliminarily economic evaluation was nevertheless carried out, using the following assumptions:

(a) **Project Features** - Stage II construction consists of the necessary main connecting canals, structures, and irrigation service area facilities for an additional 29,300 ha. The service area includes the following four different sections, separated by ridges or small hills; Magsaysay (8,600 ha), Liwan-Gadu (8,500 ha), Enrile (3,200 ha), and the Chico East (9,000 ha). Construction would commence in 1980 and be completed in 1984.

(b) **Benefits** - Stage II would irrigate an additional 29,300 ha of rice in the wet season, and 28,000 ha in the dry season. The cropping pattern, cropping calendar, expected paddy yields, prices, gross returns, production costs, net costs, and labor requirements per ha used for Stage II are the same as those for Stage I. Table 2 shows the areas cropped and expected benefits at full agricultural development.

(c) **Foreign Exchange** - Foreign exchange costs and earnings are converted to local currency equivalents at a shadow exchange rate of US$1.00 = ₱ 8.30 as for Stage I.

(d) **Investment Costs** - The total investment cost, calculated in mid-1976 prices, included in the analysis is US$57.1 million. Annual O&M costs of US$16 per ha include the incremental cost of the Water Management Technologists. All cost figures include physical contingencies, but exclude price increases because of inflation.

(e) **Development Period** - The four service areas would be developed more or less simultaneously. The Chico East section would be completed in mid-1983, and the 1983-84 wet season crop
would be the first crop grown under improved conditions. As storage water from the power dam would not be available until 1985, this would be the first year in which an improved dry season crop could be grown. The other three sections would be completed in 1984, and the 1985 dry season crop would be the first crop grown under upgraded conditions. Farmers would achieve the projected yield levels over five years in equal installments. Stage II would reach full development in 1990.

(f) Labor Pricing - Farm labor was evaluated at a shadow wage rate, which varies seasonably and averages ₱ 3.1 per man-day over the year under "with" project conditions at full development, compared to a full employment wage of ₱ 6.0 per man-day. This shadow wage rate is slightly larger than that used in the Stage I calculations because the Stage II cropping intensity is a little higher than Stage I's (196% versus 186%). The use of unskilled labor in construction and development works is limited, and all labor employed in such works was valued at the market wage rate.

10. Using the foregoing assumptions and discounting benefits and costs over 50 years, the economic rate of return would be 20% (Table 5).

Sensitivity Analysis

11. Although Stage II design has yet to be finalized, sensitivity of the rate of return as calculated under the foregoing assumptions was tested to cost overruns; reductions and delays in benefits; and a higher world market rice price. The results were as follows:

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Rate of Return %</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) A two-year delay in reaching full project benefits because of construction slowdowns.</td>
<td>19</td>
</tr>
<tr>
<td>(b) A 20% increase in construction costs</td>
<td>18</td>
</tr>
<tr>
<td>(c) A 25% decrease in project benefits</td>
<td>16</td>
</tr>
<tr>
<td>(d) A 25% increase in the world market rice price</td>
<td>24</td>
</tr>
<tr>
<td>(e) Foreign exchange costs and returns valued at the official exchange rate</td>
<td>24</td>
</tr>
</tbody>
</table>
Stages I and II

12. Using the assumptions listed for Stages I and II, and discounting their benefits and costs over 50 years, the combined economic rate of return is 17% (Tables 3 and 6). If Stage II implementation is delayed by two years, the entire project’s rate of return falls only 0.3%. A 20% cost increase, however, depresses the rate of return to 15%.

13. While the storage dam on the Chico river would be constructed expressly to generate hydro-power, around US$15 million of the dam’s cost could be charged against irrigation, and the irrigation development would still have a 15% economic rate of return. However, up to US$60 million of the dam’s cost could be allocated to irrigation if a 12% rate of return is acceptable for the irrigation component.

14. The economic rate of return of the Chico 4 power project will be determined in the feasibility study to be prepared by NPC with consultant assistance, as costs are firmed up and details of the power market and the project implementation schedule are worked out. However, the preliminary studies carried out by NPC show that the Chico 4 project would be economically viable on a power only basis.
### Economic Analysis - Net Value of Production - Stage I

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>Paddy Yield (ton/ha)</th>
<th>Farm Gate Price (P/ton)</th>
<th>Gross Value of Production (P/ha)</th>
<th>Production Cost 1/ (P/ha)</th>
<th>Net Value of Production (P/ha)</th>
<th>Net Returns from Project Area (P million)</th>
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</thead>
<tbody>
<tr>
<td><strong>Wet Season</strong></td>
<td></td>
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</tr>
<tr>
<td>Irrigated Rice</td>
<td>7,500</td>
<td>2.6</td>
<td>1,350</td>
<td>3,510</td>
<td>880</td>
<td>2,630</td>
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<tr>
<td>W</td>
<td>19,700</td>
<td>4.0</td>
<td>1,350</td>
<td>5,400</td>
<td>1,390</td>
<td>4,010</td>
</tr>
<tr>
<td>Rainfed Rice</td>
<td>12,200</td>
<td>1.7</td>
<td>1,350</td>
<td>2,295</td>
<td>505</td>
<td>1,790</td>
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<tr>
<td><strong>Dry Season</strong></td>
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<td></td>
</tr>
<tr>
<td>Irrigated Rice</td>
<td>5,300</td>
<td>3.1</td>
<td>1,350</td>
<td>4,185</td>
<td>975</td>
<td>3,210</td>
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<tr>
<td>W</td>
<td>17,000</td>
<td>4.0</td>
<td>1,350</td>
<td>5,400</td>
<td>1,380</td>
<td>4,020</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<td>85.2</td>
<td>147.3</td>
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<td></td>
</tr>
</tbody>
</table>

1/ From Annex 16, Table 1
2/ W = Future with project
3/ W = Future without project
3/ From Annex 17, Table 2
4/ Adjusted by P 0.7 million for irrigation pumping costs.

Total Net Value of Production Before Costing Labor:

<table>
<thead>
<tr>
<th>W</th>
<th>(P million)</th>
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</thead>
<tbody>
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<td>58.5</td>
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</table>

Less Imputed Labor Cost 3/:

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<th>(P million)</th>
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<tbody>
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<td>5.9</td>
<td>10.2</td>
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</tbody>
</table>

Total Net Value of Production at Full Project Development:

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<th>W</th>
<th>(P million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51.9</td>
<td>137.1</td>
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</tbody>
</table>

Net Incremental Value of Production at Full Project Development:

<table>
<thead>
<tr>
<th>W</th>
<th>(P million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>85.2</td>
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</tr>
<tr>
<td>Area (ha)</td>
<td>Paddy Yield (ton/ha)</td>
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<td>----------</td>
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</tr>
<tr>
<td>Wet Season</td>
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<tr>
<td>Irrigated Rice</td>
<td>6,500</td>
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<tr>
<td>W 29,300</td>
<td>4.0</td>
</tr>
<tr>
<td>Rainfed Rice</td>
<td>22,800</td>
</tr>
<tr>
<td>W -</td>
<td>-</td>
</tr>
<tr>
<td>Dry Season</td>
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</tr>
<tr>
<td>Irrigated Rice</td>
<td>2,700</td>
</tr>
<tr>
<td>W 28,000</td>
<td>4.0</td>
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<tr>
<td>Total</td>
<td>32,000</td>
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<tr>
<td>W 57,300</td>
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</tbody>
</table>

1/ See footnotes Table 1
2/ " " " "
3/ " " " "
4/ Adjusted by P 0.7 million (rounded) for irrigation pumping costs.

Total Net Value of Production before costing labor: 66.6 230.1
Less Imputed Labor Cost 3/ 7.8 17.5
Total Net Value of Production 4/ 58.1 212.6
Net Incremental Value of Production at Full Project Development 154.5
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Economic Analysis - Net Value of Production - Stages I and Stage II

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>Paddy Yield (ton/ha)</th>
<th>Farm Gate Price (P/ton)</th>
<th>Gross Value of Production (P/ha)</th>
<th>Production Costs (P/ha)</th>
<th>Net Value of Production (P/ha)</th>
<th>Net Returns from Project Area -(P Million) ---</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Season</td>
<td></td>
<td></td>
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<tr>
<td>Irrigated Rice</td>
<td>14,000</td>
<td>2.6</td>
<td>1,350</td>
<td>3,510</td>
<td>880</td>
<td>2,630</td>
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<tr>
<td>W</td>
<td>49,000</td>
<td>4.0</td>
<td>1,350</td>
<td>5,400</td>
<td>1,390</td>
<td>4,010</td>
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<td>Rainfed Rice</td>
<td>35,000</td>
<td>1.7</td>
<td>1,350</td>
<td>2,295</td>
<td>505</td>
<td>1,790</td>
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<td>W</td>
<td></td>
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<td>Dry Season</td>
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<tr>
<td>Irrigated Rice</td>
<td>8,000</td>
<td>3.1</td>
<td>1,350</td>
<td>4,185</td>
<td>975</td>
<td>3,210</td>
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<td>W</td>
<td>45,000</td>
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<td>1,350</td>
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<td>Total</td>
<td>57,000</td>
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<td>W</td>
<td>94,000</td>
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</table>

1/ See footnotes Table 1.

2/ " " " "

3/ " " " "

4/ Adjusted by P 1.4 million for irrigation pumping costs.

Total net value of production before costing labor
Less Imputed Labor Cost 3/
Total Net Value of Production 4/
Net Incremental Value of Production at Full Project Development

125.2 377.4
13.3 26.5
110.5 350.9
240.4
### Table 4

**PHILIPPINES**

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

*Economic Costs and Benefits: Stage I*  
*(US$ Million)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Capital</th>
<th>O&amp;M</th>
<th>Total</th>
<th>Project Benefits</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>(1976)</td>
<td>0.7</td>
<td>0</td>
<td>0.7</td>
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<tr>
<td>2</td>
<td>(1977)</td>
<td>2.0</td>
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<td>3</td>
<td>(1978)</td>
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<td>4</td>
<td>(1979)</td>
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<td>18.3</td>
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<tr>
<td>5</td>
<td>(1980)</td>
<td>11.5</td>
<td>0.1</td>
<td>11.6</td>
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<tr>
<td>6</td>
<td>(1981)</td>
<td>0</td>
<td>0.2</td>
<td>0.2</td>
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<tr>
<td>7</td>
<td>(1982)</td>
<td>0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>8</td>
<td>(1983)</td>
<td>0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>9</td>
<td>(1984)</td>
<td>0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>10</td>
<td>(1985)</td>
<td>0</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>11-50</td>
<td>(1986-2025)</td>
<td>0</td>
<td>0.4</td>
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**Economic Rate of Return**  
15%
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Economic Costs and Benefits: Stage II
(US$ Million)

<table>
<thead>
<tr>
<th>Year</th>
<th>Project Costs</th>
<th>Incremental Project Benefits</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Capital</td>
<td>O&amp;M</td>
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<tr>
<td>1 (1976)</td>
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<td>0</td>
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<tr>
<td>2 (1977)</td>
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<tr>
<td>3 (1978)</td>
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<td>4 (1979)</td>
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<td>6 (1981)</td>
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<td>7 (1982)</td>
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<td>11 (1986)</td>
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<td>12 (1984)</td>
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<tr>
<td>13 (1988)</td>
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<td>14 (1989)</td>
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<tr>
<td>15-50 (1990-2025)</td>
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Economic Rate of Return

20%
PHILIPPINES

CHICO RIVER IRRIGATION PROJECT: STAGE I

Economic Costs and Benefits: Stage I & Stage II
(US$ Million)

<table>
<thead>
<tr>
<th>Year</th>
<th>Project Costs</th>
<th>Incremental Project Benefits</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
<td>18.2</td>
<td>0.1</td>
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<tr>
<td>5</td>
<td>14.2</td>
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<tr>
<td>9</td>
<td>13.6</td>
<td>0.5</td>
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<tr>
<td>10</td>
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<tr>
<td>11</td>
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<td>0.8</td>
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<tr>
<td>12</td>
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<tr>
<td>13</td>
<td>0</td>
<td>0.8</td>
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<tr>
<td>14</td>
<td>0</td>
<td>0.8</td>
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<tr>
<td>15-50</td>
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<td>0.8</td>
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Economic Rate of Return 17%
# PHILIPPINES

## CHICO RIVER IRRIGATION PROJECT: STAGE I

### SCHEDULE OF EARLY EVENTS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible Agency</th>
<th>Target Date</th>
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<tbody>
<tr>
<td><strong>A. Irrigation Development: Stage I</strong></td>
<td><strong>NIA</strong></td>
<td></td>
</tr>
<tr>
<td>1. First civil works contract (ICB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Complete detailed engineering design, tender documents, prequalification and advertise</td>
<td></td>
<td>April, 1977</td>
</tr>
<tr>
<td>(b) Evaluate bids and award contract</td>
<td></td>
<td>Oct., 1977</td>
</tr>
<tr>
<td>(c) Start construction</td>
<td></td>
<td>Jan., 1978</td>
</tr>
<tr>
<td>2. First force account construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Complete tender documents for force account equipment and advertise (ICB)</td>
<td></td>
<td>July, 1976</td>
</tr>
<tr>
<td>(b) Evaluate bids and award contracts</td>
<td></td>
<td>Sept, 1976</td>
</tr>
<tr>
<td>(c) Receive construction equipment</td>
<td></td>
<td>March, 1977</td>
</tr>
<tr>
<td>(d) Complete detailed engineering design and specifications.</td>
<td></td>
<td>April, 1977</td>
</tr>
<tr>
<td>(e) Start construction</td>
<td></td>
<td>April, 1977</td>
</tr>
<tr>
<td><strong>B. Provincial Road Improvement</strong></td>
<td><strong>DPH</strong></td>
<td></td>
</tr>
<tr>
<td>1. Complete detailed engineering design, tender documents, prequalification and advertise (ICB)</td>
<td></td>
<td>June, 1976</td>
</tr>
<tr>
<td>2. Complete right-of-way acquisition</td>
<td></td>
<td>Aug., 1976</td>
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<tr>
<td>3. Evaluate bids and award civil works contracts</td>
<td></td>
<td>Sept, 1976</td>
</tr>
<tr>
<td>4. Start construction</td>
<td></td>
<td>Jan., 1977</td>
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<tr>
<td><strong>C. Erosion Control Study</strong></td>
<td><strong>NIA</strong></td>
<td></td>
</tr>
<tr>
<td>1. Select consultant and finalize TOR</td>
<td></td>
<td>June, 1976</td>
</tr>
<tr>
<td>2. Initiate erosion control assessment</td>
<td></td>
<td>July, 1976</td>
</tr>
<tr>
<td>3. Start aerial photography</td>
<td></td>
<td>Jan., 1977</td>
</tr>
<tr>
<td><strong>D. Input-Output Monitoring</strong></td>
<td><strong>NIA</strong></td>
<td></td>
</tr>
<tr>
<td>1. Select consultants and finalize TOR</td>
<td></td>
<td>June, 1976</td>
</tr>
<tr>
<td>2. Initiate monitoring program</td>
<td></td>
<td>July, 1976</td>
</tr>
<tr>
<td><strong>E. Feasibility Study, Stage II Irrigation</strong></td>
<td><strong>NIA</strong></td>
<td></td>
</tr>
<tr>
<td>1. Initiate detailed mapping and data collection</td>
<td></td>
<td>Jan., 1977</td>
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<tr>
<td>2. Initiate engineering studies, plan formulation and coordination with Chico I dam feasibility study.</td>
<td></td>
<td>April, 1977</td>
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### PHILIPPINES

**CHICO RIVER IRRIGATION PROJECT: STAGE I**

Implementation Schedule

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<td><strong>IRRIGATION DEVELOPMENT</strong></td>
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<tr>
<td>Chico Plain Area (2,000 ha)</td>
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<tr>
<td>Preliminary technical</td>
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<td>Construction</td>
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<tr>
<td>Chico Damsa Dam and Main Canal (contract no. 1)</td>
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<td>Prepare tender documents and prequalification</td>
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<tr>
<td>Tender period</td>
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<tr>
<td>Evaluation and award</td>
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<td>Mobilization</td>
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<tr>
<td>Construction</td>
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<td>Season - Agricultural Area (10,100 ha)</td>
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<td>Division Canal No. 1 and Trench Area (2,400 ha)</td>
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<td>Taliaon Catch Dam and Trench - Gapan Area (1,200 ha)</td>
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<td>Adsorbing Area (2,350 ha)</td>
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<td><strong>PROVINCIAL ROAD IMPROVEMENT</strong></td>
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<td>Detailed engineering and prepare tender documents</td>
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<td>Land acquisition</td>
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<td>Prequalification of contractors</td>
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<td>Tender period</td>
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<td>Evaluation and award</td>
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<td>Contract signing and mobilization</td>
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<td>Construction</td>
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<td><strong>EROSION CONTROL STUDY</strong></td>
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<td>INPUT - OUTPUT MONITORING</td>
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PHILIPPINES
CHICO RIVER IRRIGATION PROJECT: STAGE I
NIA Organization for Special Projects

NIA BOARD

ADMINISTRATOR

ASSISTANT ADMINISTRATOR
SPECIAL PROJECTS

ENGINEERING DEPARTMENT

PLANNING AND DESIGN DIVISION

CONSTRUCTION MANAGEMENT DIV.

OPERATION AND MAINT. DIVISION

EQUIPMENT DIVISION

AGRICULTURE DEPARTMENT

WATER MGT. AND LAND USE DIV.

FARMERS ASSISTANCE
AND TRAIN. DIV.

EVALUATION AND STATISTICS DIV.

BUSINESS MANAGEMENT
OFFICE

GROUNDWATER PUMP
IRRIGATION PROJECT

MAGAT MULTIPURPOSE
PROJECT

CHICO RIVER IRRIGATION PROJECT:
STAGE I

AGUSAN DEL SUR
IRRIGATION PROJECT

CENTRAL LUZON PROJECTS

ANGAT–MAGAT INTEGRATED
AGRICULTURAL DEVELOPMENT PROJECT
(AMIAOAP)

DAVAO DEL NORTE
INTEGRATED IRRIGATION PROJECT
(DNIIP)

① Includes Upper Pampanga, Aurora–Penasanta & Tarlac Projects

World Bank—9533(2R)
PHILIPPINES
CHICO RIVER IRRIGATION PROJECT: STAGE I
PHILIPPINES
CHICO RIVER IRRIGATION PROJECT: STAGE I
Proposed Organization for Operation and Maintenance

NIA ADMINISTRATOR

ASST. ADMINISTRATOR
SPECIAL PROJECTS

PROJECT MANAGER
(AGMP)

EQUIPMENT DIVISION

AGRICULTURAL DEVELOPMENT DIVISION

MARIS DAM DIVISION

ADMINISTRATIVE DIVISION

DISTRICT 1
SANTIAGO
(21,600 Ha)

ZONE SUPERINTENDENT 1/
(2)

DIVISION SUPERVISOR
(3)

WATER MANAGEMENT TECHNOLOGIST
(43)

DITCHTENDERS
(210)

DISTRICT 2
SAN MATEO
(33,000 Ha)

ZONE SUPERINTENDENT 1/
(2)

DIVISION SUPERVISOR
(3)

WATER MANAGEMENT TECHNOLOGIST
(65)

DITCHTENDERS
(335)

DISTRICT 3
ROXAS
(20,400 Ha)

ZONE SUPERINTENDENT 1/
(2)

DIVISION SUPERVISOR
(3)

WATER MANAGEMENT TECHNOLOGIST
(41)

DITCHTENDERS
(204)

DISTRICT 4
CHICO
(19,700 Ha)

ZONE SUPERINTENDENT 1/
(2)

DIVISION SUPERVISOR
(3)

WATER MANAGEMENT TECHNOLOGIST
(40)

DITCHTENDERS
(200)

1/ Personnel requirements shown in parentheses
Proposed Cropping Calendar

PHILIPPINES
CHICO RIVER IRRIGATION PROJECT: STAGE I

Wet Season Rice (19,700 Ha.)

Dry Season Rice (17,000 Ha.)

Notation:
C: Cultivation
N: Nursery
T: Transplanting
M: Management
H: Harvest

Rainfall mm.

System Maintenance

Typhoon Frequency
10 Yr. Period

World Bank--9536(R)