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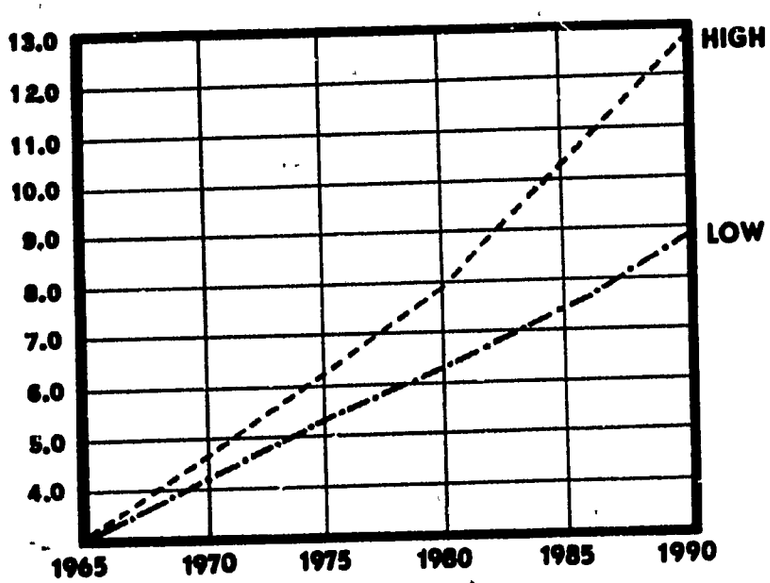

PHILIPPINE RICE NEEDS TO 1990: OUTPUT AND INPUT REQUIREMENTS

FRANK H. GOLAY
and
MARVIN E. GOODSTEIN

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FOREWORD

It's a curious commentary on the intellect and ingenuity of man. He has learned to harness and have at his beck and call the unbelievable power and energy of the atom. He sends ships to the moon and orbits the earth. He delves into the farthest reaches of space and the most intimate secrets of life and matter. He has invented fertilizer, pesticides, and artificial fibers. He has developed hybrid corn and miracle rice. But, as if by some cruel fate, there are more hungry, starving and undernourished people in the world today than ever before — tomorrow there will be still more! Twenty years from now there will have been added billions to this vast horde of hungry, starving, undernourished human begins! Not a very pleasant prospect.

As if he had released some evil Genie from a bottle — man's concern for his health and suffering has led to such discoveries as vaccinations, antibiotics, vitamins, disinfectants and miracle medicines. These in turn have reduced dramatically the death rates that once kept human population under control. But also it has brought the human race face to face with the prospect of mass starvation. Man today cannot grow enough food to feed himself, and tomorrow the situation will be worse.

The Philippines has embarked on a concerted rice production program. Achievements to date indicate that the country will in all probability be self-sufficient in rice by 1969. But what about ten, twenty or thirty years from now?

To look into the future variables of the land, food, population equation, A.I.D. brought Frank H. Golay and his colleague, Marvin E. Goodstein, to Manila during the summer months of 1967. This report is the result of their studies. It marshals rather convincing evidence to show that by 1990 the Philippines will require a domestic rice production of at least 10 million tons — 250% of its present level of production — if it is to over the food requirements of its people. The implications of this level of production in terms of requirements: irrigation, fertilizer, and other physical and human inputs are also set forth both in general magnitude and time schedule.

This study will undoubtedly become an important planning document for future development programs in the Philippines.

Frank H. Golay is at present a Professor of Economics and Asian Studies, Director, Cornell Philippines Project, and Associate Director, Cornell Southeast Asia Program, Cornell University. He needs no introduction to Philippine readers, but for the convenience of friends and scholars

it seems appropriate to set forth in a concise manner a summary of his earlier association with the Philippines.

During 1955-56, he was in the Philippines as a postdoctoral Fulbright Research Scholar, returning in 1960 as a Guggenheim Foundation Fellow, and again in 1965 as a consultant to the Agency for International Development.

He is the author of *The Philippines: Public Policy and Economic Development* and editor of *Santo Tomas Story,* the original text of which was written by an internee, A. V. H. Hartendorp, until recently Editor of the *American Chamber of Commerce Journal.* Hartendorp, who is well known for his comprehensive and discriminating reporting the Philippine postwar economic developments, says Professor Golay is recognized and accepted by the Philippine academic and business community as one of the most knowledgeable and authoritative students of the Philippine economy, past and present.

Because of his outstanding knowledge of and close, friendly relationship with the Philippines, Professor Golay was selected by the American Assembly to edit the publication, *Philippine-American Relations,* as background reading for participants in the Philippine-American Assembly at Davao, Mindanao, February 23-26, 1966. He also contributed a chapter, *Economic Collaboration The Role of American Investment,* to the volume.

The high regard in which he is held is reflected in the wording of the citation accompanying the honorary degree of Doctor of Laws, *honoris causa,* conferred on him at Ateneo de Manila, February 19, 1966.

"Dr. Frank Golay is an exceptional type," reads the citation, "an academic administrator who continues to be a productive scholar. Ateneo de Manila does itself honor in manifesting gratitude to this admirable gentleman by conferring upon him, in a spirit of deep friendship, the honorary degree of Doctor of Laws."

Marvin E. Goodstein, Professor of Economics, University of the South, Sewanee, Tennessee, received his doctorate in Economics from Cornell University in 1962 His dissertation, a perceptive and careful reevaluation of Philippine national product accounts, established the definitive base for linking postwar Philippine economic development to levels achieved in the late 1930's. His revised dissertation, *The Pace and Pattern of Philippine Economic Growth 1938, 1948 and 1956* (Cornell Southeast Asia Program Data Paper No. 48) appeared in 1962.

W. C. Haraldson

W. C. HARALDSON
Director, USAID Mission
Manila, Philippines
August 31, 1967

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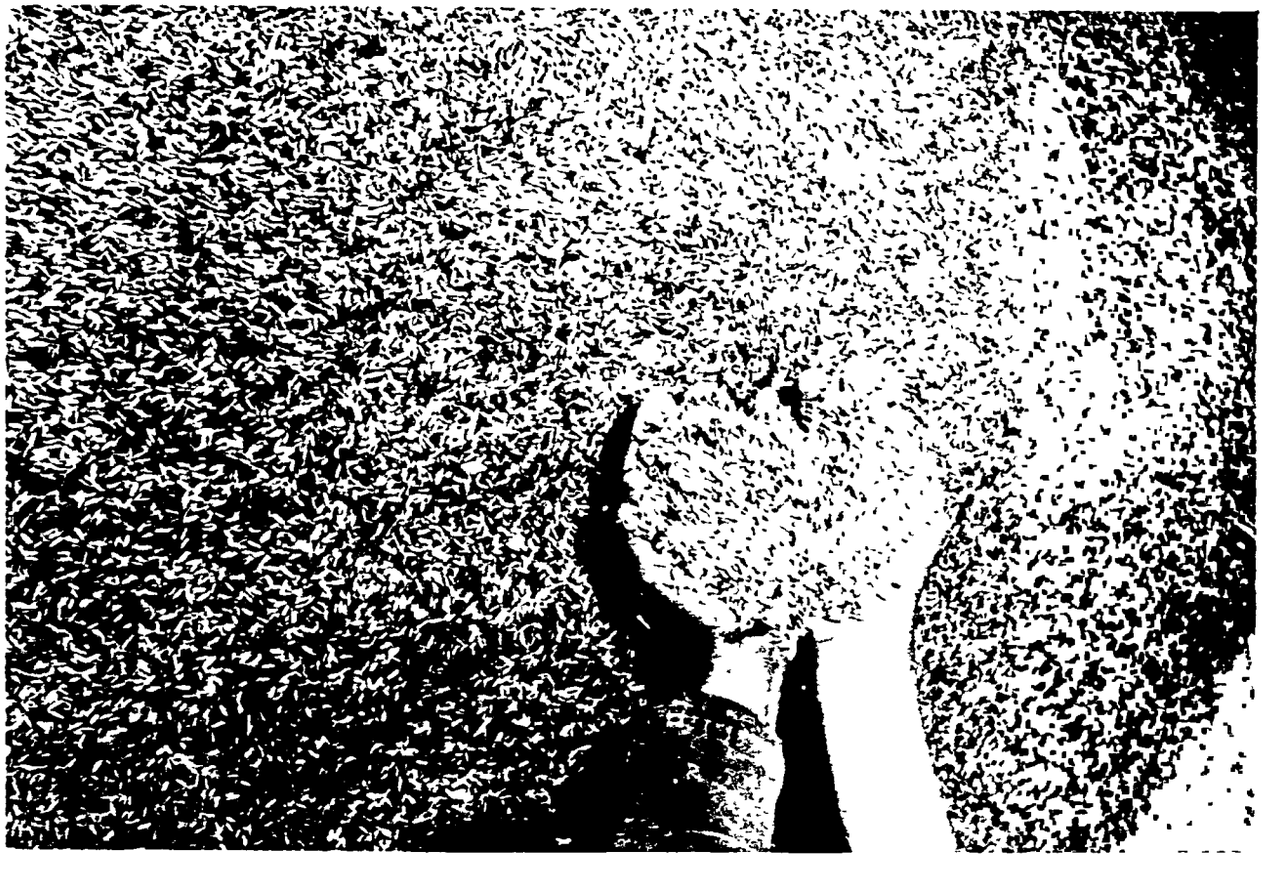


CHAPTER I

INTRODUCTION AND SUMMARY [1]

The purpose of this study is to provide a series of statiscal "bench marks" from which statesmen, public officials, economists, aid officials, and laymen, can begin to think systematically about the required development of the Philippine rice economy over the next quarter-century. The study was comissioned by the Agency for International Development and was completed by the authors in eight weeks in the summer of 1967

The projections in this study vary widely in firmness and, in a number of cases, should be used only as "orders of magnitude". They are tentative because projections over a 25-year period are inherently hazardous and frequently foolish and because processes of change, particularly in areas of technology, have accelerated enormously in our life time.[2]

Fortunately, the basic projections in this study, the estimates of rice requirements in 1990, are relatively firm. They are firm, first of all, because they are based on relatively reliable knowledge of Philippine population growth characteristics over the next quarter-century. Because fertility and mortality rates are relatively stable, the basic dimensions of the Philippine population in 1990 almost certainly have been established by the characteristics of the population today. Confidence in the projections of rice requirements in 1990 also derives from the remarkable stability in per capita direct consumption of milled rice by Filipinos since 1910, and the even greater stability in per capita direct absorption of cereal calories over this period. Annual per capita absorption of milled rice has fluctuated rather closely around 83 kg. since 1910, with some evidence of a declining trend. Per capita absorption of milled rice, milled corn equivalent and wheat flour equivalent combined has been even more stable, fluctuating narrowly around 112 kg. annually.

Combining the "hard" estimates of population growth with the evident stability over long periods of time in the quantity of rice consumed

1 The research necessary to this study was assisted by many people The substantial debt to the scholars, technicians, civil servants and others, who, in the past, have produced reliable knowledge that could be integrated into this study is acknowledged A similar contribution was made by civil servants, statisticians, and economists who liberally gave of time and energy in providing additional information, comments and advice to the authors The contributions of the secretaries who typed the successive drafts and the artists who produced the charts are acknowledged with thanks We would be ingrates if we did not also recognize the contribution of the administrative secretary and staff members of the Program Office, AID/Manila, who facilitated our work in countless ways.

2 Confidence in the fundamental reliability of Philippine statistics is implicit in this study. Philippines statistics are subject to valid criticisms, a number of which are well documented On the other hand, there is no evidence of a systematic bias in the various series used in this study After sifting through the available statistical data and other information, the authors are convinced that time spent in refining the data inputs in his study would not significantly change the projections On the other hand, alternative, and defensible assumptions would change the substance of the estimates

by the average Filipino permits a relatively high degree of confidence in the projection of per capita cereals absorption in 1990. Such an estimate is relatively firm in the sense that, if cereals are available, the average Filipino is going to consume directly about 112 kg. of milled rice, milled corn equivalent and wheat flour equivalent combined. This level of absorption has been associated with social and political stability in the past and will sustain stability in the future.

To bracket the range within which total rice absorption is likely to take place in 1990, we present alternative *Low* and *High* projections of rice requirements. Both projections are based on relatively firm population estimates and cereals absorption data. They diverge markedly because of (a) slight difference in assumed fertility and mortality rates, (b) radically different proportions of rice and other grains in the alternative projections of total cereals absorption, and (c) the assumption used in the *High* projection that per capita cereals absorption in the Philippines by 1990, will rise to the average annual nutritional intake of cereals currently recommended for the Philippine population of 120 kg.

Table 1

Philippines: **Summary of Projections of Rice Requirements, 1965-1990**

Average annual rice absorption 1963-1965 (MT, palay equivalent)	4,407,478
Average annual rice production 1964-1966 (MT, palay equivalent)	3,940,000
Low Projection of rice requirements in 1990 (MT, palay)	9,685,000
High Projection of rice requirements in 1990 (MT, palay)	13,652,000
Increase in rice (palay) production necessary to provide "*Low*" rice requirements in 1990	146%
Increase in rice (palay) production necessary to provide "*High*" rice requirements in 1990	246%

Once rice requirements for 1990 are estimated, the study considers the changes in land under cultivation, irrigation facilities, and other inputs which *may* materialize to provide estimated rice requirements in 1990. In the case of land, projections are based on assumptions of (a) a one per cent annual increase in total land cultivated (excluding area second cropped), and (b) an increase of one-and-a-half per cent annually in the

geographic area utilized to produce rice. These estimated represent a sharp slackening in land settlement as compared to postwar rates and reflect the growing volume of evidence that the Philippines is beginning to approach physical limits to the land suitable for cultivation of present crops with current techniques, particularly land suitable for wet rice cultivation.

Table 2

Philippines: **Summary of Projections of Extension of Geographic Area Under Cultivation, 1965-1990**

Area under cultivation in 1990 (has., exclusive of area in second crops)	9,618,000
Increment of area brought under cultivation, 1965-1990 (has., exclusive of area in second crops)	2,118,000
Area allocated to production of rice in 1990 (has., exclusive of area in second crops)	3,835,000
Increment of area allocated to production of rice, 1965-1990 (has., exclusive of area in second crops)	1,192,000
Increment of rice output attributable to increment of area allocated to production of rice (MT, palay equivalent)	1,210,000

Next, the study presents two alternative projections of potential irrigation development between 1965 and 1990 and estimates the public capital expenditures (at 1965 prices) required to complete the irrigation development in these projections. In contrast to the earlier estimates, these projections do not represent predictions of what *will* happen, but are estimates of what *could* happen if Philippine political leaders and the society generally recognize the dimensions of the commitments necessary to sustain adequate levels of rice absorption over the next quarter-century. In essence, *Irrigation Projection I* consists of an estimate of the total amount of land to which gravity and pump irrigation could be extended. It is based on firm information in surveys of seven major Philippine river basins which have been completed for the Philippine government by the Bureau of Reclamation of the United States government.

Although the estimate of gravity and pump irrigation potential is relatively firm, there is no implication in the estimate that this potential will be developed. The challenge to realize the potential for gravity and pump irrigation will require the mobilization of fiscal, human, and material resources many times the amounts of such resources allocated to irrigation development in the past. After two years, the *Rice and Corn Productivity Coordination Council (revised) Master Plan* for irrigation development for

rice self-sufficiency by 1970, is lagging badly and is unlikely to materialize on schedule. There is little evidence in the past performance of the Philippine public sector to encourage optimism in assessing the prospects that the targets in *Irrigation Projection I* will be met. At the same time, it must be emphasized that the irrigation goals in our projections of possible development are clearly within the society's capabilities if political leadership should measure up to the task.

Irrigation Projection II includes a substantial program of storage irrigation superimposed on the development of gravity and pump irrigation in *Irrigation Projection I*. The *caveat* expressed in the immediately preceding paragraph requires double emphasis here. The fiscal, material, and human resources necessary to complete the target in *Irrigation Projection II* are clearly within Philippine capabilities. Whether or not they are mobilized to achieve those targets will depend upon the quality of legislative and executive leadership over the next 25 years.

Table 3

Philippines: **Summary of Alternative Projections of Irrigation Development, 1965-1990**

	Irrigation Projection I	*Irrigation Projection II*
Geographic area irrigated and planted to first crops, 1990 (has.)	1,980,000	2,380,000
Increment in geographic area irrigated and planted to first crops, 1990 (has.) ..	1,230,000	1,630,000
Total area of irrigated rice plantings, first and second crops, 1990 (has.)	2,637,	3,527,000
Increment in .total area of irrigated rice plantings, first and second crops, 1964-66 to 1990 (has.)	1,688,000	2,578,000
Increment of rice output attributable to projected expansion in irrigation (MT, palay)	1,274,000	2,497,000

The final section of the study uses available information on recommended levels of application to estimate the quantities of fertilizer and other modern inputs — pesticides, herbicides, fungicides — required if existing high yielding rice varieties should be planted in 1990 on the irrigated area included in the alternative irrigation projects. Subsequently, cost data are used to estimate the market value of these input quantities

and the resulting value estimates are combined with projections of cash labor outlays and irrigation fees to estimate requirements of working capital in 1990. In addition, estimates of the capital cost (1965 prices) of the required expansion in the productive capacity of the Philippine fertilizer industry are developed using available investment data. No comparable estimates of capital needs for production of requirements of pesticides, herbicides, and fungicides are presented.

Obviously, the projections of modern input requirements are no better than the irrigation projections themselves, which, as was emphasized previously, are merely non-controversial assessments of irrigation development within Philippine capabilities. The mechanistic estimation procedure employed, however, detracts from the emphasis which needs to be given to irrigation development if historical levels of Philippine cereals absorption are to be maintained. The productivity of new rice varieties combined with the "package" of modern inputs will be critically dependent upon adequate and controlled supplies of water.

Table 4

Philippines: **Summary of Projections of Requirements of Some "Modern Inputs" for Cultivation of High Yielding Rice Varieties on Irrigated Area Planted to Rice in 1990**

	Irrigation Projection I	*Irrigation Projection II*
Nitrogenous fertilizer required for irrigated plantings of rice in 1990 (MT nitrogen, levels of application recommended for IR-8 variety of rice)	207,000	284,000
Outlays for agricultural chemicals (insecticides, herbicides, fungicides) required for irrigated plantings of rice in 1990 (₱, 1965 prices, levels of application recommended for IR-8 variety of rice)	501,000,000	670,000,000
Estimated total cash outlays for labor required for irrigated plantings of rice in 1990 (₱)	158,000,000	212,000,000
Estimated total irrigation fees charged against irrigated rice plantings in 1990 (₱. 1966-67 rates)	139,600,000	166,800,000
Increment of output attributable to "modern inputs" necessary to fill "gap" in *Low Projection* of rice requirements in 1990 (MT, palay)	3,261,000	2,038,000

Table 4 *(continued)*

Increment of output attributable to *"modern inputs"* necessary to fill "gap" in *High Projection* of rice requirements in 1990 (MT, palay)	7,228,000	6,005,000

Note: Nitrogen applied to rice plantings in 1964 estimated to total 15,000 MT. The retail value of imports of agricultural chemicals in 1965 estimated to be ₱16 million.

Table 5

Philippines: **Estimated Capital Requirements Necessary to Provide Some "Modern Input" Requirements for Irrigated Plantings of Rice in 1990**

	Irrigation Projection I	*Irrigation Projection II*
Public capital cost of projected expansion in irrigation facilities (₱ million)	1,962	7,520
Capital cost of expansion in capacity to produce nitrogenous fertilizer required by irrigated rice plantings (₱ million)	540	757
Working capital (cash balances of farm enterprises plus credit) required by plantings of high yielding rice varieties on irrigated area in 1990 (₱ million)[a]	1,089	1,447

[a] Including estimated cash outlays for nitrogenous fertilizers, fungicides, herbicides, pesticides, labor, and irrigation fees

Table 6

Philippines: **Summary Table**

	Low Projection of Rice Requirements	*High Projection of Rice Requirements*
Rice requirements in 1990, (MT, palay)	9,685,000	13,652,000
Average annual palay production, 1964-1966 (MT)	3,940,000	3,940,000
Increment of palay production required, mid-1960s to 1990 (MT)	5,745,000	9,712,000

	Irrigation Projection I	*Irrigation Projection II*	*Irrigation Projection I*	*Irrigation Projection II*
Increment of palay output attributable to expansion in geographic area planted to rice (MT)	1,210,000	1,210,000	1,210,000	1,210,000
Increment of palay output attributable to expansion in irrigated area planted to rice (MT)	1,274,000	2,497,000	1,274,000	2,497,000
"Gap" to be filled by modern inputs; new varieties, fertilizer agricultural chemicals, and so forth (MT) ..	3,261,000	2,038,000	7,228,000	6,005,000
	5,745,000	5,745,000	9,712,000	9,712,000

	Irrigation Projection I	*Irrigation Projection II*	*Irrigation Projection I*	*Irrigation Projection II*
Average yield increment from irrigated rice plantings in 1990, necessary to meet estimated rice requirements in 1990[a] (Kg. of palay per hectare)	1,237	578	2,741	1,703
Average yield increment from rainfed and irrigated plantings of lowland rice in mid-1960s necessary to meet estimated rice requirements in 1990[b] (Kg. of palay per hectare)	1,807	1,807	3,388	3,388

a For details of calculations, see p 100

b Increase in average yield (from plantings equivalent to rainfed and irrigated plantings in crop years 1964-1966) over average annual yields from such plantings in 1964-1966 necessary to meet required increment in palay production under alternative estimates of rice requirements in 1990. Assumes that output increments attributable to additional land brought under cultivation are realized, but no irrigation development takes place For average annual plantings of lowland rice and yields in 1964-1966, see Table 15

The task of meeting rice and other cereals requirements in the future is a formidable one, but there are three favorable factors "going for" the Philippines. First, plant breeders have produced new varieties of rice which, if they receive recommended levels of modern inputs in conjunction with adequate and controlled supplies of water, clearly embody the yield potential necessary to meet rice requirements over the next quarter-century. Second, the rate at which traditional values and attitudes of the Filipino small holder will change in the future probably will ensure that elements of peasant traditionalism will not be a serious constraint on the increases in productivity required over the next quarter century. Confidence in this prediction is supported by the individualism evident in the rapid extension of cultivation over the postwar period. It is also supported by the tentative and encouraging response of rice farmers to the opportunities to increase their productivity and incomes which is evident in current programs to propagate high yielding rice varieties. Finally, the vigorous private sector can be depended upon to bring into existence the marketing, milling, warehousing and transportation facilities at rates which will not impede the necessary expansion in aggregate rice availability. Similarly, Filipino entrepreneurs, with, or without the collaboration with large international chemical firms, undoubtedly can mobilize Filipino resources as necessary to produce the estimated requirements of complex modern inputs. The nature and extent of future participation of non-Filipino resources in this process, of course, will be a Philippine decision. To make the foregoing assessment, is to emphasize once again the critical responsibility of the political leaders. They are responsible to mobilize the fiscal and human resources which will ensure that lack of irrigation facilities does not prevent adequate expansion of Philippine cereals production over the next quarter-century.

Promising Philippine economic development and industrialization since 1950 has been sustained by a process of rapid agricultural development which is imperfectly perceived and little appreciated. A basic consequence of public economic policies since 1950 has been the imposition of forced savings on the agricultural sector — particularly the export sector — which were used to subsidize the burgeoning industrial and commercial sectors. In important respects, this major transfer of income duplicated a development process which can be identified in the histories of Japan, the United States, the Soviet Union, and other countries which have sustained economic growth over prolonged periods. In the case of the Philippines, this structure of policy was socially tolerable because agricultural output — depressed by the capital destruction and dislocation of the war — expanded following Liberation at rates in excess of the growth of agricultural popula-

tion and real welfare of the average smallholder and tenant-cultivator increased slowly.

The Philippine society now is confronted by the necessity to adapt to a fundamentally changed pattern of agricultural development. Basic constraints on land settlement appear to be imminent and Philippine agriculture must increasingly meet requirements of cereals and export crops by improvements in productivity. In time, this will require an intensification of policy emphasis upon agricultural development, which heretofore could be — and was — neglected because agriculture was expanding autonomously and rapidly. The change in policy ultimately required, does not foreclose emphasis on policies for industrialization. It is the obvious and, perhaps, the only path to Philippine industrialization. Moreover, it has been the path that can be identified in the histories of all developed countries. Without improvements in agricultural productivity, which "feed" aggregate demand and facilitate the necessary mobilization of savings in the most populous sector, industrialization and development will be slower than they need be and the continuation of the Philippine political system may be jeopardized by social instability. Agricultural development and industrialization are not alternatives in any meaningful sense, they are mutually reinforcing. In order to have effective policies to support both goals requires the Philippine society to take steps to ensure that institutions of the public sector function effectively in mobilizing national capabilities. This will not be an easy task

We choose to emphasize the need for *new* commitments, policies and institutions to facilitate the inevitable transformation which faces Philippine agricultural development as additional land suitable for cultivation becomes scarce. Candor compels us to admit, however, that agricultural development may remain "autonomous" over the next twenty-five years in the sense that the role of public resources and leadership may be no more important to expansion of the cereals sector over this period than they have been to growth in the past. An important part of the required expansion may result from the spread of vigorous individualism to the agricultural sector, including the smallholder cultivators of lowland rice, which will ensure the realization of a substantial part of the yield increments possible from rainfed cultivation with more modern inputs. Having made this admission, we point out that throughout Philippine history to 1967, population increased to 35 million; the next 35 million of population almost certainly will materialize by 1990; and a third 35 million probably will be eating rice in 2000.

We close with a final projection in which we have great confidence. Numerically small elements in the Philippine society may seize upon this study as evidence that the authors seek to keep Filipinos "hewers of wood and drawers of water". On the contrary, we contend that the permanence of such a role for Filipinos generally, may be assured by neglect of agricultural development: Improved productivity of the agricultural sector has been a prerequisite for Philippine development and industrialization in the past and will continue to be a prerequisite in the future. Once the autonomous process of agricultural development of the past — from which the economy has derived great benefits — is slowed and eventually interrupted by limits on land settlement, the process of agricultural development must change character. The Philippine society ultimately must confront and solve this policy problem. Hopefully, it will do so early rather than late.

CHAPTER II

THE ABSORPTION OF RICE AND OTHER CEREALS, 1910-1965, AND PROJECTION OF FUTURE CEREAL REQUIREMENTS

Introduction

The purpose of Chapter II of this study is to establish a statistical base from which rice and other cereal requirements of the Philippine population can be projected into the future. Such projections in turn, will be used in subsequent chapters to support estimates of input requirements of capital invested in irrigation facilities and in fertilizer capacity, as well as quantities of fertilizer and other agricultural chemicals, working capital and production credit, necessary to achieve projected levels of rice and other cereal requirements.

Following a brief survey of the structure of the Philippine agricultural economy, historical data on plantings, yields and production of agricultural crops, particularly rice and corn, are analyzed to establish the outlines of agricultural development from 1910 through 1965. Domestic production of the latter crops has provided the basic caloric requirements of the Philippine population in the past and almost certainly will do so in the future. Subsequently, data on domestic production of rice and corn are adjusted for milling recovery rates, diversion to industrial uses, allowances for seed and wastage, and net imports, to establish the pattern of apparent direct absorption of milled rice and milled corn equivalent. These data are combined with net imports of wheat flour equivalent to analyze levels of direct absorption of cereals by the Philippine population since 1910. Chapter I concludes with a discussion of the procedure for projecting rice and cereal requirements through 1990 and the projections are presented.

The statistical data supporting he analysis and projections are included in the Statistical Appendix to this chapter.

STRUCTURE OF THE AGRICULTURAL ECONOMY

The Philippine agricultural economy is customarily described in terms of two sectors; a sector producing the basic food requirements of the population and the export crop sector. Making this distinction, however, is not to identify technological dualism as a dominant characteristic of the agricultural economy. Such dualism, in which a food crop sector of tradition-bound, technologically static, small-scale, subsistence units exist in

juxtaposition with, but economically unintegrated with an export sector organized into large-scale, capital-intensive, plantation-industrial enterprises, is frequently attributed to underdeveloped, export-specialized economies. This concept has limited relevance for the Philippines.

Both the food crop sector and the export sector, with the exception of sugar cane production, are dominated, both in number of enterprises and land used, by small-scale producing units. The Agricultural Census of 1960 enumerated 2,166,210 farms with an average area of 3.6 hectares of which 2.6 hectares were under cultivation in annual and perennial crops. The average size of farm varied from a low of 1.67 hectares for tobacco farms and 2.50 hectares for corn farms to a high of 13.9 hectares for sugar cane farms and 5.8 hectares for abaca farms. Only in sugar cane production, where farms larger than 200 hectares occupied 43 per cent of the total area, do farms of this size account for as much as one-tenth of the land in farms specializing in the production of a particular crop.

Table 7

Philippines: **Size of Farm by Crop Category, 1960** [a]

	Number of Farms (000)	Area In Farms (000 Has.)	Average Size of Farms (Has.)	Proportion of Total Area: Farms of 10 Has. or More	Proportion of Total Area: Farms Larger Than 200 Has.
All farms	2,166.2	7,772,5	3.6	.332	.082
Rice (Palay)	1,041.9	3,112.1	2.98	.200	.018
Corn	378.8	949.3	2.50	.202	.010
Sugar Cane	17.8	249.4	13.86	.801	.433
Abaca	36.0	209.0	5.81	.486	.078
Tobacco	22.9	38.4	1.67	.083	.000
Coconut	440.3	1,938.6	4.40	.382	.034

In view of the rapid growth in the Philippine population and the lagging generation of employment outside the rural sector, the prospect of reducing the proportion of the population dependent upon agriculture in this century is remote and the prospect of reducing the absolute numbers of Filipinos engaged in agriculture is non-existent. This conclusion, combined with the existence of imminent constraints upon expansion in land under cultivation, leads to the further conclusion that the land input into the average agricultural enterprise in the Philippines is not going to increase.

Over the decade and a half ending with 1965, plantings of food crops have ranged from 70 to 81 per cent of the total area planted with rice and corn accounting for from 60 to 69 of the percentage points. Over this period, the area planted to corn steadily increased relative to that planted to rice until for the five years ending with 1965, corn plantings averaged

a Bureau of Census and Statistics, Census of the Philippines, 1960, Agriculture, Vol. II, Summary Report.

64 per cent of rice plantings as compared to an average ratio of 42 per cent in the period of 1950-54.[1] During the decade of the 1930s, five-eighths of the total area planted was in rice and corn with plantings of rice averaging three times those of corn.

Since 1960, plantings of the remaining food crops, root crops, vegetables, fruits and other perennial crops, have occupied about 900,000 hectares, or 11-13 per cent of total plantings. This ratio has remained relatively steady throughout the post war period.

Table 8

Philippines: **Area Under Cultivation, 1951-1965** [a]
(000 Hectares)

Crop Year or Average for Period	*Total Area under Cultivation* [b]	*Food Crops* *Rice*	*Corn*	*Other*	*Export Crops*
1951-55	5,899	2,535	1,121	704	1,539
1956	6,817	2,743	1,675	858	1,541
1957	7,004	2,768	1,787	905	1,555
1958	6,997	3,154	1,381	935	1,526
1959	7,910	3,329	2,107	915	1,559
1960	7,596	3,307	1,846	856	1,587
1961	7,834	3,198	2,046	875	1,716
1962	7,918	3,179	2,016	878	1,847
1963	7,934	3,161	1,950	869	1,957
1964	7,956	3,088	1,898	883	2,080
1965	8,245	3,200	1,923	874	2,250

Before concluding this brief summary of the food crop economy supplying the domestic market, it should be pointed out that major shares of the output of sugar, coconuts and tobacco, which are classified as export crops, are consumed domestically. If the data on the areas planted to food crops are increased by the areas which have been planted to export crops but which represent resources supporting domestic consumption of the latter, it becomes clear that the actual share of cultivated land applied to meeting the consumption requirements of the Philippine population since 1950 has ranged from 80 to 85 per cent.

In the case of the export crop sector, American colonial commercial policy of mutual free trade between the Philippines and the United States,

1 Philippine agricultural statistics are compiled for crop years ending June 30, approximately the beginning of the rainy, first-crop season Postwar crop years are tabulated under hyphenated years, as 1964-65, which ended June 30, 1965 Prewar statistics are tabulated under crop years designated by a single year, as 1940, which ended June 30, 1940

a Estimates of Department of Agriculture and Natural Resources Hereinafter referred to as DANR.

b Includes area planted to second, dry season, crops.

which prevailed from 1913 to 1935, stimulated rapid expansion in Philippine production of coconuts and sugar until, by the early 1930s, approximately one-third of the total area planted was devoted to export crops. Although this American policy shifted significantly with the Philippine Independence Act of 1934, export production expanded slowly over the remaining years until the outbreak of World War II.

Following the war, the Philippines chose to maintain the prewar exchange party which substantially overvalued the peso and expansion in plantings of export crops lagged behind growth elsewhere in the agricultural economy. For the decade 1951-1960, the area planted to export crops remained stable, ranging from 1,520,000 to 1,587,000 hectares, and was below levels prevailing in 1939 and 1940 (see Table A3). As a result, the proportion of export crops in the total area planted declined steadily until in 1959 and 1960, it amounted to one-fifth. Although exports of coconut products (in the aggregate) were substantially in excess of prewar, sugar exports remained stable at the level defined by the Philippine quota in the American market, and abaca exports were well below levels maintained in 1930s.

In the meantime, successive exchange decontrol steps which culminated in the devaluation of the peso at the beginning of 1962 established strong incentives to export expansion. As a result, plantings of export crops increased rapidly following 1960, until in 1965 they reached 2,250,000 hectares, almost half again as large as levels of such plantings maintained during the decade 1951-1960. In 1965, plantings of export crops amounted to 26 per cent of the total planted area.

THE RICE AND CORN ECONOMY

The essential nature of Philippine agricultural development over the past half century is well understood and adequately documented. The basic caloric intake of the population has been provided by domestic production of rice and corn and per capita production of these cereals has remained relatively stable since 1920. Over this period, the per capita area planted to rice and corn has shown no tendency to increase, which, given the preceding statement, means that yields (in the aggregate) also have remained relatively stable. In other words, Philippine agricultural development since 1920, has been essentially a process of expanding land under cultivation at a rate approximating the rate of population growth.

During the decade 1910-1919, the Philippines remained a rice deficit country with imports of milled rice equal to 33 per cent of estimated domestic production during the first five years of the decade and to 22 per cent during the second five years. During the decade of the 1920s expansion in the area per capita planted to rice accelerated and dependence upon

imports declined rapidly. Over this decade, imports averaged 3.3 per cent of estimated domestic production. The period of the 1930s was one of slow expansion in the area planted to rice, declining per capita plantings, and slightly reduced dependency upon imports of milled rice which averaged 2.5 per cent of estimated domestic production over this period.

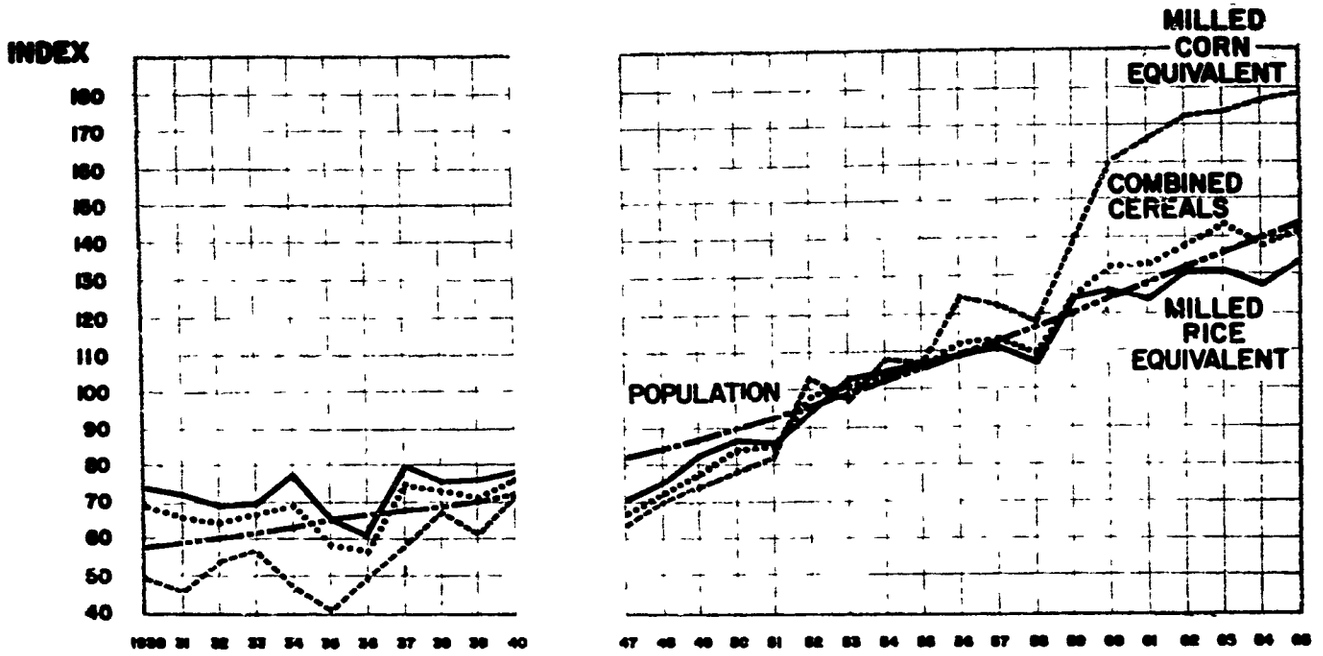
In the case of corn, which occupied about one-third of the area of rice, per capita plantings remained quite stable throughout the 30 years prior to World War II, yields were equally stable, and the Philippines remained self-sufficient in this cereal which provided from one-sixth to one-eighth of the cereal calories absorbed by the population over this period.

The disruption of World War II, produced far-reaching changes in the agricultural sector. Land went out of production during the war and the initial three postwar years through 1948 were years of rehabilitation in which aggregate plantings and production of rice and corn recovered to earlier levels. In the meantime population had continued to increase and the area per capita planted to rice and corn combined remained below prewar levels. The next decade, through 1959, was a period in which the extension of cultivation proceeded faster than population growth and the area per capita planted to cereals slowly climbed until peak prewar levels were attained in crop years 1959 and 1960 Within this basic change, however, there was a fundamental shift in the proportions allocated to the two crops as the share of corn in the area planted to cereals per capita increased until it reached three-fifths of that planted to rice Underlying this change was the extension of cultivation to rougher land less suitable for lowland rice

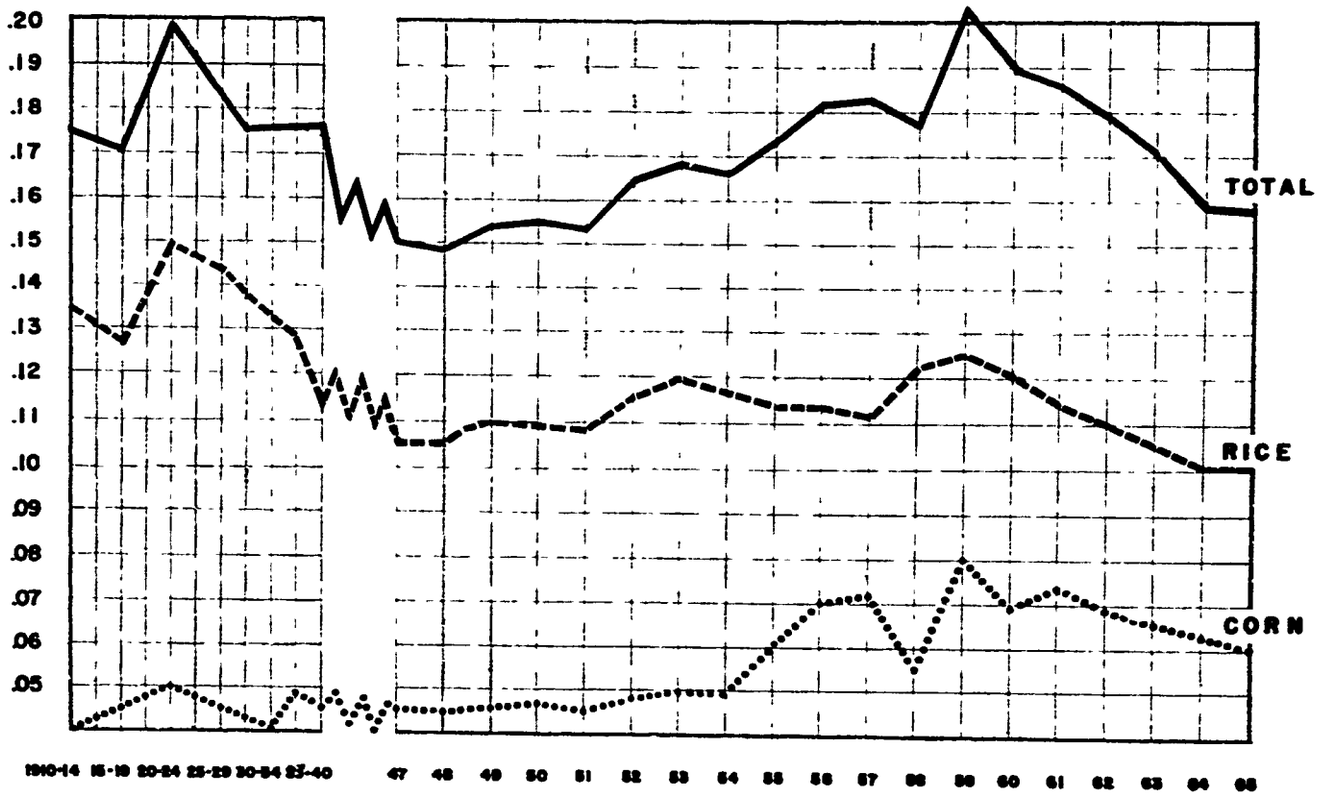
The ominous implications in this process of development as cultivation was extended to marginal lands under conditions of rapid population growth began to appear following 1959. Over the next six years the total area under cultivation (including plantings of second crops) increased by 335,000 hectares, or by four per cent, as compared to the increase in population of 22 per cent. Over this period the area planted to rice and corn declined by 313,000 hectares or by six per cent. On the other hand, plantings of export crops, stimulated by the successive decontrol measures of the late 1950s which culminated in the devaluation of the peso at the beginning of 1962, expanded by 691,000 hectares. In the aggregate, the transfer of land resources from cereals production to export production accounted for approximately half of the expansion in the latter sector. Fortunately, the consequences of the rapid decline in per capita plantings of cereals was eased by significant improvement in yields of both rice and corn plantings and total production of cereals increased although at a rate well below that of population growth.

PHILIPPINES: PRODUCTION OF CEREALS AND POPULATION GROWTH, 1930-1965

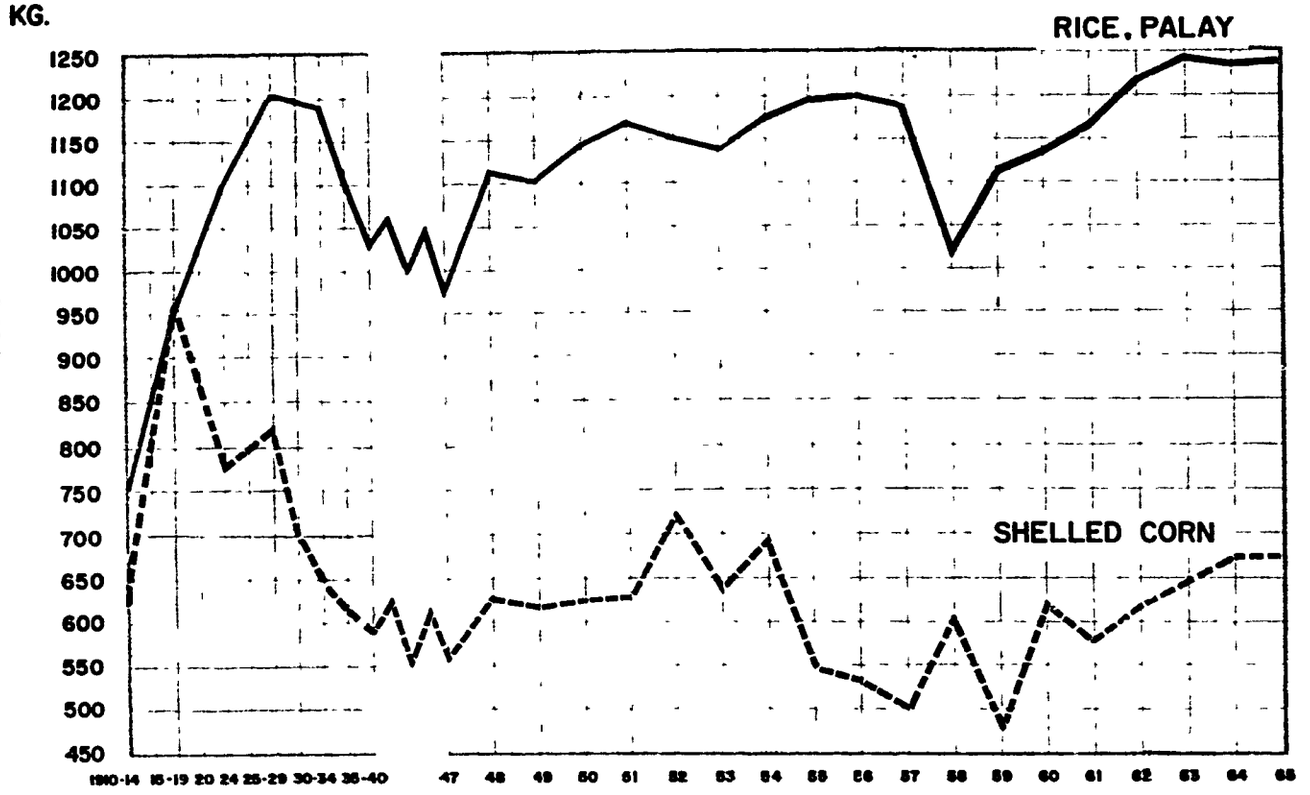
(INDEXES, 1951-'55 = 100)



PHILIPPINES: AREA PER CAPITA PLANTED TO RICE AND CORN, 1910–1965
(HECTARES, CROP YEAR OR AVERAGE FOR PERIOD)



PHILIPPINES: RICE AND CORN YIELDS, 1910-1965
(KG. PER HECTARE, CROP YEAR OR AVERAGE FOR PERIOD)



To summarize; the Philippines over the past half century has experienced a sustained process of agricultural development in which new land was brought under cultivation and the rural population redistributed to frontier areas of land colonization. In the aggregate, the per capita area planted to cereals and production per capita have remained stable. This means, of course, that yields in the aggregate have remained relatively stable. The latter generalization conceals the yield differentials from rice and corn plantings in the established rice-producing areas of Central Luzon as compared to the frontier areas of Mindanao and the Cagayan Valley of Northern Luzon which account for a disproportionate share of the expansion in area planted since World War II. There is clear evidence of yield improvement in the long established and relatively high-yielding rice areas of Luzon over the past decade and a half. This is to say, that the decline in average productivity of land planted to rice which should have resulted from the extension of cultivation to marginal lands in recent years has been offset by the improvement in yields from established relatively well-irrigated areas of fertile alluvial soils.

Table 9

Philippines: **Yields of Palay by Region, 1954-1965** [a]
(MT per hectare harvested)

Crop Year	*National Average*	*Central Luzon*	*Southern and Western Mindanao*	*Cagayan Valley*
1953-54	1.20	1.33	3.18	1.59
54-55	1.21	1.50	1.93	1.30
55-56	1.21	1.50	1.93	1.30
56-57	1.21	1.61	1.36	1.25
57-58	1.02	1.41	1.03	1.08
58-59	1.12	1.51	1.04	1.28
1959-60	1.13	1.39	1.03	1.38
60-61	1.16	1.57	1.13	1.09
61-62	1.23	1.79	1.14	1.21
62-63	1.25	1.82	1.27	1.28
63-64	1.24	1.86	1.26	1.13
64-65	1.25	1.82	1.04	1.21
65-66	1.31	1.98	1.05	1.52

The solution to the problem of providing the cereal calories required by the Philippine population over the next quarter century becomes more clear with each passing year as the margin of cultivation is extended to

a International Rice Research Institute, Department of Agricultural Economics, Compilation of Statistical Data, Rice, Table 6.

less productive land. As population increasingly presses on land resources suitable for cereals production, caloric requirements will have to be met by yield increases.

ABSORPTION OF CEREALS

Rice is consumed directly as milled rice, the availability of which includes domestic production of palay adjusted for wastage, use for seed, and for the recovery rate in milling, plus net imports of milled rice, less net additions to inventories. In estimating direct absorption of milled rice, no allowance for changes in inventories has been made because DANR estimates of stocks of rice, both government and commercial, exist only for the period following 1957. The available statistics, however, provide no evidence of a secular trend, or pattern of instability in stocks which would be of statistical significance in assessing trends in the absorption of cereals (see Table A20).

Over the period 1947-1965, the apparent direct per capita absorption of milled rice varied from a low of 75.6 kg. per capita for the crop year 1946-47 to a high of 91.9 kg. for the crop year 1964-65. Absorption in crop years 1947 and 1948 was low because of the partial recovery of production in the early years following World War II. Absorption in crop year 1964-65 also was affected by special circumstances, namely, the unprecedented import of 600,000 metric tons of rice which was the amount "certified" as the "shortage" of rice in that year. As is well known, it has become a practice of the Philippine Executive to import large amounts of rice in election years to ensure stable and low prices of rice and 1965 was the year of a presidential election. If we eliminate the rehabilitation years 1947-48, and the terminal year 1964-65 from the series, the apparent per capita absorption of milled rice varied from a low of 77.7 kg. to a high of 85.6 kg. and there was no clear tendency for per capita absorption to increase over the postwar period in which per capita real income rose substantially.

Examination of per capita direct absorption of milled rice over the longer period, 1910-1965, reveals that absorption reached a peak in the 1920s and subsequently declined in the 1930s, but throughout the period from 1915 to 1940 absorption remained above levels prevailing after World War II.[2]

In the case of milled corn products, per capita direct absorption (excluding inventory changes) has varied over the period following the war,

2 The decline in milled rice absorption in the postwar period as compared to earlier periods is more apparent than real. The use of commercial milling recovery rates to adjust palay production for loss in milling, introduces an upward bias, the relative importance of which has shifted over the period examined. The proportion of palay production milled mechanically has increased over time and the share prepared by home "pounding" has declined. Upward bias arises because the recovery rates for home pounding average some 15-25 percentage points lower than in mechanical milling. It should be pointed out that adjustment for this factor would contribute to greater stability in per capita absorption of rice over the entire period 1910-1965

from 14.6 kg. to 23.6 kg. with a clear increasing trend. During this period direct absorption of calories in the form of milled corn products averaged one-fifth to one-quarter those obtained from milled rice which dominates the total pattern of cereals absorption. (see Table A12) When we extend the analysis to the prewar period, we find that per capita direct absorption of ground corn products was relatively high during the period 1915-1925. Absorption declined thereafter, and was fairly stable during the 1930s at levels substantially below those prevailing in the postwar period. Because per capita production and absorption of milled corn products fluctuated around a smaller base, they have been less stable than have comparable indexes for milled rice.

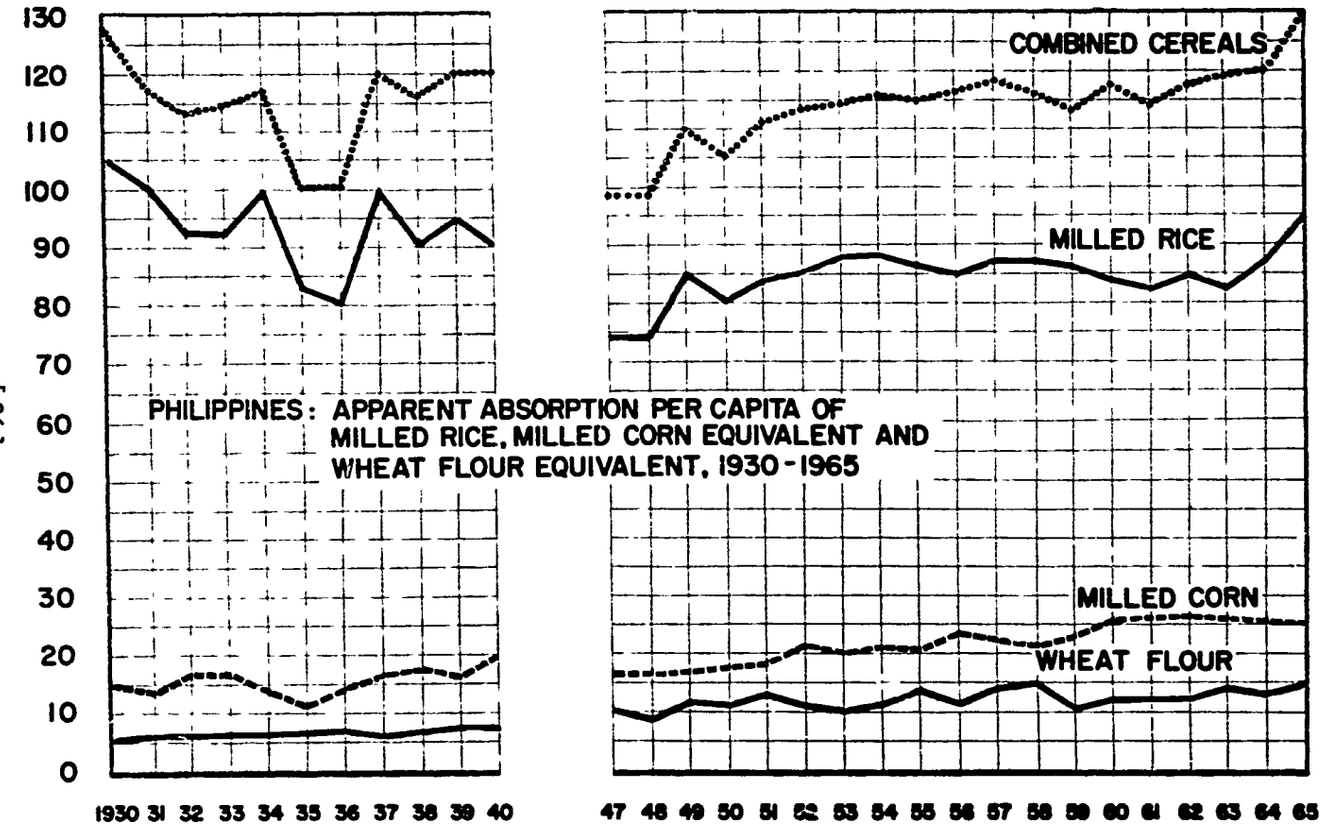
Per capita absorption of wheat flour equivalent (excluding inventory changes) over the postwar period has varied from one-twelfth to one-sixth of milled rice absorption by weight and has been relatively volatile from year-to-year (see Table A12). This instability reflects the relatively small volume of wheat flour absorption and the fact that availability was subject to stringent and variable import controls throughout most of the postwar period. Although wheat flour absorption has been volatile, the trend has been increasing and when the series is extended back to 1910, the increasing trend in absorption is evident throughout the period 1910-1965.

To summarize to this point; Philippine per capita absorption of milled rice over the postwar period has remained somewhat below earlier levels and has displayed basic stability with no increasing trend. On the other hand, per capita absorption of wheat flour and milled corn equivalent have been relatively unstable around an increasing trend. The net effect of these changes, therefore, has been to substitute both milled corn and wheat flour for rice in the diet of the average Filipino.

There remains the problem of combining the three cereals into a single index of per capita cereals—absorption. This was done by combining them by weight, as the caloric content by weight of milled rice, milled corn and wheat flour are virtually identical.[3]

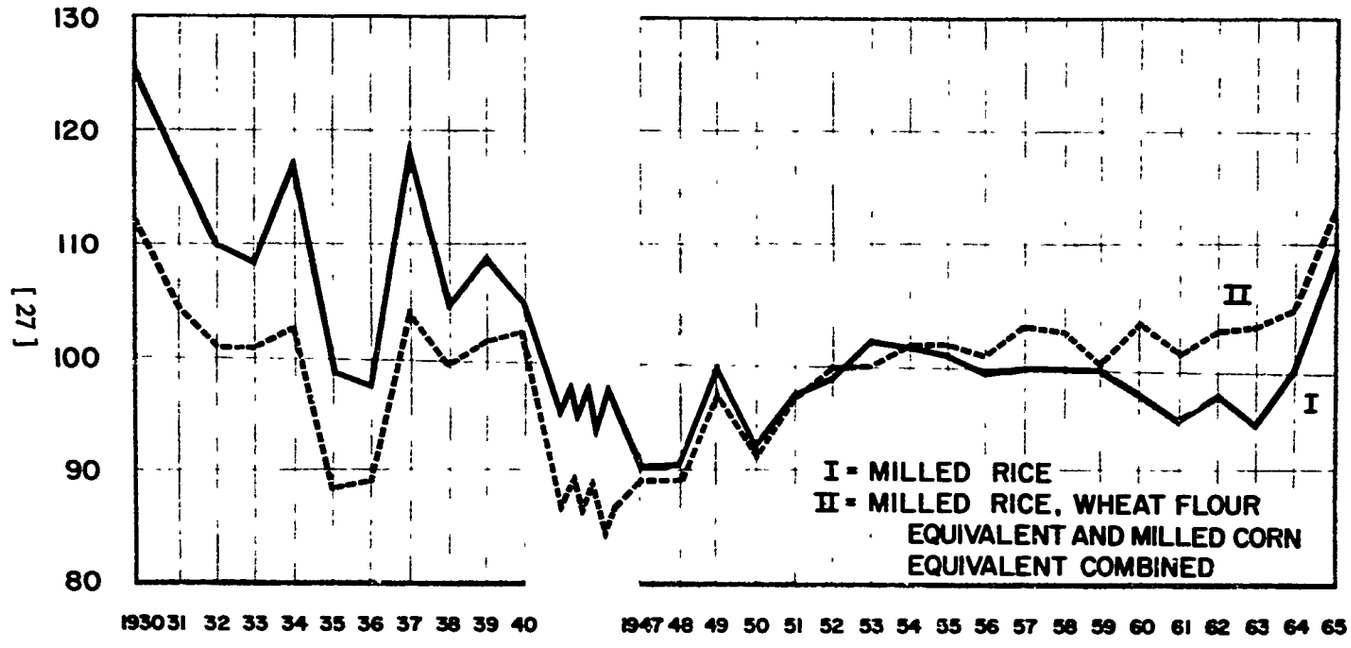
The effect of combining the three cereals is to produce an index of per capita absorption of cereals which is more stable than any one of the component indexes as the decline in postwar absorption of milled rice, as compared to prewar, is offset by the increase in the per capita absorption of milled corn and wheat flour. For the 35 years following 1930 through 1965 (excluding the period of World War II), per capita direct absorption of milled rice, milled corn equivalent and wheat flour equivalent combined per annum varied from a minimum of 98.4 kg. in crop year 1935, to a maximum of 125.4 kg. in 1964-65. Annual per capita absorption, moreover, has been much more stable since World War II than it

3 FAO, **Food Composition Tables for International Comparisons**, Nutritional Studies No 3, 1949. Average caloric content (calories per kilogram) are listed as follows. Rice, milled white, 3,600, corn, whole meal, 3,560, corn, degerminated meal, 3,630, wheat flour, white, low extraction, 3,640.



PHILIPPINES: APPARENT ABSORPTION PER CAPITA OF MILLED RICE, MILLED CORN EQUIVALENT AND WHEAT FLOUR EQUIVALENT, 1930-1965

PHILIPPINES: APPARENT DIRECT ABSORPTION OF CEREALS PER CAPITA, 1930-1965
(INDEXES, 1951-55 = 100)



was in the interwar period. If we eliminate crop year 1965 from the time series of total cereal absorption for the reasons which were discussed earlier, annual per capita absorption of cereals over the postwar period, ranges from a high of 117.8 kg. in crop year 1963 to a low of 99.1 kg. in 1947.

Before leaving analysis of per capita cereals absorption, two issues remain to be considered. First, is the need to identify factors other than population which may have influenced cereals absorption and to assess the direction and significance of the influence of such factors. One such factor is the downward shift in the age composition of the Philippine population as improved infant and child mortality rates and apparent increases in fertility have interacted to increase the proportion of the young, particularly those under 15 years, in the total population. To assess this influence, recommended nutritional standards of cereals absorption were applied to the age and sex distribution of the population for the three census years 1939, 1948, and 1960.[4] This calculation indicates that the reduction in total cereals absorption called for by the declining age composition of the population in 1960 as compared to 1939 is of the order of magnitude of 2.3 per cent.

It should not be concluded, however, that the effect of the declining average age of the Philippine population was to reduce the quantity of cereals demanded and that the effect of this factor was offset by other influences which operated to increase per capita cereals intake, thereby explaining the stability in total absorption. Inasmuch as per capita absorption of cereals in the Philippines remained well below recommended nutritional standards throughout the period 1930-1965, it seems unlikely that the increasing proportion of young in the population had a significant impact on the actual absorption of cereals.

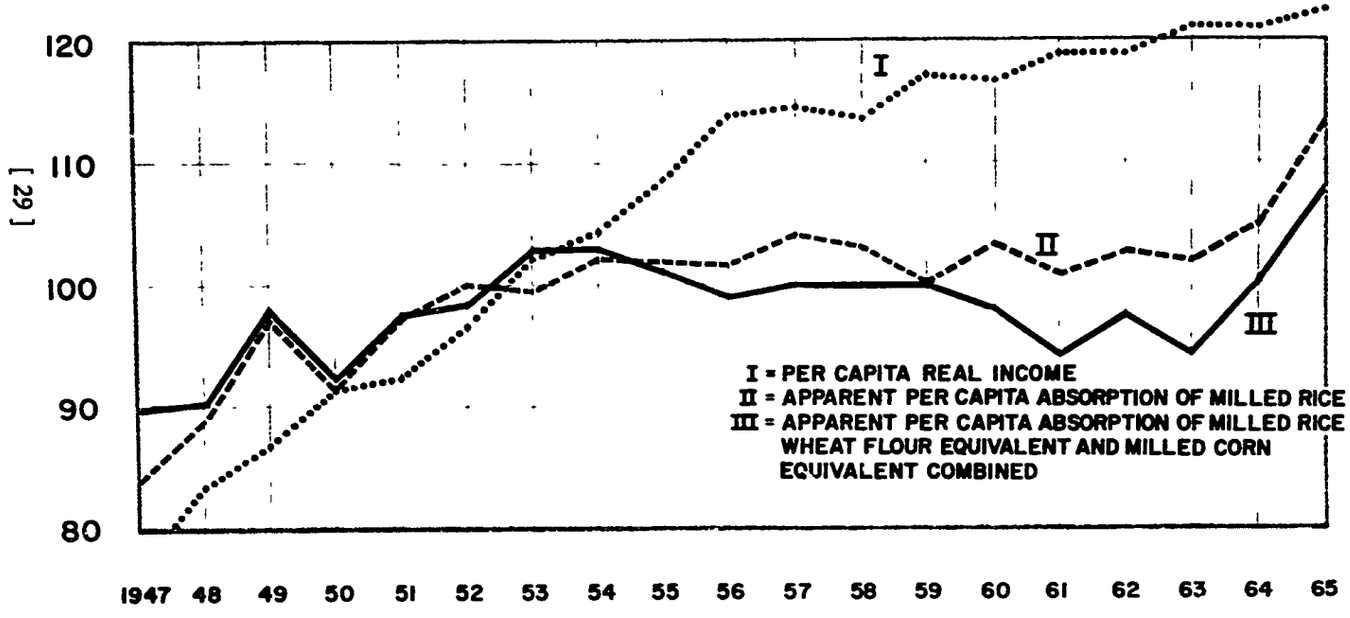
Table 10

Philippines: **Population Distribution by Age Group, Censuses of 1939, 1948, 1960**

	1939		1948		1960	
Age Group	*Per Cent*	*Cumulative Percentage*	*Per Cent*	*Cumulative Percentage*	*Per cent*	*Cumulative Percentage*
Under 5 yrs.	16.3	16.3	15.6	15.6	16.9	16.9
5-14 years	26.8	43.1	28.6	44.2	28.8	45.7
15-24 "	19.9	63.0	19.9	64.1	19.5	65.2
25-34 "	14.1	77.1	13.6	77.7	13.0	78.2
35-44 "	9.2	86.3	9.8	87.5	9.3	87.5
45-65 "	10.2	96.5	9.4	96.9	9.8	97.3
65 yrs. & over ...	3.5	100.0	3.2	100.0	2.7	100.0

4 For recommended nutritional levels of cereals absorption by sex, age, and intensity of physical activity, see **Republic of the Philippines, Food and Nutrition Center, Publication No. 76** (Revised January 30 1963)

PHILIPPINES: PER CAPITA REAL INCOME AND PER CAPITA ABSORPTION OF CEREALS, 1947-1965
(INDEXES, 1951-55 = 100)



Absorption of cereals conceivably has been influenced by changes in per capita real income which had recovered to 1938 levels by 1948[5] and thereafter, through 1965, increased by two-fifths. On the other hand, the two existing studies of income elasticity of Philippine demand for various cereals, conclude that the income elasticity of demand for rice is very low or negative for the three categories of population studied — Manila, other urban, and rural.[6] In the case of corn, the coefficients are negative for all categories;[7] and for wheat flour, positive for all categories.[8] For cereals in the aggregate, the available studies suggest that increase in per capita real income following 1938 exerted a negligible effect on absorption.

More interesting was the shift in the composition of total cereals absorption as corn was substituted for rice in the average diet. This is surprising in view of the persistent observation that Filipinos prefer rice to corn and will shift consumption to rice when real income rises. The available supplies of both cereals were consumed throughout a period in which per capita real income was increasing and in which the price of corn did not decline relative to the price of rice (see Table A21). The explanation for the observed shift from rice to corn lies in basic shifts in the supply conditions for the two cereals. Supplies of corn increased relative to those of rice because the margin of cultivation was extended from alluvial valleys onto rougher land. The rural population was redistributed to the frontier areas and corn absorption increased relative to rice because (a) population increased relatively in the areas where corn was produced and (b) lack of transport and marketing facilities necessitated direct, subsistence consumption.

It should also be remarked that the proportion of corn in total cereals absorption increased although relative prices of corn tended to remain above those for rice (see Table A21). Also interesting is the fact that per capita cereals absorption remained steady over the decade and a half through 1965 in spite of the softness of cereal prices relative to other internal prices.[9] The index of cereal prices remained below the retail price index (Manila) of foodstuffs generally and substantially below the cost of living index (see Table A21).[10]

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5 Marvin E. Goodstein, **The Pace and Pattern of Philippine Economic Growth: 1938, 1948 and 1956**, Cornell Southeast Asia Program Data Paper No. 48, Cornell University, July 1962, p 25

6 AGRECO, **The Philippines Long-Term Projection of Supply and Demand for Selected Agricultural Products**, U S Department of Agriculture, ERS Foreign-34, p 96 and H.L Cook, et al, **Long-Range Requirements for Selected Foods in the Philippines** (International Cooperation Administration, Manila, 1957), p 18. The surveys of household expenditures on which the estimates of income elasticity coefficients in these studies were based, raise legitimate doubts about the value of the estimates.

7 The rapid increase in corn absorption over the postwar period in which per capita real income was increasing can only raise doubts about the usefulness of the estimates of income elasticities.

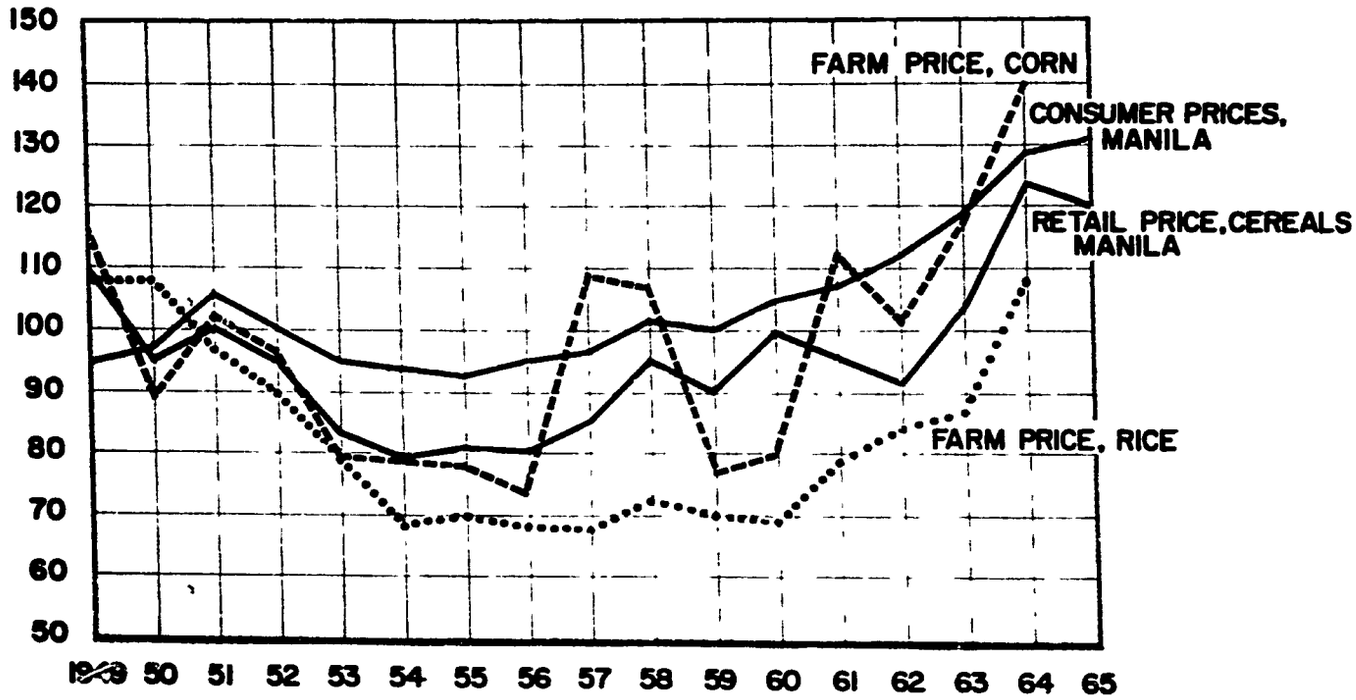
8 Significant rural-urban differences revealed by household budget surveys points up the influence of urbanization in increasing per capita absorption of wheat flour equivalent.

9 See Ruben Trinidad, "A Measurement of the Nation's Output at Constant Prices," **Statistical Reporter** (3), April 1959, pp 23 31

10 During the postwar period, it was Philippine policy to import marginal quantities of rice in order to implement a stable retail price policy For analysis of Philippine agricultural price policies, see U N, ECAFE, **Food and Agricultural Price Policies**, pp. 95-100.

PHILIPPINES: POSTWAR MOVEMENTS IN RELATIVE PRICES OF CEREALS AND CONSUMER PRICES GENERALLY

(INDEXES, 1949 -52 = 100)



No attempt has been made to quantify the influence on cereals absorption of the declining average age of the Philippine population, the increase in per capita real income, or the postwar softness of cereals prices relative to other items in the cost of living. We consider that the negative effect of the first factor was small and that it was offset by the small positive effect of the third factor and that the influence of real income was small and of indeterminate direction. The influence of (a) increasing urbanization and (b) the changing proportions in which land was allocated to alternative uses as cultivation was extended had significant effect on the composition of cereals absorption but little impact on per capita intake.[11]

A second issue to be raised concerns the discrepancies between the production estimates of the DANR for crop years 1960, 1948 and 1939 and production for those years reported in the agricultural censuses. In the case of rice production, the DANR estimates exceeded those of the censuses in each year and by a relatively stable ratio. In 1960, the DANR estimate was 115 per cent of production reported in the census, in 1948, 116 per cent, and in 1939, 125 per cent. In the case of corn production, DANR estimates were biased downward in 1948 and 1960 and upward in 1939. In 1960, the DANR estimate was 81 per cent of production reported in the census and in 1948, 80 per cent. The ratio of upward bias in 1939 is smaller, but has not been calculated as production reported by the census is distributed between shelled corn and ears of green corn.

If the DANR estimates of rice production for the years 1930-1940 and 1947-1965, are adjusted by the average ratio of their downward bias in the three census years, and if DANR corn production estimates for the years 1947-1965, are adjusted by the average ratio of their downward bias in the two postwar census years, the net effect is to reduce estimates of per capita absorption of cereals combined by 4-7 per cent. The calculated ratio of upward bias in the DANR rice and corn estimates combined, declines over the postwar period as corn was substituted for wheat in the Filipino diet.

If the census figures accurately reflect persistent bias in the DANR estimates, the projections of cereals requirements in the future will be understated in proportion to the net upward bias in the divergent rice and corn production estimates of the DANR. Alternative projections using adjusted absorption estimates have not been made although adjusted estimates of production and absorption are presented in appendix tables A14-A18.

PROJECTION OF RICE REQUIREMENTS

Making projections is at best precarious, and the issue is complicated in the case of Philippine rice requirements by the considerable and uncertain variation possible over the next 20 years in factors which will affect rice consumption. Therefore, two projections are presented; one encom-

11 Another related issue not treated in this study is the absorption of cereal substitutes such as sweet potatoes and cassava which contribute significantly to the caloric intake of the Philippine population.

passing alternative "low" estimates of rice requirements and a second which accommodates alternative "high" estimates.

The basic factor influencing rice requirements in the future will be population growth. On the basis of an assumed moderate decline in fertility (and mortality), the most recent projections of Philippine population anticipate 70,536,000 people living on the islands by 1990. Alternatively, if fertility remains at the rate of 1960-65 (and mortality declines moderately) the population will reach 77,721,000 by 1990.[12] One reason for making two sets of estimates of rice requirements is to allow for these alternative sets of demographic assumptions. More basic in explaining the divergent projections of rice requirements, however, are the alternative assumptions of per capita cerals absorption and its rice component.

In the *Low Rice Projection,* which incorporates the lower estimate of population in 1990, we assume that (a) per capita direct absorption of cereals, which has remained remarkably stable since 1930, will be maintained in the future at the average annual rate sustained from 1949 through 1964 and (b) the proportion of rice absorption in total cereals absorption which prevailed during 1949-1964 will continue in the future. In other words, we assume that annual per capita absorption of cereals in the future will be 112 kg., of which 83 kg will be provided by milled rice. The projection also provides for the elimination of rice imports by crop year 1970 and the maintenance of rice self-sufficiency thereafter.

We consider the *Low Projection* described above to be a conservative minimum estimate of future rice requirements because of (a) factors which will tend to lead to the substitution of rice for other cereals in future absorption and (b) factors which will tend to increase per capita cereals absorption.

First, yield increases in rice production are expected to be more substantial than those presently anticipated from corn plantings. Current optimism about the future of Philippine rice yields arises in the research results of the International Rice Research Institute and other institutions, including the Bureau of Plant Industry. In view of the gap between recommended nutritional levels and current rates of cereals absorption, increases in rice production are likely to be consumed directly. Moreover, to the extent that rice production expands more rapidly than the availability of other cereals, relative price changes may occur which will act to reverse the tendency, evident over the postwar period, for other cereals to be substituted for rice in total cereals absorption.

Second, and more important, is the pressure on rice supplies which is likely to arise as the availability of milled corn and wheat flour for

12 F. W. Lorimer, "Analysis and Projections of the Population of the Philippines," in **First Conference on Population** (Proceedings of the Conference sponsored by the Population Institute of the University of the Philippines, Quezon City, 1966), p. 301, adjusted to June 30 by interpolation.

direct consumption tend to lag behind population growth in the future. Implicit in our *Low Projection* of future rice requirements, is the expectation that per capita absorption of milled corn and wheat flour combined will be maintained at average levels prevailing from 1949 through 1964. This requirement can be met by some combination of yield increases in corn production, expansion in the area planted to corn, and increased imports of corn and/or wheat flour equivalent. The changes required to maintain per capita absorption of milled corn and wheat flour obviously are formidable. Expansion in corn plantings will be subject to limits on suitable land and the pressures to shift resources to rice production as yield "breakthroughs" improve the returns to land planted to rice relative to its use for corn production. The postwar increase in corn supply has come from expansion in the area cultivated whereas in the future the burden will have to fall primarily on yield increases which currently are not in sight, at least in the magnitude required to maintain per capita absorption.

The prospects of maintaining per capita corn and wheat flour absorption through imports are no more promising. Pressures on foreign exchange earnings are heavy at present and are unlikely to be moderated in the future.[13]

In addition to supply factors affecting the relative availability of rice, corn and wheat so as to increase the share of milled rice in total direct cereals absorption there are a number of demand factors which, in the future, may result in increased per capita absorption of cereals including milled rice. There are good reasons for believing that the stability in per capita absorption of rice since 1949 has reflected supply limitations rather than demand behavior. Expansion in cereals output in the postwar period has been constrained by the necessity of turning to less productive land and, beginning in the 1960s, by the diversion of land to export crops. Moreover, although the supply of rice has been augmented by imports, the magnitude of these has been determined by administrative decision rather than by market demand, and there has been little carry-over from one year to the next.

Under conditions where supply were less constrained, several demand factors leading to an increase in per capita rice consumption would be permitted freer play. One is the increase in the population of the areas in which rice is the main cereal of the diet relative to the population of the corn areas. Between 1948 and 1960 the share of the Visayas (the major corn eating area) in the total population declined from 35.0 per

13 To provide wheat necessary for per capita absorption of wheat flour equivalent in 1990 of 9.9 kg., the average level sustained during the five years 1961-1965, will require wheat grain imports totaling 966,000 M.T. The foreign exchange required for estimated imports in 1990, would be $64 million as compared to $28 million in 1965 (wheat imports valued using unit value, f.o.b., of wheat imports in 1965).

cent to 29.9 per cent.[14] There is little reason to expect this trend to be reversed in the future given the pressures on land in that part of the Philippines and the resulting incentive to migrate. Similarly, to the extent that fertility and adult mortality decline, the age structure of the population will shift upward in the direction of those having higher caloric requirements.

A number of additional forces can be identified which will act to increase per capita rice consumption although they are likely to be of negligible importance in the aggregate. First, is the possibility of a more equal distribution of income which will increase the share going to those whose income elasticity of demand for rice is higher. Second, is the possibility of changes in the occupational structure of the population to increase non-agricultural activity involving more intensive labor and thus greater nutritional demands. Third, is the possibility of greater per capita indirect absorption of cereals in the form of feed for livestock and poultry as per capita real income rises in the future. To the extent that this occurs, particularly the diversion of corn to feed uses, pressures will arise to maintain direct cereals absorption through increased consumption of rice and/or wheat flour.

The last factor listed above may be offset by increased supplies of sorghums and other animal feeds. Promising techniques for second season production of new crops in rotation with rice are being developed and, as they spread through the country and output of such crops increase, corn supplies may be released to replace rice in direct human consumption. Still another influence acting to moderate demands on rice supplies is the likelihood of more rapid population growth in urban areas such as Metropolitan Manila, where per capita rice consumption is lower than in the rural areas.

A final factor relevant to assessment of future rice requirements is the income elasticity of demand. On the basis of the evidence cited earlier, it would seem that, in the aggregate, the income elasticity of demand for rice in the Philippines is virtually zero, or perhaps slightly negative. Alternatively, if the stability of per capita rice absorption in the postwar period is explained largely by supply factors, as has been suggested, then more rice would have been consumed at the then-existing prices had it been available. If this was the case, the pressure of rising per capita real income must be accorded at least some positive role in projecting future rice requirements.

We have confined ourselves to identifying the diverse influences which may exert significant effect on absorption of rice and other cereals

14 Census of the Philippines, 1960. Population and Housing, Vol. II: Summary Report. (Part I: "Population"), Table 2

in the future. The net effect of these influences is not clear and attempts to quantify their significance do not promise to yield reliable results.

To encompass the various factors discussed above which may operate in the future to increase per capita absorption of rice, an alternative *High Rice Projection* of future rice requirements is presented. This projection assumes that (a) the rate of per capita cereals absorption increases by 1990 from the annual average of 112 kg. sustained during 1949-1964 to 120 kg., the recommended nutritional intake;[15] (b) the entire increase in total cereals absorption is met by increased direct absorption of milled rice, and (c) rice imports are eliminated by mid-1970. We further assume that current levels of fertility will persist in conjunction with slightly lower mortality, resulting in the higher of the alternative paths of population growth.

Rapid substitution of rice for other cereals in the diet of the average Filipino is built into the *High Rice Projection,* as we have assumed that total absorption of cereals other than rice remains constant while population is growing rapidly. Over the period of the projection to 1990, annual per capita milled rice absorption increases by 23 kg., to 106 kg., or by 28 per cent. Over this period, annual per capita absorption of milled corn equivalent and wheat flour equivalent combined declines from 29 kg., to 14 kg.

We consider our *High Projection* of rice requirements to be "conservative" in the sense that it almost certainly will include all possible increments in per capita absorption of milled rice. It is likely that increases in yields will characterize corn production in the future. Similarly, additional land will be brought under cultivation and a relatively large share of such land is likely to be planted to corn. These factors will tend to increase production and support higher levels of total direct absorption of milled corn which will moderate pressures to maintain per capita cereals absorption by consuming more rice.

On the side of imports, it is likely that net imports of wheat flour (and corn) will increase as export earnings and foreign exchange expenditures continue their postwar expansion.

It is worth noting that the *High Rice Projection* will accommodate extreme values of income elasticity of demand for rice and rather high coefficients for cereals combined. For example, if per capita real income should increase over the period to 1990 at the rate of one per cent per year, and if other factors affecting absorption remain unchanged, the im-

15 To avoid unrealistically large increases in required palay production in the initial years of the period covered by the High Rice Projection, we assume that the required increase in annual per capita absorption of cereals is postponed until the mid-1970s. The required increase in annual per capita absorption of cereals necessary to achieve the recommended nutritional level occurs in 2 kg increments every five years beginning in 1975.

plicit average income elasticity of demand for cereals combined for the period of the projection would be .25. If real income should increase by one-and-a-half per cent, the implicit average income elasticity of demand for cereals combined would be .16. Since annual per capita absorption of rice increases from 83 kg. at the beginning of the projection period to 106 kg. in 1990, the implicit average income elasticity coefficients for rice alone are unrealistically high; .62 if per capita real income increases by 1.5 per cent year and .98 if the rate of increase is 1.0 per cent.

Under the *Low Rice Projection,* the Philippines will require 9.7 million metric tons of palay in 1990, or 246 per cent of the production of 4.0 million tons in the 1965 crop year. Under the *High Rice Projection,* rice requirements will total 13.7 million metric tons of palay in 1990, or 346 per cent of palay production in 1965. The alternative estimates of population growth account for 24.9 per cent of the difference between the two projections of rice requirements in 1990 and 75.1 per cent is explained by the increase in milled rice absorption in the *High Rice Projection.*[16] Of the latter increment, 25.9 percentage points are due to the increment of cereals absorption necessary to reach recommended nutritional levels which is built into the *High Rice Projection*

Assuming rice imports are to be eliminated by 1970, and do not reappear, the "Low" and "High" Projections call for increases in average annual palay production of 245,000 and 265,000 metric tons respectively between 1965 and 1970, or from six to six-and-a-half per cent of production in 1965. From 1970, the average annual increments in palay production necessary to the alternative projections diverge at increasing rates, reaching 267,000 metric tons for the *Low Projection* in the period 1985-1990 and 557,000 metric tons for the *High Projection.*[17]

The divergent projections of future rice requirements provide a margin for error which almost certainly will bracket levels of cereals absorption which are likely to materialize and, at the same time, are consistent with maintenance of social and political stability in the Philippines. The *Low Projection,* in and of itself, represents a formidable challenge to the agricultural economy but one which is clearly necessary and one which is also within Philippine capabilities.

After prolonged sifting of the evidence we predict that Philippine per capita cereals absorption in 1990 will be closer to the lower of the alternative levels projected for that year.

16 Necessary to maintain 1949-1964 levels of combined cereals absorption in the absence of any increase in total absorption of milled corn and wheat flour.

17 The time series for the Low Projection shows a decline in the required average annual increment in production after the elimination of imports in 1970 followed by a rise.

PHILIPPINES: "HIGH" AND "LOW" PROJECTIONS OF PALAY PRODUCTION REQUIRED THROUGH 1990
(MILLION METRIC TONS)

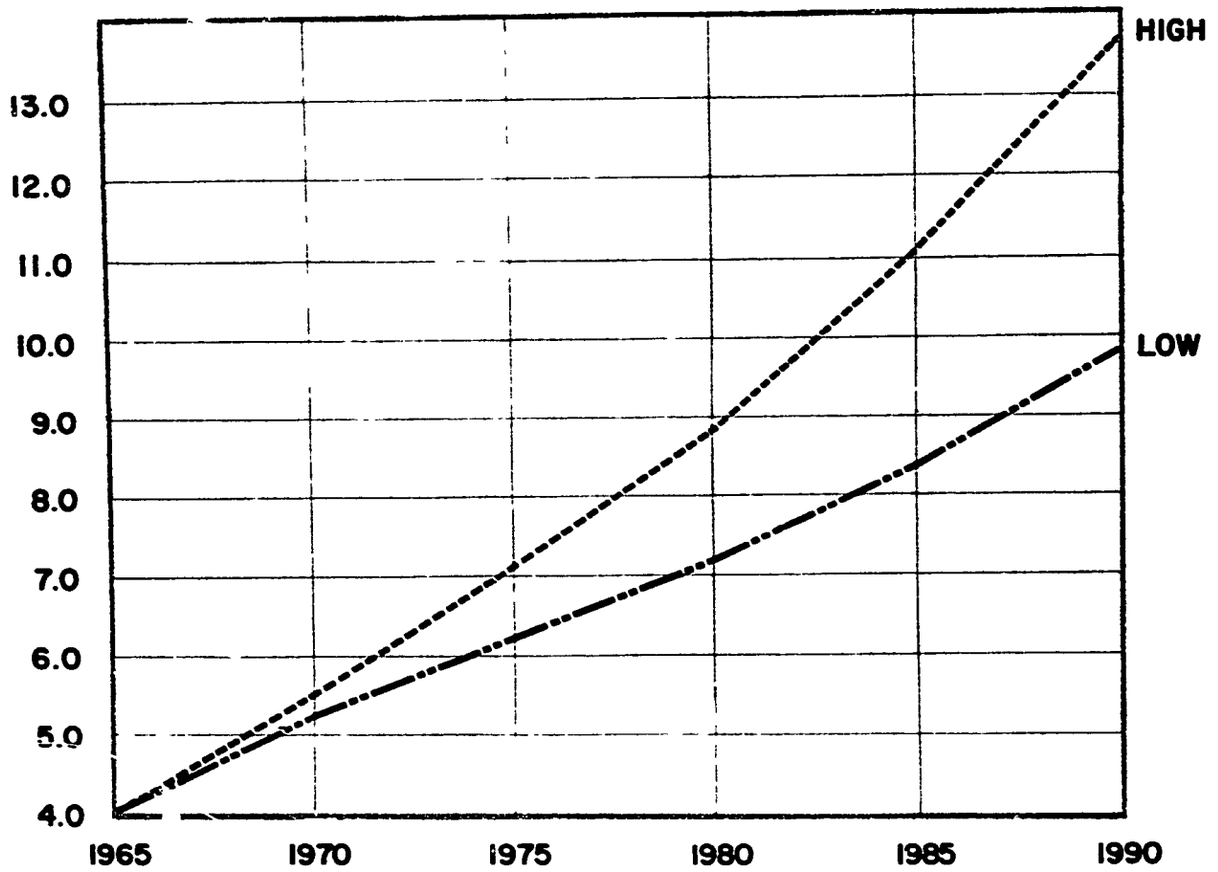


Table 11

Philippines: **"Low" Projection of Rice Requirements, 1970-1990**

	(1)	(2)	(3)		(4))	(5)
	Estimated Population (As of June 30)[a]	*Projected Aggregate Milled Rice Requirement*[b]	*Projected Aggregate Palay Production Required*[c]		*Increment in Palay Production Required Over Average Annual Output of Palay, 1964-1966*	*Average Annual Increment in Palay Production Required*
Year	000	MT	MT	Index 1964-66 = 100	MT	MT
1970	37,852	3,142,000	5,197,000	130.9	1,227,000	245,000[d]
1975	44,397	3,685,000	6,096,000	153.6	2,126,000	180,000
1980	52,016	4,317,000	7,142,000	179.9	3,172,000	209,000
1985	60,820	5,048,000	8,351,000	210.4	4,381,000	242,000
1990	70,536	5,854.000	9,685,000	246.0	5,715,000	267,000

a F W Lorimer, "Analysis and Projections of the Population of the Philippines," in **First Conference on Population** (Proceedings of the Conference sponsored by the Population Institute of the University of the Philippines, Quezon City, 1966), p 301, (Hypothesis C) Lorimer's estimates, which are as of February 15, have been adjusted to mid-year by interpolation.

b Col (1) multiplied by 83.0 kg, which is the average apparent per capita direct absorption of milled rice during 1949-64 (For the underlying data see Appendix Table A6

c Metric tonnage equal to Col. (3) divided by O 6045. (For derivation of this conversion factor, see note b, Table A6 Estimated average annual palay production for crop years 1964-1966 equalled 3,940,000 tons

d Refers to 1965-70 average

PHILIPPINES: "HIGH" AND "LOW" PROJECTIONS OF AVERAGE ANNUAL INCREMENTS IN PALAY PRODUCTION REQUIRED FOR FIVE-YEAR PERIODS THROUGH 1990

(000 METRIC TONS)

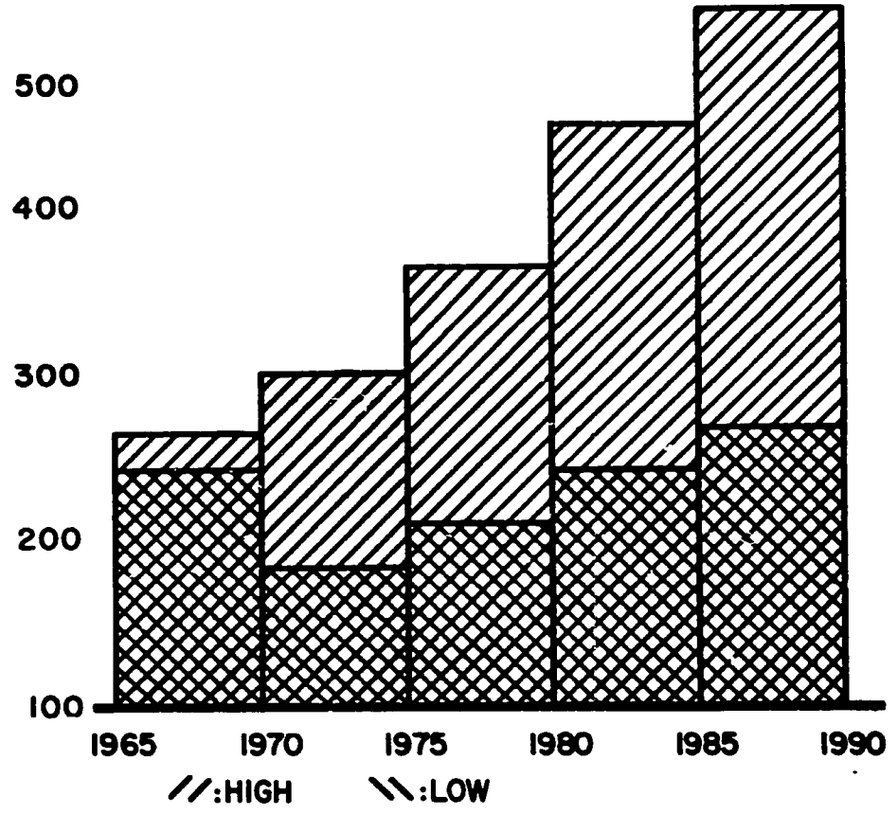


Table 12

Philippines: **"High" Projection of Rice Requirements, 1970-1990**

Year	(1) Estimated Population (As of June 30)[a] 000	(2) Projected Aggregate Cereal Requirement[b] MT	(3) Projected Aggregate Milled Rice Requirements[c] MT	(4) Projected Aggregate Palay Production Required[d] MT	Index 1964-66=100	(5) Increment in Palay Production Required Over Average Annual Output of Palay, 1964-1966 MT	(6) Average Annual Increment in Palay Production Required MT
1970	38,162	4,274,000	3,200,000	5,294,000	133.4	1,324,000	265,000[e]
1975	45,372	5,172,000	4,099,000	6,780,000	170.8	2,810,000	297,000
1980	54,138	6,280,000	5,206,000	8,613,000	217.0	4,643,000	366,000
1985	64,783	7,644,000	6,571,000	10,870,000	273.8	6,900,000	451,000
1990	77,721	9,327,000	8,253,000	13,652,000	346.0	9,682,000	557,000

a Lorimer, p 301 (Hypothesis A) adjusted to mid-year
b For 1970, Col (1) multiplied by 112 0 Kg, which is the average apparent per capita direct absorption of milled rice, wheat flour equivalent and milled corn equivalent combined during 1949-64 (For the underlying data, see Appendix Tables A12 and A13 Starting with 1975, it is assumed that the per cereal requirement increases by 2 0 Kg every five years and that in 1990 the intake equals the recommended nutritional level per capita of 120.0 Kg
c Col (2) minus the apparent aggregate direct absorption of wheat flour equivalent and milled corn equivalent combined for 1965, which amounted to 1,073,687 metric tons (See Appendix Tables A8 and A10.)
d Metric tonnage equal to Col (3) divided by 0.6045 (For derivation of this conversion factor, see Note b, Table A6). Estimated average annual palay production for crop years 1964-1966 equalled 3,940,000 tons.
e Refers to 1965-70 average

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Table A1

Philippines: **Population, 1910-1965**[a]
(Mid-year)

Year	*Population* (000)	*Year*	*Population* (000)
1910	8,220	1935	14,731
1911	8,387	1936	15,084
1912	8,576	1937	15,445
1913	8,786	1938	15,814
1914	9,016	1939	16,000
		1940	16,460
1915	9,269		
1916	9,542	1947	17,786
1917	9,836	1948	19,144
1918	10,314	1949	19,674
1919	10,324	1950	20,275
1920	10,445	1951	20,894
1921	10,673	1952	21,533
1922	10,908	1953	22,191
1923	11,152	1954	22,869
1924	11,405	1955	23,568
1925	11,666	1956	24,288
1926	11,935	1957	25,030
1927	12,212	1958	25,795
1928	12,498	1959	26,584
1929	12,792	1960	27,410
1930	13,094	1961	28,313
1931	13,405	1962	29,257
1932	13,724	1963	30,241
1933	14,051	1964	31,270
1934	14,387	1965	32,345

a Population censuses 1918, 1939, 1948 and 1960. Other entries are estimates of Bureau of Census and Statistics.

Table A2

Philippines: **Real Income and Real Consumption Expenditures 1947-65** [a]

(1955 prices)

Year	*National Income* (₱ Million)	*Private Consumption* (₱ Million)	*Per Capita Income* [b] (₱)	Index 1951-55=100	*Per Capita Private Consumption Expenditures* [b] (₱)	Index 1951-55=100
1947	4,341	4,246	231	77.0	226	76.6
1948	4,806	4,521	251	83.7	236	80.0
1949	5,106	5,250	260	86.7	267	90.5
1950	5,567	5,137	275	91.7	253	85.8
1951	5,788	5,667	277	92.3	271	91.9
1952	6,211	6,195	288	96.0	288	97.6
1953	6,734	6,569	303	101.0	296	100.3
1954	7,060	6,884	309	103.0	301	102.0
1955	7,624	7,501	323	107.7	318	107.8
1956	8,293	7,666	341	113.7	316	107.1
1957	8,550	8,156	342	114.0	326	110.5
1958	8,766	8,317	340	113.3	322	109.2
1959	9,438	8,778	350	116.7	326	110.5
1960	9,519	9,092	350	116.8	327	110.8
1961	10,090	7,362	356	118.7	331	112.2
1962	10,411	9,844	356	118.7	336	113.9
1963	10,933	9,674	362	120.7	319	108.1
1964	11,301	9,722	362	120.7	322	109.2
1965	11,872	10,687	367	122.3	330	111.9

a For 1947-1956, see Ruben F. Trinidad, "A Measurement of the Nation's Output at Constant Prices", **Statistical Reporter** (3), April 1959, pp. 23-31 For subsequent years, see Philippine National Accounts, published in the April issue of **The Statistical Reporter**. Note that the latest revisions of the National Accounts were used for the successive years.

b For population estimates see Table A1

Table A3

Philippines: **Area Under Cultivation, 1930-1965** [a]
(000 Hectares)

Crop Year	*Rice*	*Corn*	*Export Crops* [b]
1930	1,813	517	1,386
1931	1,791	524	1,376
1932	1,782	577	1,364
1933	1,854	629	1,391
1934	2,004	539	1,428
1935	1,964	567	1,379
1936	2,049	685	1,427
1937	2,061	659	1,472
1938	1,912	703	1,454
1939	1,965	817	1,631
1940	2,080	913	1,645
1947	1,880	812	1,329
1948	2,026	826	1,375
1949	2,164	866	1,434
1950	2,214	909	1,467
1951	2,252	953	1,530
1952	2,466	1,044	1,524
1953	2,655	1,101	1,539
1954	2,645	1,120	1,556
1955	2,656	1,388	1,544
1956	2,743	1,675	1,541
1957	2,768	1,787	1,555
1958	3,154	1,381	1,526
1959	3,329	2,107	1,559
1960	3,307	1,846	1,587
1961	3,198	2,046	1,716
1962	3,179	2,016	1,847
1963	3,161	1,950	1,957
1964	3,088	1,898	2,087
1965	3,200	1,923	2,250

a DANR estimates.
b For years 1930-37 and 1939, plantings include coconuts, sugar cane, abaca and tobacco, but do not include minor crops.

Table A4

Philippines: **Area Planted to Rice and Yields, 1910-1965** [a]

Crop Year of Average for Period	*Hectares*	Rice Area *Hectares Per Capita* [b]	*Yields, Palay Kg./Hectare*	*Area Planted to Rice and Corn Hectares Per Capita*
1910-14	1,140,194	.133	757	.173
1915-19	1,251,342	.127	960	.171
1920-24	1,650,636	.151	1,102	.201
1925-29	1,770,180	.145	1,199	.188
1930-34	1,848,558	.135	1,188	.175
1935-40	2,005,240	.129	1,104	.177
1946-47	1,879,600	.106	984	.151
1947-48	2,026,380	.106	1,111	.149
1948-49	2,164,100	.110	1,106	.154
1949-50	2,214,000	.109	1,151	.154
1950-51	2,251,800	.108	1,177	.153
1951-52	2,466,040	.115	1,162	.163
1952-53	2,655,000	.120	1,148	.169
1953-54	2,645,440	.116	1,184	.165
1954-55	2,655,540	.113	1,203	.172
1955-56	2,742,480	.113	1,206	.182
1956-57	2,768,120	.111	1,194	.182
1957-58	3,154,100	.122	1,016	.176
1958-59	3,329,410	.125	1,107	.204
1959-60	3,306,460	.121	1,131	.188
1960-61	3,197,750	.113	1,159	.185
1961-62	3,179,190	.109	1,230	.178
1962-63	3,161,320	.105	1,255	.169
1963-64	3,088,000	.099	1,244	.159
1964-65	3,200,000	.099	1,248	.158

a DANR estimates from International Rice Research Institute, Department of Agricultural Economics, Compilation of Statistical Data, Rice, Table 3

b For population estimates, see Table A1 All conversions of crop year values to per capita basis use mid-year population estimates The rationale for this procedure is that the output and inputs into agriculture during the crop year support the population existing at the end of the crop year

Table A5

Philippines: Area Planted to Corn and Yields, 1910-1965 [a]

Crop Year of Average for Period	Corn Area *Hectares*	*Hectares Per Capita* [b]	*Yields, Shelled Corn Kg./Hectare*
1910-1914	347,242	.040	642
1915-1919	430,642	.044	969
1920-1924	544,178	0.50	774
1925-1929	530,210	.043	816
1930-1934	557,368	.041	667
1935-1940	723,992	.046	605
1946-1947	812,300	.046	581
1947-1948	826,490	.043	628
1948-1949	866,200	.044	617
1949-1950	909,000	.045	631
1950-1951	953,170	.046	633
1951-1952	1,043,970	.048	730
1952-1953	1,101,250	.050	644
1953-1954	1,120,000	.049	697
1954-1955	1,388,000	.059	555
1955-1956	1,675,000	.069	542
1956-1957	1,787,000	.071	501
1957-1958	1,381,000	.054	617
1958-1959	2,107,000	.079	482
1959-1960	1,846,000	.067	631
1960-1961	2,046,000	.072	591
1961-1962	2,016,000	.069	628
1962-1963	1,950,000	.064	653
1963-1964	1,898,000	.061	681
1964-1965	1,923,000	059	683

a DANR estimates, For production, area planted and yield series, 1910-1954, see DANR, **Philippine Agricultural Statistics**, Vol. I (Manila, 1955). Production and area planted series for subsequent years from IRRI, **Compilation**, op. cit., Tables 1 and 2.
b For population estimates, see Table AI.

Table A6

Philippines: **Production, Net Imports and Apparent Absorption of Milled Rice, 1946-1965**

Crop Year	*Production of Palay* [a] MT	*Production Milled Rice Equivalent* [b] MT	*Net Imports Milled Rice Equivalent* [c] MT	*Availability Milled Rice* [d] MT	*Apparent Per Capita Absorption of Milled Rice* [e] Kg
1946-47	2,088,240	1,262,341	83,880	1,345,221	75.6
47-48	2,240,853	1,354,596	96,656	1,451,252	75.8
48-49	2,491,289	1,505,984	135,576	1,641,560	83.4
49-50	2,606,058	1,575,362	neg.	1,575,362	77.7
1950-51	2,616,390	1,581,608	129,864	1,711,472	81.9
51-52	2,830,745	1,711,186	63,112	1,774,298	82.4
52-53	3,144,156	1,900,641	neg.	1,900,641	85.6
53-54	3,182,432	1,923,780	42,616	1,966,396	86.0
54-55	3,201,521	1,935,319	63,504	1,998,823	84.8
1955-56	3,272,939	1,978,492	42,392	2,020,884	83.2
56-57	3,345,543	2,022,381	77,896	2,100,277	83.9
57-58	3,203,093	1,936,270	230,664	2,166,934	84.0
58-59	3,684.061	2,227,015	6,496	2,233,511	84.0
59-60	3,739,059	2,260,261	neg.	2,260,261	82.5
1960-61	3,704,311	2,239,256	9,200	2,248,456	79.4
61-62	3,909,586	2,363,345	30,560	2,393,905	81.8
62-63	3,966,507	2,397,753	4	2,397,757	79.3
63-64	3,842,398	2,322,730	298,858	2,621,588	83.8
64-65	3,991,984	2,413,154	559,560	2,972,714	91.9

a DANR estmiates from IRRI, **Compilation, Op. cit.**, Table 3.
b It is assumed that 7% of palay production is absorbed in wastage and used as seed. For the 93% of palay which is milled, the recovery rate is assumed to be 65%. To obtain estimated production of milled rice, multiply palay production by factor. .6045 (.93 x .65).
c Bureau of Census and Statistics, **Foreign Trade Statistics of the Philippines.** Calendar year. Second year listed under crop year.
d Production of milled rice equivalent plus net imports of milled rice.
e It is assumed that milled rice availability is consumed directly.

Table A7

Philippines: **Production, Imports and Apparent Absorption of Milled Rice 1910-1940**

Crop Year or Average for Period	*Production of Palay*[a] MT	*Production of Milled Rice*[b] MT	*Imports of Milled Rice*[c] MT	*Apparent Direct Absorption of Milled Rice* MT	*Apparent Direct Absorption of Milled Rice Per Capita* Kg
1910-1914	864,577	522,637	172,983	695,620	80.9
1915-1919	1,201,647	726,396	157,807	884,203	89.7
1920-1924	1,818,760	1,099,440	67,032	1,166,472	106.8
1925-1929	2,123,202	1,283,476	65,968	1,349,444	110.4
1930	2,269,824	1,372,109	10,528	1,382,637	105.6
1931	2,184,173	1,320,333	11,592	1,331,925	99.4
1932	2,080,769	1,257,825	12,880	1,270,705	92.6
1933	2,105,092	1,272,528	19,488	1,292,016	91.9
1934	2,332,053	1,409,726	1,176	1,410,902	98.1
1935	2,016,304	1,218,856	4,648	1,223,504	83.1
1936	1,857,662	1,122,957	91,112	1,214,069	80.5
1937	2,420,692	1,463,308	71,960	1,535,268	99.4
1938	2,303,189	1,392,278	9,072	1,401,350	88.6
1939	2,296,511	1,388,241	85,064	1,473,305	92.1
1940	2,362,746	1,428,280	38,136	1,466,416	89.1

a DANR estimates from IRRI, **Compilation**, op. cit , Table 3
b Production of palay converted to production of milled rice by first reducing palay production by 7% for wastage and seed and then applying the milling conversion factor by weight of .65.
c Bureau of Customs, **Annual Report of the Insular Collector of Customs**. For 1939 and 1940, Bureau of Census and Statistics, **Yearbook of Philippine Statistics, 1940**.

Table A8

Philippines: **Production, Net Imports and Apparent Absorption of Shelled Corn, 1946-1965**

Crop Year	*Production of Shelled Corn* [a] MT	*Net Imports of Shelled Corn* [b] MT	*Availability of Shelled Corn* MT	*Per Capita Availability* [c] Kg	*Apparent Direct Absorption of Shelled Corn Products* [d] MT	*Apparent Direct Per Capita Absorption of Shelled Corn Products* Kg
1946-47	472,194	3,187	475,381	26.7	259,558	14.6
47-48	519,012	1,178	520,190	27.2	284,024	14.8
48-49	534,067	7,936	542,003	27.5	295,933	15.0
49-50	573,734	6,626	580,360	28.6	316,877	15.6
1950-51	603,187	458	603,645	28.9	329,590	15.8
51-52	761,873	30	761,903	35.4	415,999	19.3
52-53	709,479	neg.	709,449	32.0	387,359	17.5
53-54	780,999	16	780,916	34.1	426,380	18.6
54-55	770,127	(159)	769,968	32.7	420,403	17.8
1955-56	907,377	34	907,411	37.4	495,447	20.4
56-57	895,356	10,572	905,928	36.2	494,637	19.8
57-58	852,070	20,147	872,217	33.8	476,230	18.5
58-59	1,015,900	(76,620)	939,280	35.3	512,847	19.3
59-60	1,165,300	(10,549)	1,154,751	42.1	630,494	23.0
1960-61	1,209,600	(6,155)	1,203,445	42.5	657,081	23.2
61-62	1,266,300	14	1,266,314	43.3	691,408	23.6
62-63	1,272,800	78	1,272,878	42.1	694,991	23.0
63-64	1,292,700	62	1,292,762	41.3	705,848	22.6
64-65	1,312,700	2,248	1,314,948	40.7	717,961	22.2

a DANR estimates from IRRI, Compilation, Op. cit., Table 2.
b Bureau of Census and Statistics, Foreign Trade Statistics of the Philippines. Calendar year basis Second year listed under crop year. Net exports in parentheses.
c For population estimates, see Table AI.
d To obtain direct absorption of shelled corn products, it is assumed that 30% of shelled corn availability is diverted to livestock and poultry feeds and to industrial uses (not including starch manufacturing) and 5% is allocated to wastage and to use as seed It is further assumed that the extraction rate for corn milling (including starch manufacturing where extraction rate is 56-60%) averaged 84%. To obtain estimates of shelled corn products consumed directly, multiply availability by .546 (.65 x 84).

Table A9

Philippines: **Production, Imports and Apparent Absorption of Corn, 1910-1940**

Crop Year or Average for Period	*Production of Shelled Corn* [a] MT	*Net Imports of Shelled Corn* [b] MT	*Availability of Shelled Corn* MT	*Apparent Direct Absorption of Milled Corn* [c] MT	*Apparent Direct Absorption of Milled Corn Per Capita* Kg
1910-1914	222,984	n.r.	222,984	115,952	13.5
1915-1919	417,240	n.r.	417,240	216,965	22.0
1920-1924	421,401	(16)	421,385	219,120	20.1
1925-1929	432,402	1,542	433,944	225,651	18.5
1930	361,323	9,722	371,045	192,943	14.7
1931	338,637	6,372	345,009	179,405	13.4
1932	407,550	(1)	407,549	211,925	15.4
1933	412,509	7,152	419,661	218,224	15.5
1934	338,694	(552)	338,142	175,834	12.2
1935	295,545	3	295,548	153,685	10.4
1936	363,147	(52)	363,095	188,809	12.5
1937	437,646	(53)	437,593	227,548	14.7
1938	500,574	n.r.	500,574	260,298	16.5
1939	459,135	11	459,146	238,756	14.9
1940	578,751	6,585	578,751	300,951	18.3

a DANR estimates.
b Bureau of Customs **Annual Report of the Insular Collector of Customs.** For 1939 and 1940, Bureau of Census and Statistics, **Yearbook of Philippine Statistics,** 1940. Net exports in parentheses.
c To obtain the direct absorption of shelled corn products, it is assumed that 30 per cent of output is diverted to livestock and poultry feeds and other industrial uses (not including starch manufacturing), and 5 per cent is absorbed as wastage and seed corn. It is further assumed that the extraction rate for corn milling (including starch manufacturing where the extraction rate is 56-60 per cent) averaged 80 per cent To obtain the estimates of the apparent direct absorption of milled corn, shelled corn availability is multiplied by the factor .52 (.65 x .80).

Table A10

Philippines: Imports of Wheat, Wheat Flour and Wheat Flour Products and Apparent Per Capita Absorption of Wheat Flour Equivalent, 1946-1965

Calendar Year	Imports of Wheat Flour and Flour Equivalent[a]: Wheat Imports[b] MT	Flour Imports[c] MT	Vermicelli, Macaroni, etc. Imports[b] MT	Availability of Flour Equivalent MT	Apparent Per Capita Absorption of Wheat Flour Equivalent[d] Kg
1947	—.—	155,711	2,376	158,086	8.9
1948	—.—	165,418	3,800	165,218	8.6
1949	99	192,502	3,346	195,947	10.0
1950	—.—	176,556	1,261	177,817	8.8
1951	—.—	216,134	1,522	217,656	10.4
1952	37	195,974	1,319	197,330	9.2
1953	—.—	166,986	1,611	168,597	7.6
1954	—.—	187,745	1,752	189,497	8.3
1955	16	244,730	2,305	247,051	10.5
1956	—.—	215,101	500	215,600	8.9
1957	—.—	286,616	379	286,995	11.5
1958	6,208	299,479	196	305,884	11.9
1959	57,314	139,542	548	197,404	7.4
1960	82,656	161,767	54	244,477	8.9
1961	178,493	80,211	(1)	258,703	9.1
1962	231,940	20,521	167	252,628	8.6
1963	294,596	22,448	323	317,367	10.5
1964	249,000	58,193	322	307,515	9.8
1965	312,132	52,680	539	365,351	11.3

a Bureau of Census and Statistics, **Foreign Trade Statistics of the Philippines.** Statistics of wheat, wheat flour, macaroni and vermicelli imports for period 1946-60 are republished in AGRECO, **Philippines' Long-Term Projection of Supply and Demand for Selected Agricultural Products, USDA, ERS-Foreign-34,** p. 172.

b Wheat imports converted to flour equivalent using recovery factor by weight of .72. Macaroni and vermicelli products converted to flour equivalent by factor 1 0

c In order to keep the data for 1961-65 comparable to the figures in the AGRECO study, we have used the data for import classification 046 less imports of meal of wheat and spelt, but including imports of flour for non-food uses

d For population estimates, see Table A1.

Table A11

Philippines: **Imports and Apparent Absorption of Wheat Flour Equivalent, 1910-1940**

Calendar Year	*Net Imports of Wheat Flour* [a] MT	*Net-Imports of Macaroni and Vermicelli in Flour Equivalent*[a] (MT)	*Absorption of Apparent Wheat Flour Equivalent* MT	*Absorption of Apparent Wheat Flour Equivalent Per Capita* Kg
1910-1914	35,778	1,000	36,778	4.3
1915-1919	34,712	1,292	36,004	3.7
1920-1924	48,762	1,549	50,311	4.6
1925-1929	71,515	1,994	73,509	6.0
1930	70,539	1,858	72,397	5.5
1931	79,013	2,325	81,338	6.1
1932	69,225	2,138	71,363	5.2
1933	69,382	2,365	71,747	5.1
1934	69,567	1,894	71,461	5.0
1935	71,454	1,850	73,304	5.0
1936	91,655	2,152	93,807	6.2
1937	75,288	2,356	77,644	5.0
1938	92,471	2,280	94,751	6.0
1939	100,264	2,325	102,589	6.4
1940	102,085	1,920	104,005	6.3

a Bureau of Customs, **Annual Report of the Insular Collector of Customs.** For 1939 and 1940, Bureau of Census and Statistics, **Yearbook of Philippine Statistics, 1940.** No imports of wheat reported.

Table A12

Philippines: Apparent Per Capital Direct Absorption of Milled Rice, Wheat Flour Equivalent and Milled Corn Equivalent, 1910-1965

Crop Year or Average for Period	*Apparent Per Capita Direct Absorption of Milled Rice*		*Apparent Per Capita Direct Absorption of Wheat Flour Equivalent* [a]		*Apparent Per Capita Direct Absorption of of Milled Corn Equivalent*	
	Kg	Index 1951-55=100	Kg	Index 1951-55=100	Kg	Index 1951-55=100
1910-1914	81.0	96.3	4.3	46.9	13.5	75.3
1915-1919	89.7	106.6	3.7	40.2	22.0	112.9
1920-1924	106.8	126.9	4.6	50.0	20.1	112.9
1925-1929	110.4	131.9	6.0	65.2	18.5	103.9
1930	105.6	125.5	5.5	59.8	14.7	82.6
1931	99.4	118.1	6.1	66.3	13.4	75.3
1932	92.6	110.1	5.2	56.5	15.4	86.5
1933	91.9	109.2	5.1	55.4	15.5	84.3
1934	98.1	116.6	5.0	54.3	12.2	68.5
1935	83.1	98.8	5.0	54.3	10.4	58.4
1936	80.5	95.7	6.2	67.4	12.5	70.2
1937	99.4	118.1	5.0	54.3	14.7	82.6
1938	88.6	105.3	6.0	65.2	16.5	92.7
1939	92.1	109.5	6.4	69.6	14.9	83.7
1940	89.1	105.9	6.3	68.5	18.3	102.8
1946-47	75.6	85.1	8.9	91.3	14.6	77.6
1947-48	75.8	90.1	8.6	95.7	14.8	83.4
1948-49	83.4	99.1	10.0	108.7	15.0	84.7
1949-50	77.7	92.2	8.8	95.7	15.6	87.7
1950-51	81.9	97.3	10.4	113.0	15.8	88.7
1951-52	82.4	97.9	9.2	100.0	19.3	108.3
1952-53	85.6	101.7	7.6	82.6	17.5	98.2
1953-54	86.0	102.2	8.3	90.2	18.6	104.6
1954-55	84.8	100.8	10.5	114.1	17.8	100.3
1955-56	83.2	98.9	8.9	96.7	20.4	114.7
1956-57	83.9	99.7	11.5	125.0	19.8	111.0
1957-58	84.0	98.8	11.9	129.3	18.5	103.7
1958-59	84.0	98.8	7.4	80.4	19.3	108.3
1959-60	82.5	98.1	8.9	96.7	23.0	129.1
1960-61	79.4	94.4	9.1	98.9	23.2	130.4
1961-62	81.8	97.2	8.6	93.5	23.6	132.8
1962-63	79.3	94.2	10.5	135.9	23.0	129.1
1963-64	83.8	99.6	9.8	106.5	22.6	126.7
1964-65	91.9	109.2	11.3	119.6	22.2	124.8

[a] Calendar year basis. Year is second of two years indicated beginning with 1946-47.

Table A13

Philippines: **Apparent Per Capita Direct Absorption of Cereals Relative to Recommended Nutritional Requirements, 1910-1965**

Crop Year or Average for Period	*Apparent Per Capita Direct Absorption of Milled Rice and Wheat Flour Equivalent* Kg.	Index 1951-55=100	*Apparent Per Capita Direct Absorption of Milled Rice, Wheat Flour Equivalent and Milled Corn Equivalent* Kg.	Index 1951-55=100	*Ratio of Apparent Per Capita Direct Absorption of Cereals to Current Recommended Annual Nutritional Requirement of 120.1 Kg.*[a]
1910-1914	85.3	91.4	98.7	88.8	82.2
1915-1919	93.4	100.1	113.5	102.1	94.5
1920-1924	111.4	119.3	131.5	118.3	109.5
1925-1929	116.4	124.7	134.9	121.4	112.3
1930	111.1	119.0	125.8	113.2	104.7
1931	105.5	113.0	118.9	107.0	99.0
1932	97.8	104.8	113.2	101.6	94.3
1933	97.0	103.9	112.5	101.2	93.3
1934	103.0	110.3	115.2	103.7	95.9
1935	88.0	94.3	98.4	88.9	81.9
1936	86.7	92.9	99.2	89.3	82.6
1937	104.4	111.8	119.1	107.2	99.2
1938	94.6	101.3	111.1	100.0	92.5
1939	98.5	105.6	113.4	102.0	94.4
1940	95.4	102.2	113.7	102.3	94.7
1946-47	84.5	90.6	99.1	89.2	82.5
1947-48	84.4	90.5	99.2	89.3	82.6
1948-49	93.4	100.1	108.4	97.5	90.3
1949-50	86.5	92.7	102.1	91.9	85.0
1950-51	92.3	98.9	108.1	97.3	90.0
1951-52	91.6	98.1	110.9	99.8	92.3
1952-53	93.2	99.8	110.7	99.6	92.2
1953-54	94.3	101.0	112.9	101.6	94.0
1954-55	95.3	102.1	113.1	101.8	94.2
1955-56	92.1	98.7	112.5	101.2	93.7
1956-57	95.4	102.2	115.2	103.7	95.9
1957-58	95.9	102.7	114.4	102.9	95.3
1958-59	91.4	97.9	110.7	99.6	92.2
1959-60	91.4	97.9	114.4	102.9	95.3
1960-61	88.5	94.8	111.7	100.5	93.0
1961-62	90.4	96.8	114.0	102.6	94.9
1962-63	89.8	96.2	112.8	101.5	93.9
1963-64	93.6	100.3	116.2	104.6	96.8
1964-65	103.2	110.6	125.4	112.8	104.4

a Republic of the Philippines, Food and Nutrition Research Center, Publication No. 76 (Revised, January 30, 1963)

Table A14

Philippines: Adjusted Production, Availability and Apparent Absorption of Milled Rice 1946-65

Crop Year	*Production of Palay* [a] MT	*Adjusted Milled Rice Production* [b] MT	*Adjusted Milled Rice Availability* [c] MT	*Adjusted Apparent Per Capita Absorption of Milled Rice* [d] Kg.
1946-47	2,088,240	1,093,061	1,175,941	66.1
47-48	2,240,853	1,172,945	1,269,601	66.3
48-49	2,491,289	1,304,032	1,439,608	73.2
49-50	2,606,058	1,364,106	1,364,106	67.3
1950-51	2,616,390	1,369,514	1,499,378	71.8
51-52	2,830,745	1,481,716	1,544,828	71.7
52-53	3,144,156	1,645,765	1,645,765	74.2
53-54	3,182,432	1,665,801	1,708,417	74.7
54-55	3,201,521	1,675,793	1,739,297	73.8
1955-56	3,272,939	1,713,176	1,755,568	72.3
56-57	3,345,543	1,751,180	1,829,076	73.1
57-58	3,203,093	1,676,616	1,907,280	73.9
58-59	3,684,061	1,928,372	1,934,868	72.8
59-60	3,739,059	1,957,160	1,957,160	71.4
1960-61	3,704,311	1,938,972	1,948,172	68.8
61 62	3,909,586	2,046,420	2,076,980	71.0
62-63	3,966,507	2,076,214	2,076,238	68.7
63-64	3,842,398	2,011,251	2,310,109	73.9
64-65	3,991,984	2,089,550	2,649,110	81.9

a DANR estimates from IRRI, Compilation, op. cit, Table 3.

b DANR production estimates adjusted for upward bias as compared to palay production reported in agricultural censuses of 1948 and 1960 The agricultural census of 1948 reported production of 43,864,222 cavans of palay for crop year 1947-48 or 8612 of palay production for crop year 1947-48 estimated by DANR of 50,928,480 cavans. The agricultural census of 1960 reported palay production of 73,990,660 cavans for crop year 1959 60 or 8705 of the production for that year of 84,988,800 estimated by DANR. An average adjustment factor of 8659 was applied to obtain adjusted milled rice production

c Adjusted production of milled rice equivalent plus net imports of milled rice For latter, see Table A6 imports on calendar year basis for second year of crop year period

d For population estimates, see Table A1 It is assumed that milled rice availability is consumed directly

Table A15

Philippines: Adjusted Production, Availability and Apparent Absorption of Milled Rice 1930-1940

Crop Year	*Adjusted Production of Milled Rice* [a] MT	*Imports of Milled Rice* MT	*Adjusted Milled Rice Availability* MT	*Adjusted Apparent Direct Absorption of Milled Rice Per Capita* Kg
1930	1,090,877	10,528	1,101,405	84.1
1931	1,049,714	11,592	1,061,306	79.2
1932	1,000,018	12,880	1,012,898	73.8
1933	1,011,707	19,488	1,031,195	73.4
1934	1,120,785	1,176	1,121,961	78.0
1935	969,036	4,648	973,684	66.1
1936	892,792	91,112	983,904	65.2
1937	1,163,384	71,960	1,235,344	80.0
1938	1,106,913	9,072	1,115,985	70.6
1939	1,103,703	85,064	1,188,767	74.3
1940	1,135,536	38,136	1,173,672	71.3

a DANR estimates of palay production adjusted for upward bias as compared to palay production reported in 1939 Census. The 1939 Census reported palay production for crop year 1938-39 of 41,888,988 cavans or .795 of DANR estimate of palay production for crop year 1938-39 of 52,193,430 cavans To calculate the "Adjusted Production" series, DANR palay production estimates have been reduced by 07 for wastage and seed, resulting estimates of palay milled have been multiplied by average recovery rate by weight of 65, resulting estimates of milled rice production have been reduced by factor .205 for upward bias as compared to rice production tabulated in 1939 Census. Adjustment factors combined (93 x .65 x 795) — .4806.

Table A16

Philippines: Adjusted Production, Availability and Apparent Absorption of Shelled Corn 1946-1965

Crop Year	*Adjusted Corn Production* [a] MT	*Adjusted Corn Availability* [b] MT	*Adjusted Per Capita Availability* [c] Kg	*Apparent Adjusted Direct Absorption of Shelled Corn Products* MT	*Apparent Adjusted Per Capita Direct Absorption of Shelled Corn Products* Kg
1946-47	586,937	590,124	33.2	322,208	18.1
47-48	645,132	646,420	33.8	352,891	18.4
48-49	663,845	671,771	34.1	366,787	18.6
49-50	713,151	719,775	35.5	392,997	19.4
1950-51	749,761	750,219	35.9	409,620	19.6
51-52	947,008	947,038	44.0	517,083	24.0
52-53	881,882	881,882	39.7	481,508	21.7
53-54	970,659	970,675	42.4	529,989	23.2
54-55	957,268	957,109	40.6	522,582	22.2
1955-56	1,127,870	1,127,904	46.4	615,836	25.4
56-57	1,112,928	1,123,500	44.9	613,431	24.5
57-58	1,059,123	1,079,270	41.8	589,281	22.8
58-59	1,262,764	1,186,144	44.6	647,635	24.5
59-60	1,448,468	1,437,919	52.5	785,104	28.6
1960-61	1,503,533	1,497,378	52.9	817,568	28.9
61-62	1,574,011	1,574,025	53.8	859,418	29.4
62-63	1,582,090	1,582,168	52.3	863,864	28.6
63-64	1,606,826	1,606,888	51.4	877,361	28.1
64-65	1,631,686	1,633,934	50.5	892,128	27.6

a DANR production estimates (see Table A8) adjusted for downward bias in production estimates as compared to corn production reported in agricultural censuses of 1948 and 1960 The 1948 census reported production of 11 393 000 cavans which was 25 1% greater than corn production estimated for the 1947-48 crop year by the DANR of 9,105,000 cavans The 1960 census reported production of 25,247,042 cavans which was 23.5% greater than corn production estimated for the 1959-60 crop year by the DANR of 20 444,000 cavans The average adjustment factor for the two census years of 24.3% was used to calculate the adjusted production of corn.

b Adjusted corn production plus net imports of shelled corn For latter see Table A8

c For population estimates, see Table A1

Table A17

Philippines: **Adjusted Apparent Per Capita Absorption of Milled Rice and Milled Corn Equivalent, 1930-1965**

Crop Year	*Adjusted Apparent Per Capita Direct Absorption of Milled Rice*		*Adjusted Apparent Per Capita Absorption of Milled Corn*	
	(Kg.)	Index (1951-55 = 100)	(Kg.)	Index (1951-55 = 100)
1930	84.1	114.8	14.7[a]	66.4
1931	79.2	108.1	13.4[a]	60.5
1932	73.8	100.8	15.4[a]	69.6
1933	73.4	100.2	15.5[a]	70.0
1934	78.0	106.5	12.2[a]	55.1
1935	66.1	90.3	10.4[a]	47.0
1936	65.2	89.0	12.5[a]	56.5
1937	80.0	109.2	14.7[a]	66.4
1938	70.6	96.4	16.5[a]	74.5
1939	74.3	101.4	14.9[a]	67.3
1940	71.3	97.4	18.3[a]	82.7
1946-47	66.1	90.3	18.1	81.8
1947-48	66.3	90.5	18.4	83.1
1948-49	73.2	99.9	18.6	84.0
1949-50	67.3	91.9	19.4	87.6
1950-51	71.8	98.0	19.6	88.5
1951-52	71.7	97.9	24.0	108.4
1952-53	74.2	101.3	21.7	98.0
1953-54	74.7	102.0	23.2	104.8
1954-55	73.8	100.8	22.2	100.3
1955-56	72.3	98.7	25.4	114.7
1956-57	73.1	99.8	24.5	110.7
1957-58	73.9	100.9	22.8	103.0
1958-59	72.8	99.4	24.4	110.2
1959-60	71.4	97.5	28.6	129.2
1960-61	65.8	89.8	28.9	130.5
1961-62	71.0	96.9	29.4	132.8
1962-63	67.8	92.6	28.6	129.2
1963-64	73.9	100.9	28.1	126.9
1964-65	81.9	111.8	27.6	124.7

a Unadjusted, see Table A9 A DANR estimate independent of the Census tabulation in 1939 was unavailable

Table A18

Philippines: Adjusted Apparent Per Capita Absorption of Cereals Relative to Recommended Nutritional Requirements, 1930-1965

Crop Year	*Adjusted Apparent Per Capita Direct Absorption of Milled Rice and Wheat Flour Equivalent* [a] Kg	Index (1951-55=100)	*Adjusted Apparent Per Capita Direct Absorption of Milled Rice, Wheat Flour Equivalent and Milled Corn Equivalent* Kg	Index (1951-55=100)	*Ratio of Adjusted Apparent Per Capita Direct Absorption of Cereals to Current Recommended Annual Nutritional Requirement of 120 1 Kg*
1930	89.6	108.7	104.3	99.7	86.8
1931	85.3	103.5	98.7	94.4	82.2
1932	79.0	95.8	94.4	90.3	78.6
1933	78.5	95.2	93.5	89.4	77.9
1934	83.0	100.7	95.2	91.0	79.3
1935	71.1	86.2	81.5	77.9	67.9
1936	71.4	86.6	83.9	80.2	69.9
1937	80.0	97.0	94.7	90.6	78.8
1938	76.6	92.9	93.1	89.0	77.5
1939	80.7	97.9	95.6	91.4	79.6
1940	77.6	94.1	95.9	91.7	79.8
1946-47	75.0	91.0	93.1	89.0	77.5
1947-48	74.9	90.9	93.3	89.2	77.7
1948-49	83.2	100.9	101.8	97.3	84.8
1949-50	76 1	92.3	95.5	91.3	79 5
1950-51	82.2	99.7	101.8	97.3	84.8
1951-52	80.9	98.1	104.9	100.3	87.3
1952-53	81.8	99.2	103.5	99.0	86.2
1953-54	83.0	100.7	106.2	101.5	88.4
1954-55	84.3	102.3	106.5	101.8	88.7
1955-56	81.2	98.5	106.6	101.9	88.8
1956-57	84.6	102.6	109.1	1[illegible].3	90.8
1957-58	85.8	104.1	108.6	103.8	90.4
1958-59	80.2	97.3	104.6	100.0	87.1
1959-60	80.3	97.4	108.9	104.1	90.7
1960-61	74 9	90.9	103.8	99.2	86.4
1961-62	79 6	96.6	109.0	104.2	90.8
1962-63	78.3	95.0	106.9	102.2	89.0
1963-64	83.7	101.5	111.8	106.9	93.1
1964-65	93.2	113.1	120.8	115.5	100.6

a For details of adjustment, see Note b, Table A14 and Note a, Table A15. Absorption of wheat flour equivalent is unadjusted For series on wheat flour absorption, see Tables A10 and A11 Imports of wheat flour equivalent on calendar year basis.

Table A19

Philippines: Estimated Allocation of Annual Corn Requiments, 1959-1966 [a]
(Crop years, per cent of estimated total requirements)

	1966	1965	*Average* 1962-1964	*Average* 1959-1961
Consumption of shelled corn	59.2	59.1	58.1	61.6
Consumption of green corn	1.8	1.8	n.a.	n.a.
Input into corn starch manufacture ..	4.5	4.5	3.6	2.7
Total direct consumption	65.5	65.4	61.7	64.3
Animal, poultry and mixed feeds ...	27.0	27.1	30.7	28.5
Other commercial and industrial uses	3.3	3.1	3.1	3.3
Waste	1.8	1.8	1.9	2.0
Seed corn	2.3	2.4	2.6	2.9
	100.0	100.0	100.0	100.0

Table A20

Philippines: Commercial and Government Rice stocks, 1958-1966 [b]

	Milled Rice Stocks January 1		Milled Rice Stocks July 1	
	Private Warehouses	Total: *Government and Private Warehouses*	*Private Warehouses*	Total: *Government and Private Warehouses*
1958	32,802	58,159	138,255	178,744
1959	277,172	373,628	249,985	348,809
1960	262,609	362,164	287,514	381,002
1961	254,702	262,515	217,784	117,781
1962	207,021	313,492	230,659	306,251
1963	312,995	446,761	181,572	200,670
1964	224,750	265,172	161,578	203,683
1965	375,510	451,690	185,846	258,003
1966	241,404	267,490	221,465	240,626

a NEC Annual Report of the Inter-Agency Committee on Rice and Corn Production and Consumption.
b DANR, Bureau of Agricultural Economics estimates.

Table A21

Philippines: **Cereal Price Relationships, 1949-1965**
(Indees, 1949-52 = 100)

	Retail Prices Manila [a]		*Consumer Price Index* [b]	*Farm Prices*	
	Cereal	*All Foodstuffs*	*Manila*	*Palay* [c]	*Corn* [d]
1949	108.7	99.1	95.3	107.2	114.0
1950	95.8	97.0	98.3	107.2	88.7
1951	100.6	104.2	106.5	96.4	101.6
1952	94.9	99.5	99.6	89.2	95.6
1953	83.1	93.9	96.3	78.2	79.3
1954	79.2	89.4	94.9	68.4	78.6
1955	80.8	92.1	93.9	69.4	78.4
1956	79.8	95.1	96.5	67.6	72.9
1957	84.6	98.4	98.1	67.4	108.6
1958	94.6	104.4	101.5	71.9	106.5
1959	80.6	100.1	100.5	69.9	77.5
1960	88.5	106.9	104.7	69.1	79.5
1961	95.4	109.6	106.2	78.9	111.9
1962	91.7	117.8	112.5	83.8	101.6
1963	103.0	129.3	118.8	86.8	117.8
1964	123.1	145.8	128.6	108.5	140.1
1965	120.6	148.6	131.8	n.a.	n.a.

a Central Bank of the Philippines, **Statistical Bulletin** (18), No 4, December 1966, Table 105
b Ibid, Table 104
c Average price of national output See Mahar Mangahas, Aida E Recto, and V W Ruttan, "Price and Market Relationships for Rice and Corn in the Philippines", **Journal of Farm Economics** (48), August 1966, Figure 1 Basic data are published in International Rice Research Institute, **Staff Memo** IRRI AE 65 of May 11, 1965, Table 3
d Ibid

NOTE: A limited number of tenuous links between prewar and postwar prices can be established and they indicate that the relative price relations between rice and corn, and those between cereals and prices generally, did not undergo major change in the postwar as compared to the prewar periods For example, when the DANR series of wholesale prices of rice and corn, Manila, is converted to index numbers (1949 52 — 100), the index of the price of palay in 1941 was 23 0 and that for corn was 23 5 See DANR, Division of Agricultural Economics, **Philippine Agricultural Statistics**, Volume I (Manila, 1954), Table 209, p. 193 Similarly, the Cost of Living Index, Manila (1942 52 — 100) was 28 8 in 1941, the Retail Price Index, Manila was 35.4, the index of retail pricus of all food was 28 6 and for the retail price of rice, 26 0 See Central Bank of the Philippines, **Annual Report, 1953**, Tables 38 39 and 40, pp 219 221.

CHAPTER III

ESTIMATED EXPANSION OF GEOGRAPHIC AREA UNDER CULTIVATION, 1965-1990

Chapter III of this study presents an estimate of the increase in land under cultivation which is likely to take place between 1965 and 1990, and assesses the contribution which such expansion will make to palay production.

As was pointed out earlier, Philippine agricultural development over the first 60 years of this century essentially was a process of bringing land under cultivation at a rate approximating that of population growth. In the aggregate, yields of rice and corn plantings were stable and, therefore, per capita output remained stable. Beginning in the late 1950's, expansion in land under cultivation declined to a minor fraction of the rate of population growth.[1]

Reliable soil surveys exist for the seven major river basins containing the major portion of Philippine alluvial soil resources suitable for irrigation and lowland rice cultivation.[2] These basins include 8.3 million hectares or 28 per cent of the land area of the Philippines. Within these basins, lands of soil classifications I, II and III (gradients under 25 per cent and with structures suitable for lowland rice cultivation) total about 3.1 million hectares.[3] Although estimates were not found of the area in soil classifications I, II and III, for the entire country, it is unlikely that the total would be more than three times the area of such soils in the seven major basins.[4] Moreover, a Philippine relief map will readily confirm the impression that the proportion of less suitable class III soils (gradients between 3 and 25 per cent) is much higher for the country generally than for the major basins.

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1 Rice plantings have actually declined by about five per cent from peak levels of crop years 1959 and 1960. One source has suggested that the decade of the 1960's may see the closing of the "frontier" of land settlement See International Rice Research Institute, **Annual Report**, 1965, (Los Banos IRRI 1966), pp 296-297

2 U S Department of Interior, Bureau of Reclamation, **Central Luzon Basin** (Preliminary draft), April 1966, **A Report on the Cagayan River Basin**, December 1966, **A Report on the Cotabato River Basin**, November 1966, **The Agusan River Basin** (Preliminary draft), September 1966, **The Bicol River Basin** (Preliminary draft), October 1966, and **The Ilog Hilabangan River Basin** (Preliminary draft), November 1966 The Central Luzon Basin includes the basins of the Pampanga River system and that of the Agno River

3 In the seven major river basins the area of Class IV soils totals about 4,204,000 hectares and 860,000 hectares are unclassified Class IV soils are defined as "lands which (a) have no agricultural value in the immediate future, (b) are not readily accessible for orderly examination, (c) are used for dumping of waste materials, (d) are severely eroded, and (e) swamp lands".

4 DANR, **Handbook of Agriculture**, 1959, Table 1 8 presents an estimate that the "total potential agricultural area" is 17 2 million hectares Since the concept is undefined, it is not possible to assess the significance of this estimate Clearly it exceeds the area of soils in Classifications I, II and III.

In other words, the area under cultivation in the mid-1960s (excluding the area planted to second crops) of some 7.5 million hectares probably is approaching the limits of the area suitable for agriculture with gradients under 25 per cent. To the extent that the foregoing estimates are valid, it means that additions to the cultivated area in the future are going to consist of rougher lands generally unsuitable for lowland rice cultivation.

To estimate the role of land inputs in the development of the Philippine rice economy over the 25 years following 1965, we assume that the additional area brought under cultivation (excluding the area planted to second crops) will increase one per cent per year, a total expansion of 2 1 million hectares. The area under cultivation (exclusive of second crops) in 1990, therefore, will total 9.6 million hectares as compared to 7.5 million in 1965.

Population growth will be the basic determinant of the allocation of agricultural land to alternative uses in the future, as it has been in the past, and population growth will maintain pressure to increase plantings of rice and other cereals which contribute the basic energy calories required by the Philippine population. The influence of population growth will be reinforced by other factors including new high-yielding varieties which will improve the relative productivity of resources in rice production and will tend to divert resources, including land, to rice production. On the other hand, requirements of foreign exchange, relative price movements reflecting improved productivity in rice production, diversion of consumption expenditures to foods other than rice as per capita real income rises, and urbanization, may moderate pressures on rice supplies and divert land resources to production of other crops

Because of the dominant influence of population growth in the allocation of land resources, we assume that the geographic area allocated to rice cultivation, will increase by 1½ per cent per year. This means that the total area used for rice cultivation increases from an average of 2,643,000 hectares in the three crop years 1964-1966, to 3,835,000 hectares in 1990. We further assume that three-fifths of the increment in land allocated to rice production, or 715,000 hectares, will be used to produce a single crop of upland or kaingin rice and the remainder, 477,000 hectares, will be planted to a first season crop of lowland rice. In addition, we assume that a second crop of unirrigated rice is produced on 72,000 hectares, or 15 per cent of the increment of area allocated to production of lowland rice. This ratio approximates the average proportion of second crop, non-irrigated, lowland rice plantings to first crop, non-irrigated, plantings reported by the DANR for the three crop years 1964-1966.

It follows from the foregoing assumptions that estimated plantings of upland and kaingin rice increase by 3.1 per cent per year over the 25

Table 13

Philippines: **Projected Extension of Geographic Area Under Cultivation, 1965-1990**

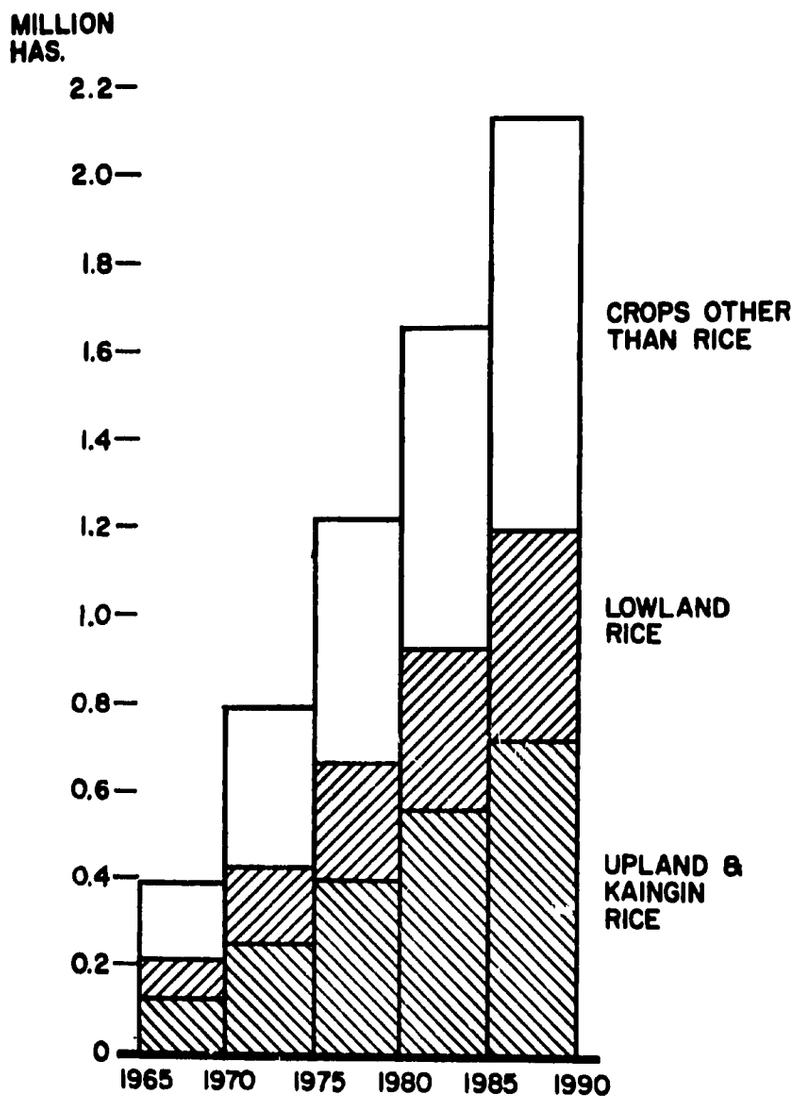
	Average of Crop Years 1964-1966	*Area Under Cultivation* 1970	1975	1980	1985	1990
Total area cultivated, exclusive of second crops [a] (has.)	7,500,000	7,883,000	2,285,000	8,707,000	9,151,000	9,618,000
Total area allocated to production of rice, exclusive of area in second crops [b] (has.)	2,634,000	2,847,000	3,067,000	3,304,000	3,560,000	3,835,000
Total area allocated to production of other crops, exclusive of area in second crops (has) ..	4,857,000	5,036,000	5,218,000	5,403,000	5,591,000	5,783,000
Total area allocated to production of kaingin and upland rice [b] (has.)	622,000	744,000	876,000	1,018,000	1,172,000	1,337,000
Total area allocated to production of lowland rice, exclusive of area in second crops [b] (has) ..	2,021,000	2,103,000	2,191,000	2,286,000	2,388,000	2,498,000

a Average of crop years 1964-1966, is computed from DANR estimates republished in International Rice Research Institute, Department of Agricultural Economics, **Compilation of Statistical Data, Rice,** Table 1 Average for crop years 1964 1966 is the total area planted less approximately 650 000 hectares in second crops During the three crop years 1964-1966 the area allocated to a second rice crop averaged 490 000 hectares (Op. cit , Tables 9-11) For 1970-1990, the total area cultivated exclusive of second crops is assumed to expand at the rate of 1% per annum

b Average of crop years 1964-1966 (Op cit , Tables 9 11) For 1970-1990 the total area cultivated to first-crop rice including irrigated and unirrigated, lowland rice and upland and kaingin rice) is assumed to expand at a rate of 1½% per annum, with 40% of the increase in area allocated to first-crop, non-irrigated, lowland rice and 60% to upland and kaingin rice

PHILIPPINES: PROJECTED EXPANSION IN AREA UNDER CULTIVATION, EXCLUSIVE OF SECOND CROPS, 1965 - 1990

(MILLION HECTARES, CUMULATIVE TOTALS)



years following 1965, as compared to an average annual increase of 5.1 per cent between the census years 1948 and 1960.[5] More dramatic is the decline in the rate of expansion in area allocated to production of lowland rice which averages 0.9 per cent annually over the period 1965-1990 as compared to an average annual increase of 2.9 per cent between the postwar census years.

To isolate the contribution of the increment in area to rice output, we assume that the additional area produces only non-irrigated rice; first crop, lowland; second crop, lowland; and upland and kaingin rice. To estimate the increments of output, we attribute to the additional areas planted to the various categories of non-irrigated rice the average annual yields obtained from the same categories estimated by the Department of Agriculture and Natural Resources for the three crop years 1964-1966.[6] These yield factors are 1,254 kg per hectare for first crop, non-irrigated, lowland rice, 863 kg. per hectare for second crop, non-irrigated, lowland rice, and 766 kg. for upland and kaingin rice.

Applying these yield factors to the estimated increases in non-irrigated plantings results in estimated output increments in 1990 as compared to the mid-1960s, of 600,000 metric tons of first crop lowland rice, 62,000 metric tons of second crop, lowland rice, and 548,000 metric tons of upland and kaingin rice. The estimated increment in rice output attributable to expansion in the geographic area planted to rice, therefore, is 1.210,000 metric tons. This is 211 of rice requirements in 1990 in the *Low Rice Projection* and .125 of rice requirements in 1990 in the *High Rice Projection.*

The implications of our estimates of the additional area allocated to rice production for input requirements of irrigation facilities, plant breeding research, fertilizers, pesticides, fungicides, herbicides, and working capital are unambiguous. From four-fifths to seven-eights of the estimated increase in rice requirements over the twenty-five years following 1965, will have to be met by inputs other than the estimated increment in land allocated to rice production. This will require a radical transformation of the rice economy which, heretofore, has met the demands of rapid population growth essentially by increases in the input of land More ominous are the implications for social stability of the "closing" of the frontier of land settlement which has served as a relief valve for population pressure throughout Philippine history. The already evident trend toward improved farm management to take advantage of the yield increments to be realized from modern inputs must inevitably exert pressure to increase the scale of enterprise. Population growth exerts powerful pressure in the opposite

5 Republic of the Philippines, Bureau of the Census and Statistics **Census of the Philippines Agriculture (1948 and 1960)**

6 DANR estimates Republished in International Rice Research Institute, Department of Agricultural Economics, **Compilation of Statistical Data, Rice,** Tables 9, 10, and 11

direction; pressure which will be intensified as the rate of land settlement declines. These pressures inevitably will intensify class conflict in high tenancy sectors of Philippine agriculture. Such conflict, in the absence of other changes which moderate social tensions, will tend to maintain and intensify resistance to better farm management which, at the same time, is necessary to realize the benefits of modern inputs.

Table 14

Philippines: **Additions to Palay Output Attributable to Estimated Expansion in Geographic Area Planted to Rice, 1965-1990**
(Cumulative Totals)

	1965-70	*1970-75*	*1975-80*	*1980-85*	*1985-90*
Additional area planted to first crop, unirrigated, palay[a] (has.)	82,000	170,000	265,000	367,000	477,000
Increment of output of first crop unirrigated, palay[b] (MT, palay)	103,000	214,000	333,000	461,000	600,000
Additional area planted to second crop, unirrigated, palay[c] (has.)	13,000	26,000	40,000	55,000	72,000
Increment of output of second crop unirrigated, palay[d] (MT, palay)	11,000	22,000	35,000	47,000	62,000
Additional area planted to upland and kaingin rice[a] (has.)	122,000	254,000	396,000	550,000	715,000
Increment of output of upland and kaingin rice[e] (MT, palay)	93,000	195,000	303,000	421,000	548,000

a Details of calculations are presented in text above
b Average yield, 1,254 Kg per hectare
c Fifteen per cent of area planted to first crop, unirrigated, lowland rice.
d Average yield, 863 Kg per hectare.
e Average yield, 766 Kg per hectare

Table 14 *(continued)*

Total increment in output of palay attributable to extension of land cultivation (MT)	207,000	431,000	671,000	929,000	1,210,000
Proportion of increment in palay requirements in Low Projection provided by estimated extension of land cultivation	0.172	0.205	0.212	0.212	0.211
Proportion of increment of palay requirements *in High Projection* provided by estimated extension of land cultivation	0.159	0.155	0.145	0.135	0.125

CHAPTER IV

REQUIREMENTS OF IRRIGATION DEVELOPMENT, 1965-1990

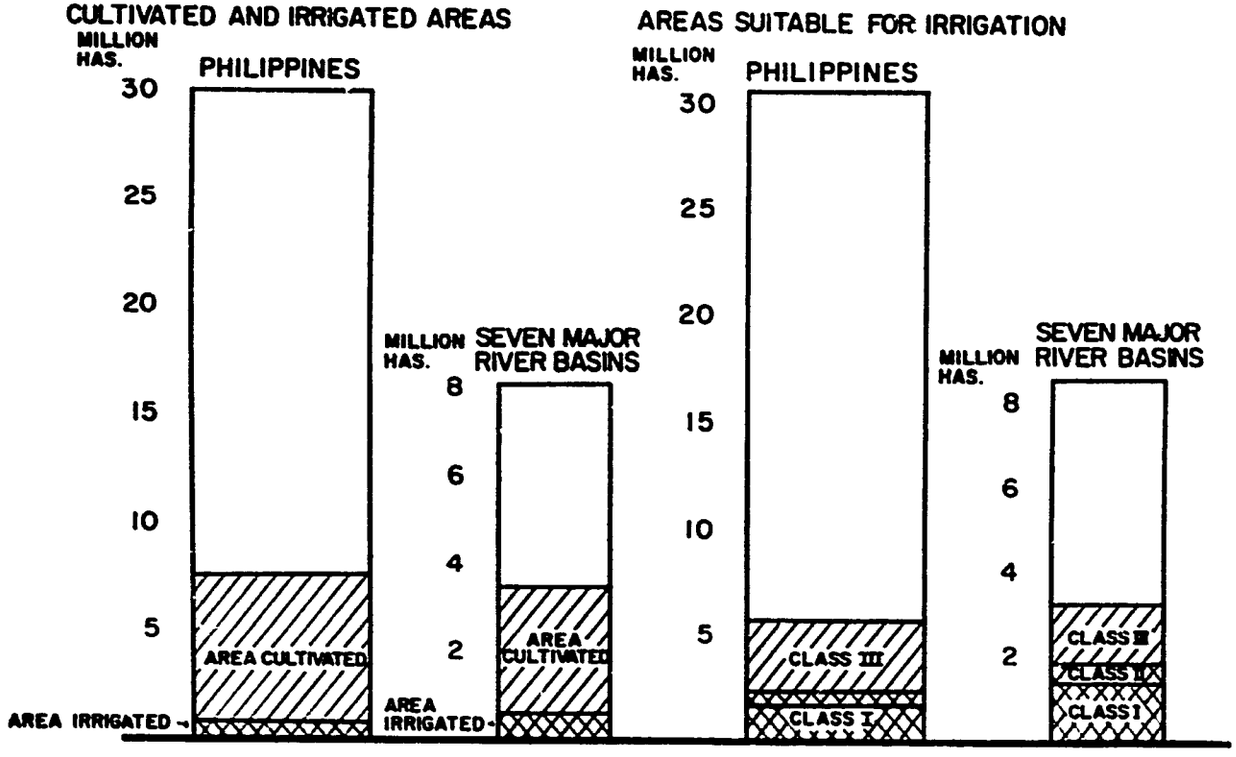
The purpose of Chapter IV of this study is three-fold. First, it includes tentative appraisals of the potentialities for irrigation development in the Philippines using alternative combinations of gravity, pump and storage irrigation. *Irrigation Projection I* is basically an assessment of the potential for expansion of gravity and pump irrigation to alluvial lands with gradients of not more than 3 per cent. Similarly, *Irrigation Projection II* is an assessment of a "feasible" path of irrigation development through a combination of storage facilities superimposed on the gravity and pump irrigation in *Irrigation Projection I*. Second, estimates of the costs (1965 prices) of the alternative projections of irrigation development and estimates of the contribution which the targets in the alternative projections would make to palay production are presented. Third, Chapter IV includes a tentative appraisal of the current *Rice and Corn Productivity Coordinating Council (revised) Master Plan* for gravity and pump irrigation and the contribution which achievement of its targets will make the goal of Philippine rice self sufficiency by mid 1970.

Although the Philippines receives relatively large amounts of rainfall in most areas, it tends to be spread unevenly over the year and agricultural production, particularly of lowland rice, is limited by inadequate water supplies at critical periods. A major contribution from irrigation, therefore, results from the use of irrigation systems to maintain more precise water regulation in growing wet season lowland rice.

As of the present time, there is no water storage for irrigation in the Philippines although the multipurpose Angat River system (design area of about 32,000 hectares) will go into operation in the near future. Irrigation development in the Philippines in the past has been concentrated in gravity systems including those (a) in which the level of river flow is raised by a barrage (low dam) and diverted into canals which distribute the water down stream on lower-lying alluvial soil, and (b) those in which ground or river water is raised by pumps and distributed by gravity flow. Such systems require the construction of main canals and smaller lateral canals to distribute the water to the fields.

As of the mid-1960s, the total area receiving irrigation water and planted to first and second crops in the Philippines was at least 900,000 hectares, with probably 600,000 to 700,000 hectares receiving sufficient

PHILIPPINES: IRRIGATION DEVELOPMENT IN THE MID-1960's AND ESTIMATED POTENTIAL FOR FURTHER DEVELOPMENT



NOTE: BARS ARE DRAWN TO SCALE

Table 15

Philippines: Summary of Irrigation Development, 1948-1966

	CROP YEAR		
	1947-48 (Census)	*1959-60 (Census)*	*Average 1964-1966 (DANR Estimates)*
Total geographic area irrigated	400,121	620,558	750,000[a]
Total area planted, first crop, lowland rice (has.)	1,183,000	1,666,000	2,020,500
Area planted, first crop, irrigated, lowland rice (has.)	330,642	592,413	661,800
Total area planted, second crop, lowland rice (has.)	259,544	351,047	489,200
Area planted, second crop, irrigated, lowland rice has.)	84,210	187,046	287,700
Average yield, first crop, lowland rice (Kg. per ha.) ..	1,134	1,327	1,421
Average yield, first crop, non-irrigated, lowland rice (Kg. per ha.)	1,043	1,190	1,254
Average yield, first crop, irrigated, lowland rice (Kg. per ha.)	1,365	1,575	1,751
Average yield, second crop, lowland rice (Kg. per ha.)	1,034	1,175	1,280
Average yield, second crop, non-irrigated, lowland rice (Kg. per ha.)	988	984	863
Yield, second crop, irrigated, lowland rice (Kg. per ha.)	1,130	1,342	1,571

a Estimated by applying ratio of total area irrigated to area planted to first crop irrigated, lowland palay reported in 1960 Agricultural Census.

water to produce major increments in yields. For the three crop years 1964-1966, plantings of first crop, lowland rice (DANR estimates) averaged 2,020,500 hectares, of which 661,800 hectares were classed as irrigated.[1] The benefits of such irrigation are indicated by the differential yields to the two categories of plantings. In the case of the irrigated plantings, yields of palay averaged 1,751 kg. per hectare while for non-irrigated plantings the average was 1,254 kg In the case of second crop, lowland rice, estimated plantings in the three crop years 1964-1966, averaged 489,200 hectares, with 287,700 hectares irrigated Estimated yields of second crop, irrigated plantings averaged 1,571 kg per hectare as compared to the average for second crop, non-irrigated plantings of 863 kg.

The structure of irrigation systems in the mid-1960s includes gravity systems constructed and administered by the national government, pump irrigation systems designed and financed by the national government and operated communally or privately by water users, and communal and private systems constructed and operated as the result of non-government initiative For the crop year 1965-66, the design area of gravity irrigation systems of the National Irrigation Administration totaled 276,000 hectares and the area planted to first crops in these systems and receiving irrigation water totaled 234,000 hectares or 85 per cent of the design area Inasmuch as such systems do not incorporate storage reservoirs, the availability of irrigation water during the second crop season is sharply limited and such plantings in crop year 1965-66 totaled 97,400 hectares, or 35 per cent of the design area.[2]

The first project of the system of gravity irrigation projects of the National Irrigation Administration comprising 5,640 hectares was opened in 1913 at a cost of P140 per hectare During the decade of the 1920s, projects totaling 60,000 hectares at an average cost of P193 per hectare were opened, in the 1930s, 22,400 hectares with an average cost per hectare of P265, during 1943-1954, 40,600 hectares averaging P428, and in the eleven years ending with 1965, 154,090 hectares averaging P710 per hectare were completed[3] Currently, the *Rice and Corn Productivity Coordinating Council (revised) Master Plan* includes projects to bring 281,500 hectares of land under irrigation in national gravity and communal systems over the four fiscal years ending in mid-1970. The estimated average cost per hectare of additional land irrigated under the *RCPCC (revised) Master Plan* is P817

A second component in the irrigation system is pump irrigation in which pumps, together with technical advice, are provided by the Irrigation

1 For a summary of data from which ratios of yield increments used in the analysis in Part III, as well as data for crop year 1959 60 from the Census of Agriculture for 1960, see Table 15.
2 National Irrigation Administration, **Annual Report, FY 1965 1966**, Tables I and II
3 National Irrigation Administration, **Annual Report, FY 1965-1966**, Table I

Service Unit of the Department of Public Works and Communications. The pump units are sold to organizations of water users or private operators under long-term financing arrangements. For the crop year 1964-65, the ISU reported that 594 pump units were in operation with an irrigable area of 49,000 hectares. During that season, 35,286 hectares (72 per cent of the design area) of first crop, lowland rice received pump irrigation and 7,500 hectares (15 per cent of the design area) of second crop, lowland rice were irrigated by pump units.[4]

The remaining part of the national irrigation system is made up of communal and private irrigation systems, for the most part river flow gravity facilities, but including some pump installations.[5] Although detailed statistics on these systems are not available, in the aggregate, the area served by these systems in the mid 1960s exceeded the area irrigated by the gravity projects of the NIA and the pump projects of the ISU combined.

The irrigation potential of the Philippines has not been adequately studied although its broad outlines can be identified. Final or preliminary reports have been prepared for the Philippine government by the U.S. Bureau of Reclamation on seven major river basins of the Philippines — Agno, Pampanga, Cagayan, Bicol, Cotabato, Agusan and Ilog Hilabangan.[6] The only major basin which has not been studied by the Bureau of Reclamation is that formed by the drainage systems of the Panay and Jalaur rivers on Panay.[7] The seven basins for which studies exist, include some 3.5 million hectares of cultivated land, or about 47 per cent of the land under cultivation in the Philippines in the mid 1960s.[8] The area covered by these studies, moreover, includes the Cagayan basin in Northern Luzon and the Cotabato and Agusan basins in Mindanao, in which are found the principal areas of land suitable for lowland rice which remain to be brought under cultivation. In other words, at least four-fifths and perhaps as much as nine-tenths of the area suitable for lowland rice cultivation and potentially irrigable by gravity systems is included in the seven major river basins.

Within these seven basins, the soils (Class I) best suited for irrigation and lowland rice cultivation comprising alluvial soils formed relatively recently, generally sticky and plastic when wet with compact subsoil and

4 Department of Public Works and Communications, Irrigation Service Unit, **13th Annual Report, July 1, 1964 — June 30, 1965**, Appendix D, pp. 62-91. Note that there are small discrepancies between the data in Appendix D and the statistical summary on p. 2.

5 Inquiry of qualified irrigation engineers confirmed the impression that at least four-fifths of the area in communal and private systems is served by river flow gravity facilities.

6 U.S. Department of Interior, Bureau of Reclamation, **Reports, op. cit.**

7 In mid-1965, the NIA administered five gravity systems on Panay with a design area of 26,100 hectares and additional NIA systems totaling 15,400 hectares were in various stages of planning. The ISU administered pump installations with a design area of 3,668 hectares. Information on other types of irrigation systems on Panay was not found.

8 Ratio of cultivated land in seven basins to average annual area under cultivation. For crop years 1961-1965, total area planted averaged 8.0 million hectares, of which the estimated area in second crops averaged .6 million hectares.

poor internal drainage and with gradients not exceeding 3 per cent, total 1,325,000 hectares or 16 per cent of the land area of the seven basins A second category of potentially irrigable soils (Class II) have developed from older alluvial deposits and have slopes ranging up to 3 per cent Soils in this category are less suitable because the substratum is relatively porous and internal drainage is excessive As a result, water requirements tend to be high as compared to the tighter Class I soils Class II soils in the seven basins total 411,000 hectares or 5 per cent of the basin area The remaining potentially irrigable area comprise those soils (Class III) which possess the physical properties of Class I soils but have excessive slopes as they are undulating to rolling with gradients to 25 per cent Such soils in the seven basins total 1,354,000 hectares or 16 per cent of the land area[9] *Irrigation Projection I* in this study includes no Class III soils and *Irrigation Projection II* includes only a minor proportion of such soils.

The land areas potentially irrigable in the seven basins (Classes I, II and III) total 3,090,000 hectares which is four and a half to five times the area presently included in the diverse irrigation projects making up the national system If we add to the resources of the seven basins, the other areas which are potentially irrigable, it seems clear that the total of such areas would be of the order of 6 5 — 7 5 million hectares or at least ten times the design area included in the existing irrigation systems of various types[10]

Any attempt to estimate the funds required for development of the irrigation potential of the Philippines must involve far-fetched assumptions which become less and less relevant as such projections are extended into the future Obviously, the current system has expanded through a process in which economic feasibility, i e, cost, was a dominant consideration as irrigation was extended to sites involving increasing unit costs Comparable development will take place in the future and current cost estimates, therefore, will have decreasing validity in projecting future costs The reliability of such estimates will also deteriorate as they are applied over time because of general increases in prices and costs Philippine inflation has been modest compared to that in many less developed countries but it has been substantial, and it has accelerated since the mid-1950s Costs per unit of land irrigated will also increase as economic considerations change over time and the Philippines moves to a stage of multi purpose development of water resources including water storage and reservoir irrigation[11]

9 For details see USDI Bureau of Reclamation **Reports, op cit**

10 Assuming that 80 per cent of all Class I and Class II soils and 25 per cent of Class III soils are found in the seven major river basins

11 Storage irrigation development will not be a process of extending irrigation to new lands so much as it will serve to increase the availability of water to lands already irrigated by gravity and pump systems This means that improvements in output will result from second cropping of land not previously planted to a second crop plus the more modest gains from improved water availability and control for plantings of both first crops and second crops presently irrigated

Table 16

Philippines: **Summary of Irrigation Development in Irrigation Projections I and II, 1965-1990**[a]

	1990 *Irrigation Projection I*	1990 *Irrigation Projection II*
Increment of area planted, irrigated, first crop, palay (has.)	1,230,000	1,630,000
Increment of area planted, irrigated, second crop, palay (has.)	457,500	947,500
Estimated capital cost exclusive of interest charges of irrigation facilities (₱ Million)	1,962	7,520
Increment of output, irrigated, first crop, palay (MT)	615,000	873,000
Increment of output, irrigated second crop, lowland palay (MT)	658,572	1,623,572
Total increment of output attributable to irrigation targets	1,273,572	2,496,572
Estimated increment in palay requirements, *Low Rice Projection* (MT)	5,745,000	5,745,000
Estimated increment in palay requirements, *High Rice Projection* (MT)	9,712,000	9,712,000
Ratio of increment of output attributable to irrigation targets to "Low" rice requirements	.222	.437
Ratio of increment of output attributable to irrigation targets to "High" rice requirements	.131	.257

a For details, see subsequent discussion and tables.

Irrigation Projection I

Irrigation Projection I asumes that all lands suitable for lowland rice cultivation and with gradients not exceeding 3 per cent will be brought under gravity and pump irrigation. The total of such soils in the seven major river basins is 1,740,000 hectares and the total for the Philippines is estimated to be about 2,100,000 hectares Since about 600,000 hectares of such soils were serviced by irrigation in the mid-1960s, we assume that all of the remaining 1,500,000 hectares of such soils can be brought under gravity and pump irrigation by 1990 We analyze this process of development in terms of three stages of 500,000 hectares each which exhaust the estimated reserve of suitable soils

To estimate construction costs (in 1965 prices) of *Irrigation Projection I*, we assume that unit costs will increase arithmetically in each succeeding stage from the levels estimated for the irrigation development in the *Rice and Corn Productivity Coordinating Council (revised) Master Plan* for FY 1966 70 In other words, *Irrigation Projection I* assumes that the first 500,000 hectares of gravity and pump irrigation development will cost P820 per additional hectare serviced by gravity irrigation and P540 per hectare of additional area under pump irrigation For the second 500,000 hectares of gravity and pump irrigation, we assume that unit costs will rise to P1,640 per hectare (1965 prices) for additional land under gravity irrigation and P1,080 per hectare added under pump irrigation For the third 500,000 hectares of additional land brought under gravity and pump irrigation (the remaining suitable land), we assume that unit costs will be P2,460 and P1,620 per hectare, respectively [11a]

Finally, we assumed that the "mix" of gravity and pump irrigation in the successive stages of *Irrigation Projection I* will include 60 per cent NIA and communal gravity systems, 30 per cent ISU pump installations and 10 per cent in private systems

Using these assumptions results in the estimate that the first increment of 500 000 hectares served by gravity and pump irrigation (including 50,000 hectares in irrigation systems financed privately), can be added at a total construction cost to the national government of P327 million (1965 prices), or P727 per hectare added in NIA, communal, and ISU projects We estimate that gravity and pump irrigation can be extended to a second increment of 500,000 hectares at a total national government budgetary cost of P654 million, or P1,453 per hectare added The final increment of 500,000 hectares estimated to exhaust the area of class I and class II soils, will require estimated capital outlays of P981 million, or P2,180 per hectare added In other words, *Irrigation Projection I* results in the estimate

11a The cost estimates in **Irrigation Projections I and II** make no allowance for fees collected from water users Past experience suggests that such fees will make a minor contribution to the capital costs of irrigation development

Table 17

Philippines **Estimated Costs of Development of Gravity and Pump Irrigation in Irrigation Projection I**

	First 500 000 hectares added to irrigation system	*Second 500,000 hectares added to irrigation system*	*Third 500 000 hectares added to irrigation system*	*Cumulative Totals*
Increment of design area in private irrigation systems[a]	50,000	50,000	50,000	150,000
Increment of design area in NIA and communal gravity irrigation targets (has)	300,000	300,000	300,000	900,000
Estimated cost per hectare of additional design area, NIA and communal gravity irrigation target (₱, 1965 prices)	820	1,640	2,460	1,640[b]
Estimated total cost of increment of design area in NIA and communal gravity irrigation targets (₱ million)	246	492	738	1,476
Increment of design area in ISU pump irrigation targets (has)	150,000	150,000	150,000	450,000
Estimated cost per hectare of additional design area in ISU pump irrigation targets (₱, 1965 prices)	540	1,080	1,620	1,080[b]
Estimated total cost of increment of design area in ISU pump irrigation targets (₱ million)	81	162	243	486
Estimated total cost to national government of combined increments of design area in NIA, communal and ISU irrigation targets (₱ million)	327	654	981	1,962

a Increment of area served by private irrigation is assumed to incur no capital cost to the national government
b Average cost per hectare of design areas of NIA and ISU projects respectively

that gravity and pump irrigation can be extended to all the suitable soils through budgetary outlays of the order of magnitude of P2 billion (1965 prices) and that in the process, the cost per hectare irrigated by NIA, communal and ISU projects will rise three-fold.

For purposes of analysis, we assume that the gravity irrigation stages in *Irrigation Projection I* materialize at a constant rate of area added over the 24 years, 1967-1990 In other words, the irrigation facilities for the first 500,000 hectares of design area are constructed over the eight fiscal years ending with 1974, the second 500,000-hectare increment over the eight years ending with 1982, and the third over the eight years ending with 1990 We also assume that the required capital funds for the NIA, ISU and communal projects are provided by the national government. It follows from these assumptions that the annual rate of national government expenditures for FY 1967-1974, will be P41 million, for FY 1975-1982, P82 million, and for FY 1983-1990, P123 million.

An impression of the fiscal challenge represented in *Irrigation Projection I* can be obtained readily. It is reasonable to assume that the Philippine population will increase between 1965 and 1990 at a constant rate of 3.2 per cent and per capita real income at a constant rate of 1 0 per cent It follows from these assumptions that real national income (1965 prices) will increase from P17 0 billion in 1965 to P21 0 billion in 1970, P29 2 billion in 1978, and P40 7 billion in 1986 The projected capital costs to the national government of the facilities in *Irrigation Projection I* as a per cent of real national income (1965 prices) would be 0 20 per cent in 1970, 0 28 per cent in 1978, and 0 30 per cent in 1986 In other words, the fiscal resources required will be a minor fraction (up to one-third) of one per cent of levels of real national income which can be expected to materialize over the next quarter century Conceived in these terms, the fiscal challenge is not overwhelming Past experience, however, does not suggest that the public sector will successfully meet even this modest challenge

The remaining task is to assess the potential contribution to output which can be attributed to gravity and pump irrigation goals in *Irrigation Projection I* Our estimates evaluate the contribution of irrigation targets in the absence of other changes productive of output The qualities of land used, the inputs of fertilizer per hectare, working capital and other factors, and techniques of production are assumed to remain unchanged from the mid-1960s To make such estimates, we assume that an average of 85 per cent of the design area of new gravity irrigation projects, both NIA and private, is planted to first crop, irrigated, palay as was true of NIA systems in crop year 1965 66 Similarly, we assume that an average of 75 per cent of the additional design area serviced by pump irrigation is

planted to first-crop, irrigated, palay which approximates the experience of the ISU in the mid-1960s.[12]

The average yield differential attributable to gravity and pump irrigation of first-crop, irrigated, palay on land previously planted to first-crop, non-irrigated, palay is assumed to be 500 kg. per hectare, which approximates the average annual yield increment estimated by the DANR for crop years 1964-1966.[13] We also assume that adequate water supplies exist in the gravity systems to sustain the production of second-crop, irrigated, palay on 35 per cent of the increment in area serviced by NIA and communal gravity irrigation and 20 per cent of the additional area serviced by pump irrigation These ratios approximate those experienced by NIA and ISU in the mid-1960s [14] We also assume that 15 per cent of the additional area planted to second crop, irrigated, palay, is land which previously produced a non-irrigated second crop. This ratio approximates the comparable ratio for crop years 1964-1966 which was 14 per cent. For this proportion of the second crop, we assume a yield differential attributable to irrigation of 700 kg, which approximates the average annual yield differential estimated by the DANR for crop years 1964-1966. It follows from the previous assumption, that 85 per cent of the additional area planted to second crop, irrigated, palay is land that did not previously produce a second crop. The output of this portion of second crop, irrigated, palay, therefore, is a net addition to production. We assume that the average yield from such plantings, in combination with the inputs used in mid-1960s, is 1,570 kg. per hectare, which is approximately the average annual yield level estimated by the DANR reported in for crop years 1964-1966.

To the extent that the assumptions underlying the foregoing analysis are valid, achievement of the targets in *Irrigation Projection I*, in and of themselves, will make a significant contribution to expansion of Philippine rice production The estimated aggregate increment in palay output over

12 We assume that all of the design area of gravity and pump irrigation projects was previously planted to first crop, non irrigated palay and that the proportion of the design areas not, in fact, receiving irrigation water (15 per cent of NIA and communal systems, and 25 per cent of ISU systems) produces a first crop of non irrigated palay No change in output, therefore, is attributed to the portion of the design areas of the added irrigation facilities which do not receive water for first crop irrigation

13 The data supporting the assumed yield differentials are summarized in Table 15

14 The assumption that the ratio of the area irrigated and planted to second crops will remain constant as gravity irrigation is extended to the limits of the suitable soils is unrealistic Although qualified irrigation engineers report that surface water runoff, in the aggregate, is adequate for all irrigation water needs, the runoff is highly irregular As gravity irrigation is extended using water pumped from rivers, water for second crop irrigation will become increasingly scarce and the ratio of the second crop area irrigated to the first crop area irrigated will fall It is quite likely that the ratio would fall by half over the extension of gravity irrigation in **Projection I**, although no adjustment has been made in Table 18 for this factor If the average ratio should fall by one half it would have the estimated increment of output of second crop palay in 1990 attributable to gravity irrigation in Projection I from 656,000 metric tons to 329,000 metric tons This in turn would reduce the estimated total increment of palay output attributable to irrigation expansion in **Projection I** from 1,274,000 metric tons to 945,000 metric tons, a reduction of 26 per cent It should be emphasized that such a calculation of the short fall in palay output because of water scarcity is misleading The short fall in output will be a multiple of that indicated because of the critical importance of irrigation to the realization of the yield potential of improved rice varieties

the three stages would be 1,273,572 MT, with the increment due to irrigation of the dry season crop slightly larger than the increment in output of wet season rice. The increase in palay output attributable to the irrigation targets would be 22.2 per cent of the projected increase in rice requirements for 1990 in the *Low Rice Projection* and 13.1 per cent of the required increase in the *High Rice Projection.*

Important as are the benefits attributable to irrigation, per se, the returns from such facilities will be augmented by the greater returns to fertilizer, high yielding seeds, and other inputs applied to irrigated rice. Any attempt to assess the contribution to output of capital expenditures on irrigation facilities, while holding the proportions and qualities of other inputs constant, is unrealistic. The modern inputs which must materialize if Philippine rice requirements are to be met from domestic production in the future, comprise a package which contributes more to output than the sum of the contributions of the parts considered in isolation. Perhaps the most important gain to be expected from the development in *Irrigation Projection I* would be the intangible benefits in bureaucratic self-confidence and morale engendered in successfully meeting the challenge to organize resources on the required scale.

Table 18

Philippines: **Estimated Additional Palay Production Attributable to Gravity and Pump Irrigation Targets in Irrigation Projection I**

	First 500,000 hectares added to design area of irrigation systems	*Second 500,000 hectares added to design area of irrigation systems*	*Third 500,000 hectares added to design area of irrigation systems*
Estimated additional area planted to first crop, irrigated, palay (has)[a] ..	410,000	820,000	1,230,000
Estimated additional output from first crop irrigated, palay (MT)[b] ..	205,000	410,000	615,000
Estimated additional area planted to second crop, irrigated, palay (has)[c]	152,500	305,000	457,500

a 85% of increment in design area of NIA and private gravity irrigation systems plus 75% of increment of pump irrigation systems.
b Estimated increment in area planted multiplied by yield increment of 500 kg., per hectare.
c 35% of increment in design areas of NIA and private gravity irrigation facilities plus 20% of increment of pump irrigation facilities.

Table 18 (*continued*)

Estimated additional output from second crop, irrigated, palay on land not previously second cropped (MT)[d]	203,511	407,022	610,533
Estimated additional output from second crop, irrigated, palay on land previously in second crop, non-irrigated, palay (MT)[e]	16,013	32,026	48,039
Total estimated additional output of palay resulting from targets in *Irrigation* Projection I (MT)[f] ..	424,524	849,048	1,273,572
Proportion of *Low Projection* of increment in palay requirements in 1990, which would be provided by achievement of targets in *Irrigation Projection I*	.074	.149	.222
Proportion of *High Projection* of increment of palay requirements in 1990, which would be provided by achievement of targets in *Irrigation Projection I*	044	.088	.131

d 85% of area planted to irrigated second crop did not produce a second crop previously. Yield increment per hectare for this component of irrigated plantings — 1,570 kg.
e 15% of area planted to second crop (21,750 has.) produced a second non-irrigated crop previously. Yield increment per hectare for this component of irrigated plantings — 700 kg.
f Sum of three palay output increments.

Irrigation Projection II

Irrigation Projection II assesses the magnitude of the effort required to develop the potential for first and second-crop irrigation through a time sequence in which expansion of gravity and pump irrigation in *Projection I* is followed by development of a "feasible" program of storage irrigation. Fortunately for the purposes of this study, reliable surveys of the potential sites and probable costs of storage irrigation facilities in the Central Luzon basin have been made by the U.S. Bureau of Reclamation.[15]

In making *Irrigation Projection II* we assume that the process of pump and gravity irrigation development outlined in *Irrigation Projection I* takes place over the 25 fiscal years through mid-1990. We further assume that the storage irrigation development planned for the Central Luzon Basin by the Bureau of Reclamation materializes over the fifteen years through mid-1990. The total amount of land that can be irrigated on a year-round basis by the planned Central Luzon Basin projects is about 290,000 hectares and the estimated total capital cost (1965 prices) of the storage irrigation facilities is ₱2,779 million. Finally, we assume that additional storage irrigation projects which aggregate to the total cost and area irrigated of those recommended by the Bureau of Reclamation for the Central Luzon Basin, will materialize elsewhere in the Philippines over the fifteen years through mid-1990. Such an assumption reflects the probable rapid growth of demand for electric power in the Philippines outside of Manila and also the realities of future political development which will enhance the claims of areas outside of Luzon to share in the national government outlays on storage irrigation. In other words, *Irrigation Projection II* assumes that storage irrigation servicing 580,000 hectares of land on a year-round basis at an estimated total construction cost for irrigation facilities of ₱5,558 million will materialize between mid-1975 and mid-1990.

For purposes of analysis, we assume that the required capital outlays for the storage irrigation facilities in *Irrigation Projection II* are made by the national government at the rate of ₱250 million annually during 1975-80, ₱375 million during 1980-85, and ₱500 million during 1985-90.[16] We also assume that the rate at which the area included in the design areas of the systems in *Irrigation Projection II* is brought under irrigation is proportionate to the rate of expenditure.

When the estimated costs of gravity and pump irrigation in *Irrigation Projection I* are added to the foregoing estimates of storage irrigation, they result in estimates of average annual national government budgetary outlays which rise from ₱82 million during FY 1975 to ₱332 million during

15 USDI, Bureau of Reclamation, Central Luzon Basin (Preliminary draft), April 1966, pp. 101-192.
16 These projections of expenditures include no accounting of interest costs, or expenditure of fees collected from water users

Table 19

Philippines: Estimated Costs of Development of Storage Irrigation in Irrigation Projection II, 1975-1990

	Central Luzon Basin[a]	*Total Philippines*
Increment of area not previously irrigated brought under year-round irrigation (has.)	190,000	400,000[b]
Increment of area previously irrigated brought under year-round irrigation (has.)	100,000	180,000[b]
Estimated total construction cost (₱ Million)	2,779	5,558
Construction cost per hectare brought under year-round irrigation (₱)	9,583	9,583

FY 1976-1980 and ultimately reach ₱623 million during FY 1986-1990. Applying the same assumptions used to appraise the magnitude of the fiscal challenge represented by *Irrigation Projection I* [17] results in the estimate that the capital costs of *Irrigation Projection II* (gravity and storage facilities combined) would be a maximum of 1.5% of real national income (1965 prices). When appraised in this way, the challenge to mobilize the financial resources necessary to achieve the targets in *Irrigation Projection II* is formidable, but clearly within the capabilities of the Philippine society. Outsiders can only hope that the leadership will prove adequate to meet the challenge.

The remaining task is to estimate the contribution to output which can be expected from the storage irrigation in *Irrigation Projection II*. Because storage results in reliable control of water through both the first-crop and second-crop seasons, the differential yields will be higher than

a U.S. Bureau of Reclamatoin, Central Luzon Basin (Preliminary draft), April 1966.
b It is assumed that the proportion of land previously irrigated which will be included in storage irrigation projects outside Central Luzon will be lower than in the Central Luzon Basin where gravity and pump irrigation is more advanced. Of the estimated total of 290,000 hectares in storage irrigation projects to be completed outside of Central Luzon, an estimated 210,000 hetcares is assumed to be land not previously under irrigation.
17 Supra, p. 75.

those indicated by yields from gravity and pump irrigation. We assume that the average increment of yield from land serviced by storage irrigation, combined with other factor inputs per units of land of amounts and qualities in mid-1960s, over the yield from the same land growing first-crop, non-irrigated, palay to be 600 kg., per hectare. Similarly, the average yield increment from storage irrigation extended to lands previously receiving gravity and pump irrigation is assumed to be 100 kg., per hectare. We further assume that the average output per hectare of second crop, storage-irrigated, palay (other inputs those of mid-1960s) to be 2,000 kg. as compared to the average output per hectare of second crop, gravity-irrigated, palay of 1,600 kg., per hectare.[18]

Table 20

Philippines: **Estimated Expansion in Rice Production Attributable to Storage Irrigation in Projection II**
(Cumulative Totals)

	1975-80	*1980-85*	*1985-90*
Increment of design area of storage irrigation targets not previously irrigated	88,889	222,222	400,000
Increment of output of first-crop irrigated, palay from above area (MT)[a]	53,333	133,333	240,000
Increment of output of second crop, irrigated, palay from above area (MT)[b]	166,443	416,109	749,000
Increment of area previously receiving gravity or pump irrigation brought under year-round storage irrigation (has.)	40,000	100,000	180,000
Increment of output of first crop, storage irrigated, palay from area previously irrigated by gravity or pump irrigation (MT)[c]	4,000	10,000	18,000

18 For the statistical basis for these assumptions, see the yields reported by the DANR for crop years 1964-1966 in Table 15

a Average increment of palay output per hectare — 600 kg. The basis for this incremental yield ratio is the average annual yield reported for first crop, non-irrigated plantings during crop years 1964-1966 of 1,254 kg per hectare as compared to estimated average yield from first crop, storage-irrigated plantings in the future of 1,850 kg The latter estimate provides for an increment of 100 kg over the average yield from first crop, gravity-irrigated plantings during crop years 1964-1966.

b Average increment of palay output per hectare on 85 per cent of area not previously planted to a second crop is estimated to be 2,000 kg This figure is based on the widely accepted evidence that yields from second crop palay receiving adequate irrigation are slightly higher than from first crop palay receiving irrigation Average increment of palay output per hectare on remaining 15% of area previously planted to a non-irrigated, second crop — 1,150 kg, or approximately the difference between 2,000 kg. and the second crop yield experienced during crop years 1964-1966 in the absence of irrigation.

c Average increment of first crop, irrigated, palay output per hectare attributable to shift from gravity and pump to storage irrigation — 100 kg

Table 20 (*continued*)

	1975-80	*1980-85*	*1985-90*
Increment of area previously gravity or pump irrigated which did not produce a second-crop of palay (has.)[d]	20,000	50,000	90,000
Increment of output of second crop storage-irrigated, palay from area previously gravity or pump irrigated which did not produce a second crop of palay (MT)[e]	40,000	100,000	180,000
Increment of output of second-crop, storage-irrigated, palay from area previously gravity or pump irrigated and producing a second crop of irrigated palay (MT)[f]	8,000	20,000	36,000
Sum of increments in palay production attributable to storage irrigation in *Irrigation Projection II*	271,776	679,442	1,223,000
Sum of increments in palay production attributable to gravity and pump irrigation and storage irrigation in *Irrigation Projection II*	n.a.	n.a.	2,496,572
Proportion of "low" projection of increment in rice requirements for 1990 provided by irrigation development in *Irrigation Projection II*	n.a.	n.a.	.437
Proportion of "high" projection of increment in rice requirements for 1990 provided by irrigation development in *Irrigation Projection II*	n.a.	n.a.	.257

d Fifty per cent of area previously irrigated. Average annual ratio of plantings of second crop, irrigated, lowland rice to first crop, irrigated plantings reported by the DANR for the crop years 1964-1966 was 43.5 per cent.

e Average increment of palay output per hectare — 2,000 kg.

f Average increment of palay output per hectare — 400 kg. Basis for this yield ratio is average annual yield reported for second crop, irrigated plantings during crop years 1964-1966 of 1,571 kg. per hectare as compared to estimated average yield to second crop plantings receiving storage irrigation in the future of 2,000 kg.

g For details of increment resulting from gravity and pump systems in Irrigation Projection I, see Table 18.

To the extent that the goals in *Irrigation Projection II* materializes in the future, the Philippines will derive substantial increments in rice output from irrigation alone. If the assumptions regarding incremental yields and areas are valid, storage irrigation development will contribute 1,223,000 metric tons of palay output in 1990 as compared to zero tons in crop years 1964-1966. If such development of storage irrigation is superimposed on gravity and pump irrigation development in *Irrigation Projection I*, the total increment of palay production in 1990 as compared to production in the mid-1960s, would be about two and a half million metric tons, or more than two-fifths of the increase necessary to maintain per capita direct absorption of rice at post-1949 levels.[19]

Assessment of the RCPCC (revised) Master Plan

The Philippines is currently engaged in a major program designed to achieve self-sufficiency in rice by 1970. The dimensions of this task are bounded by (a) growth in population which currently is increasing at an estimated 3.3 per cent annually, (b) current levels of imports of milled rice which average 222,000 metric tons annually (approximately ten per cent of domestic production) over the four years ending with 1965, and (c) the interruption in the post-war expansion in the area planted to rice.[20] If 1949-1964 levels of per capita direct rice absorption are to be maintained and imports eliminated beginning in mid-1970, it will require average annual increases in palay production during the five crop years ending with 1970 of at least 245,000 metric tons.[21] The total required increase in production of palay over this period to achieve self-sufficiency is 1,227,000 metric tons or 31 per cent of the average annual production of palay in the three crop years 1964-1966.

Central to the *Rice and Corn Productivity Coordinating Council (revised Master Plan* for rice self-sufficiency by 1970 is a program to expand the gravity irrigation network including systems administered by the National Irrigation Administration (NIA) and communal systems. Under the *RCPCC Plan,* the NIA is responsible for the completion of gravity irrigation projects (NIA and communal) which will provide irrigation to 281,497 hectares not presently irrigated. This target is equal to the design area of NIA gravity systems (282,643 has.) in operation in 1965-66 and is 121 per cent of the area of first crop, palay plantings on the land served by NIA gravity systems in crop year 1965-66.[22] Although statistics on the area of land irrigated by communal systems are not available for all provinces, the area irrigated by such systems in the seven major river

19 Or one quarter of the additional output necessary to meet the High Projection of rice requirements in 1990.
20 The area planted has actually declined from levels reached in crop years 1959 and 1960.
21 For other assumptions see discussion of Low Rice Projection in Chapter I of this study.
22 Such plantings included about one per cent in other crops. For details, see NIA, Annual Report, FY 1965-66, Tables I and II.

basins in the Philippines in the mid-1960s was about 150,000 hectares.[23] Since these seven major river basins include at least 80 per cent of the area presently irrigated, it is assumed that the total design area of communal systems presently in operation is 180,000 hectares. The target assigned to the NIA in the *RCPCC (revised) Master Plan,* therefore, is to expand the area served by NIA and communal gravity irrigation systems by about three-fifths of the design area of such systems in operation during crop year 1965-66.

The second major irrigation goal of the *RCPCC (revised) Plan* is to bring an additional 294,890 hectares under irrigation through the distribution of 10,984 pump units by the Irrigation Service Unit of the Department of Public Works and Communications over the four years ending with crop year 1969-70.[24] The revised target area is 382 per cent of the design area (77,184 hectares) of pump irrigation projects designed and financed by the Irrigation Service Unit from its founding in 1952-53 through 1966.[25] The target of 10,984 pump units is 761 per cent of the number of pumps installed (1,439 units) with ISU technical advice and finance from its founding through 1966. The target area assigned the ISU, moreover, is 836 per cent of the area planted to irrigated first crops (35,286 has. including 32,626 has. in lowland rice) served by the 594 pump units designed and financed by the ISU and actually in operation in crop year 1964-65.[26]

The combined areas presently included in NIA gravity systems, ISU pump units and the estimated area irrigated by communal systems total some 530,000 hectares of which some 450,000 were actually planted to irrigated first crops in the mid-1960s. The *RCPCC (revised) Master Plan* targets propose to bring irrigation to an additional 576,387 hectares. This is about 109 per cent of the design area of existing system in these categories in the mid-1960s, and about 128 per cent of the area planted to irrigated first crops in existing systems in these categories in the mid-1960s.

The targets assigned to the NIA and ISU represent formidable challenges to those agencies. They are charged with mobilizing resources to undertake levels of activities many times any levels they have sustained in the past and the likelihood that the targets they have been assigned will be met is not promising. Past experience does not encourage belief that the funds allocated to the NIA and ISU under the RCPCC (revised) Master

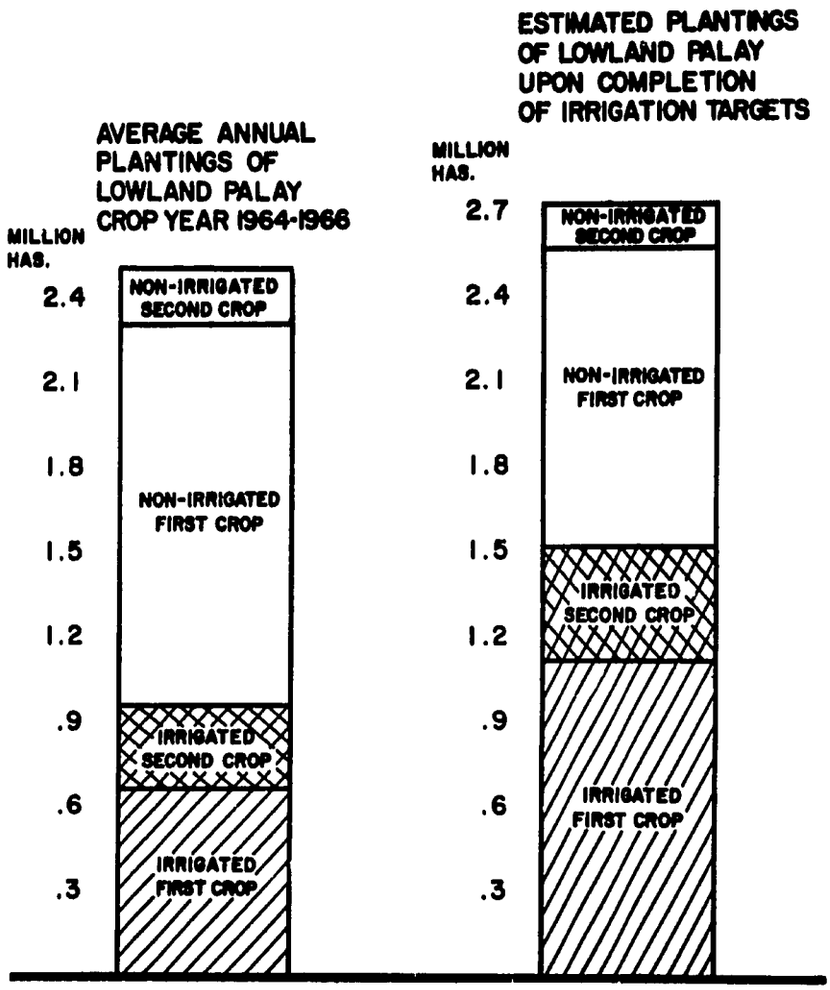
23 Including 122,000 hectares in five major basins plus half of the area in communal and private systems combined in two basins (Agusan and Ilog-Hilabangan) for which a breakdown between the two types of systems is not given.

24 The **RCPCC Master Plan** as revised in early 1967 raised the targets assigned the ISU to make up the short fall in the accomplishment of both the ISU and the NIA in 1966-67. The revised master plan raised the target area of the ISU by 69,248 hectares, to be accomplished by a "crash program" of pump installatioln in 1967-68

25 For statistics on RCPCC (revised) Master Plan targets and historical statistics on the activities of the ISU, see Sycip, Gorres, Velayo and Co., **Summary Report of Findings and Recommendations on the Irrigation Service Unit to the RCPCC First Phase, Manila,** April 1967

26 For ISU units in operation and area cultivated in crop year 1964-65, see ISU, **12th Annual Report, FY 1964-65.**

PHILIPPINES: IRRIGATION TARGETS OF RCPCC (REVISED) MASTER PLAN, FY 1966-1970



TOTAL PLANTINGS OF LOWLAND PALAY ESTIMATED TO INCREASE 1.5 PER CENT ANNUALLY

NOTE: BARS ARE DRAWN TO SCALE

Table 21

Philippines: **Targets Assigned to the National Irrigation Administration and the Irrigation Service Unit Under the Rice and Corn Productivity Coordinating Council (Revised) Master Plan for FY 1966-1970** [a]

	(Fiscal Years)				*Total*
	1966-67	*1967-68*	*1968-69*	*1969-70*	*1966-70*
NIA Targets					
Additional area to be irrigated (has.)	69,474	106,324	46,024	59,675	281,497
Estimated funds required (₱ million) ..	66.6	68.0	53.3	42.3	230.2
Estimated average cost per hectare (₱)	959	640	1,158	709	817
ISU Targets					
Additional area to be irrigated (has.)	14,200	157,150	57,700	65,840	294,890
Number of pump units to be installed	230	6,133	2,204	2,381	10,984
Additional area irrigated per pump unit (has.) .	62.0	25.6	26.2	27.6	26.8
Estimated funds required (₱ million)	5	64	43	46	158
Estimated average cost per pump unit (₱000).	21.7	10.4	19.5	19.3	14.4
Estimated average cost per hectare (₱)	352	407	745	699	536

[a] RCPCC (revised Master Plan, November 1966. Original area targets assigned ISU were: 1966-67, 50,000 has. and 1967-68, 52,100 has. Original targets for pump units were: 1966-67, 1,870 units and 1967-68, 1,562 units.

Plan will be forthcoming. Even if they should be made available, the requirements of administrative leadership and elan necessary to overcome decades of inertia and bureaucratic ennui probably can not be mobilized in time to meet the targets. That such a result is likely, is evidenced by the procedure used to "revise" the *RCPCC Master Plan*. The very substantial short-fall in planned accomplishments of the ISU and the more modest short-fall in NIA targets during fiscal year 1966-67 were merely added to the targets assigned to ISU for fiscal year 1967-68. It is difficult to believe that the ISU can increase the level of its activities in FY 1967-68 over that of FY 1966-67 by 1,100 per cent.

Be that as it may, what contribution to output can be expected should the targets of the *RCPCC (revised) Master Plan* be met, and what is the relationship of these targets to the goal of rice self-sufficiency in 1970? To estimate the magnitude of these contributions, it is necessary to estimate the proportion of the design area of the *RCPCC Plan* target areas which will actually be planted to first and second crops and the additional production which is attributable to such plantings from gravity and pump irrigation. To make such estimates, we apply yield ratios derived from those reported by the DANR for the crop years 1964-1966, and data for the mid-1960s on the areas serviced by NIA systems and ISU pump installations.[27] Our estimates, therefore, attempt to assess the contribution of *RCPCC Plan* irrigation targets with techniques and inputs used in the mid-1960s.

For the crop year 1965-66, the ratio of first crop, irrigated lowland rice plantings to the design area of existing NIA gravity systems was 85 per cent and the ratio of the second crop, irrigated plantings was 35 per cent. Applying these ratios to the *RCPCC Plan* target area assigned to NIA results in the estimate that the assigned targets will result in an additional 239,000 hectares planted to first crop, irrigated, palay and an additional 98,500 hectares planted to second crop, irrigated, palay in crop year 1970-71 as compared to such plantings in the mid-1960s.[28]

For the crop year 1964-65, the ISU reported that the ratio of first crop, irrigated plantings to the "irrigable area" of pump irrigation projects actually operating was 72 per cent and the ratio of second crop, irrigated plantings was 17 per cent. Applying these ratios to the *RCPCC Plan* targets assigned to the ISU results in the estimate that the targets will add 212,300 hectares of first crop, irrigated, palay and 50,130 hectares of second crop, irrigated, palay in crop year 1970-71 as compared to plantings in the mid-1960s.

27 For a summary of the data on which the assumed yield ratios are based, see Table 15.
28 Assuming that the entire target area was previously planted to the first season, non-irrigated, palay.

Formidable as are the targets of the *RCPCC (revised) Master Plan* targets, irrigation development alone will make only a partial contribution to the achievement of rice self-sufficiency by 1970. The increment of palay output attributable to the RCPCC irrigation targets increases from 77,207 metric tons of palay in crop year 1966-67 to 462,531 metric tons in crop year 1969-70. On the other hand, to maintain postwar per capita absorption of rice and eliminate rice imports by mid-1970 will require output increments of palay increasing from 490,000 in 1966-67 to a cumulative total of 1,225,000 metric tons in 1970. In other words, to achieve self-sufficiency by 1970 without reducing per capita absorption or rice will require other inputs — higher yielding seeds, fertilizer, insecticides, credit, and so forth — which must account for some three-fifths of the required increase in palay production over the four crop years.

The estimated funds required to achieve RCPCC targets total ₱388 million. Although the estimated funds required represent many times the rate of fund utilization by these agencies in the past, they do not represent a discouraging challenge in terms of Philippine fiscal capabilities.[29] Average annual expenditures programmed under the *RCPCC Plan* of ₱97 million represent only 5.2 per cent of average annual national government expenditures and 5.3 per cent of average annual revenues over the five fiscal years ending June 30, 1965.[30] The rate of estimated expenditures required to achieve RCPCC targets, moreover, represents only one-eighth of the increase in average annual national government expenditures and revenues during the five fiscal years ending June 30, 1965 as compared to the previous five fiscal years. The programmed level of expenditures is clearly within Philippine fiscal capabilities. This is not to say, however, that such expenditures will materialize.

A more formidable constraint that must be overcome in achieving the RCPCC targets are the administrative and organizing capabilities of the NIA and the ISU. The many-fold expansion required in the activities of these agencies will have to be matched by expansion in personnel and the writers have no basis for estimating the likelihood that this can be done without sacrificing productivity. The performance of government agencies in the past does not encourage optimism in assessing the prospect that NIA and ISU will meet the RCPCC irrigation targets.[31]

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29 For details of fund utilization, see Sycip, Gorres, Velayo and Co., **Summary Report of Findings and Recommendations** (to the RCPCC) **on the National Irrigation Administration**, Manila January 1967, and on the **Irrigation Service Unit**, Manila, April 1967.

30 For details see U.N. ECAFE, **Economic Survey of Asia and the Far East.**

31 For informed analysis of the management performance of these agencies, see Sycip, Gorres, Velayo and Co., *op. cit.*

Table 22

Philippines: Estimated Contribution of Irrigation Targets of the RCPCC (Revised) Master Plan to Achievement of Rice Self-Sufficiency (Cumulative Total)

	1966-67	*1967-68*	*1968-69*	*1969-70*
Additional target area to be irrigated by NIA (has.)	69,474	175,798	211,822	281,497
Additional target area to be irrigated by ISU (has.)	14,200	171,350	229,050	294,890
Total additional target area (has.)	83,674	347,148	450,872	576,387
Additional area harvested of first-crop, irrigated, lowland rice[a] (has.)	69,277	272,800	353,465	451,593
Additional production of first-crop irrigated, lowland rice attributable to irrigation targets[b] (MT) ...	34,639	136,400	176,732	225,797
Additional area of second crop, irrigated, lowland rice on land not previously planted to a second crop[c] (has.)	22,721	77,060	96,115	126,357
Additional production of second crop, irrigated, lowland rice on target area not previously second cropped[d] (MT)	39,762	134,855	168,201	221,125
Additional area of second crop, irrigated lowland rice on land previously producing second crop, non-irrigated lowland rice[e] (has.)	4,009	13,598	16,962	22,298

a Eighty-five per cent of NIA target area plus 72 per cent of ISU target area.

b Assumes that additional output per hectare will be 500 kg, which approximates yield differential reported by the DANR for crop years 1964-1966

c The ratio of the area planted to second crop, non-irrigated, lowland rice to that planted to first crop, non-irrigated, lowland rice reported by the DANR for the crop years 1964-1966 was 15 per cent. We assume, therefore, that all of the RCPCC design area was previously not irrigated and that 85 per cent previously did not produce a second crop. Following extension of irrigation programmed by the **RCPCC Plan**, 35 per cent of the NIA target area and 17 per cent of the ISU target area which previously did not produce a second crop is assumed to produce a second crop of irrigated lowland rice To obtain area planted, multiply NIA target area by factor .2975 (.85 x .35) and ISU target area by factor .1445 (.85 x .17).

d Increment of yield per hectare — 1,750 kg, which approximates yield reported by the DANR for the crop years 1964-1966

e Fifteen per cent of additional target area previously produced a second crop, non-irrigated, lowland rice. Following RCPCC Plan implementation, 35 per cent of the NIA portion and 17 per cent of the ISU portion of this part of the total target area will shift to production of second crop irrigated, lowland rice. To obtain area planted, multiply NIA target area by factor .0525 (.15 x .35) and ISU target area by factor .0255 (.15 x .17).

Table 22 (*continued*)

	1966-67	*1967-68*	*1968-69*	*1969-70*
Additional production of second crop, irrigated, lowland rice on land previously producing second crop, non-irrigated lowland rice[f] (MT)	2,806	9,518	11,873	15,609
Sum of increments of palay output attributable to irrigation targets of *RCPCC (revised) Master Plan* (MT)	77,207	280,773	356,806	462,531
Required cumulative increments of palay output for rice self- sufficiency in 1970 under *Low Rice Projection* (MT)	490,000[g]	735,000	980,000	1,225,000
Proportion of required (cumulalative) increment of palay output for rice self-sufficiency in 1970 which must be provided by inputs other than irrigation targets of *RCPCC Plan*	.842	.618	.636	.622

Should the targets of the *RCPCC (revised) Master Plan* be met, they would provide, in and of themselves, some two-fifths of the additional palay required for self-sufficiency at levels of direct rice absorption which have prevailed over the postwar period. Such an assessment undoubtedly was available to those who drew up the targets in the *Plan*. If this was the case, the *Plan* serves to emphasize the faith held by agricultural policy planners in the Philippines in the yield potential in the promising new rice varieties such as IR-8 and BPI-76. Such faith is not misplaced if it is combined with adequate awareness of the new rice technology as a "package" of modern inputs; each highly productive of output when combined with the others at recommended levels of application, but each modern input (with the exception of irrigation) capable of making only a limited contribution to output in isolation. Development of the Philippine irrigation potential will require a policy emphasis in the future which it has never received in the past. As suitable land resources approach exhaustion, irrigation becomes the obvious way to "produce" added inputs of land. More important, is the critical importance of adequate and controlled supplies of water to the productivity of the "package" of modern inputs.

f Increment of yield per hectare — 700 kg, which approximates yield increment reported by the DANR for the crop years 1964-1966.
g Includes required average annual increments of palay output for two years under Low Rice Projection for rice self-sufficiency in 1970.

The priority needed is not for a "crash program" for rice self-sufficiency in 1970, but to begin to "tool up" for the long term, integrated development of Philippine water resources — for irrigation, power, recreation, and direct human consumption. The lead time necessary for integrated water resource development militates against the ultimate contribution of short-term "crash programs".

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Table C1

Philippines: Area Planted, Production and Yields of Irrigated and Non-Irrigated, First Crop Palay, 1960[a]

	Area Irrigated, first crop Palay (Has.)	*Area Non-irrigated, first crop Palay* (Has.)	*Production Irrigated, first crop Palay* (MT)	*Production Non-irrigated, first crop Palay* (MT)	*Yield Irrigated, first crop Palay* (Kg./Ha.)	*Yield Non-irrigated, first crop Palay* (Kg./Ha.)
Bulacan	19,894	33,926	36,211	45,830	1,820	1,351
Nueva Ecija	72,127	86,199	137,700	133,346	1,909	1,547
Pampanga	32,124	24,251	53,700	35,614	1,672	1,469
Pangasinan	44,449	63,892	71,735	68,739	1,614	1,076
Tarlac	31,209	51,446	60,182	66,892	1,928	1,300
Central Luzon Basin	199,803	259,714	359,528	350,421	1,799	1,349
Laguna	17,372	4,463	30,867	6,090	1,777	1,373
Cavite	12,873	3,767	21,382	3,509	1,661	932
Cotabato	38,274	83,245	50,047	101,991	1,308	1,225
Agusan	1,732	8,029	1,922	8,447	1,110	1,052
Camarines Sur	21,529	27,583	31,411	31,492	1,478	1,142
Cagayan	7,654	48,514	13,409	65,136	1,752	1,343
Isabela	25,887	65,994	43,237	85,762	1,670	1,300
Above listed provinces	325,124	501,282	551,803	652,848	1,697	1,302
Total, Philippines	592,413	1,073,587	933,033	1,277,804	1,575	1,190

a Bureau of Census and Statistics, Agricultural Census, Summary, Table 17.

Table C2

Philippines: Irrigation Potential and Estimated Construction Costs of Integrated Development of the Central Luzon Basin[a]

	Area of Year-round Irrigation (Hectares)	*Area of new land* (Hectares)	*Additional Area Subject to Dry Season Irrigation*[c] (Hectares)	*Construction Costs*[d] (₱ Million)	*Construction Costs per Hectare of Land Irrigated Year-round* (₱)	*Construction Costs per Hectare of Additional Land under Dry Season Irrigation* (₱ Per Hectare)
Canaan Project[b] ..	20,700	20,700	20,700	178,655	8,631	8,631
Papaya Project ...	5,700	5,700	5,700	66,206	11,615	5,700
Balintingon	29,600	11,900	11,900	138,159	11,610	11,900
Bulu	8,600	8,600	8,600	87,148	10,133	8,600
Agno	80,000	63,000	71,160	856,145	10,701	12,031
Santa Rosa	11,400	11,400	11,400	203,561	17,856	11,400
O'Donnell	11,600	3,600	7,560	125,106	10,785	16,548
Balog-Balog	16,200	12,600	15,682	101,192	6,246	6,453
Camiling	17,800	9,800	16,696	125,386	7,044	7,570
Pila	8,000	8,000	8,000	86,786	10,848	10,848
	209,600	155,300	177,398	1,968,344	10,257	11,096
Upper Pampanga River Project ..	81,000	35,300	74,145	197,226	2,435	2,660
Central Luzon Basin	290,600	190,600	251,543	2,165,570	7,935	8,609

a U.S Department of Interior, Bureau of Reclamation, **Central Luzon Basin** (Preliminary draft), April 1966, and U.S. Department of Interior, Bureau of Reclamation, **A Report on the Upper Pampanga River Project**, September 1966.

b The Canaan Project will release water down the Pampanga River for diversion by the Bongabon Dam to irrigate 20,700 has. of land served by the Pantabangan reservoir of the upper Pampanga project. The Pantabagan water "saved" would be diverted to irrigate 20,700 has. of new land in the Guimba area. Area irrigated by Canaan Project, therefore, is considered to be new lands

c Area of new land plus area of irrigated land in existing systems multiplied by ratio of land not dry season irrigated in existing system. Dry season irrigation is attributed to only five existing systems in program for integrated development of the Central Luzon Basin. Reported ratios of dry season irrigation of land in existing systems includes Agno Project, 48.0%, O'Donnell, 49.5%, Balog-Balog, 85.6%, Camiling, 86.2%, and Upper Pampanga, 85.0%.

d Not including cost of power facilities.

Table C3

Philippines: **Irrigation Potential of Seven Major River Basins**
(Hectares)

	Central Luzon basin[b]	*Cagayan River basin*	*Bicol River basin*	*Cotabato River basin*	*Agusan River basin*	*Ilog-Hilabangan River basin*	*Total six basins*
Total land area	1,800,000	2,811,000	312,000	2,003,000	1,150,000	210,000	8,286,000
Area under cultivation	993,000	828,000	252,500	1,028,000	288,000	122,000	5,784,000
Area irrigated	290,026	114,000	21,469	64,659	18,000	24,000	532,154
NIA systems	161,820	34,728	4,913	5,300	—.—	—.—	206,761
ISU (pump) units	32,037	1,245	6,672	160	—.—	—.—	40,114
Communal systems	52,730	21,000	8,250	39,946	(18,000	(24,000	(285,235
Private systems	43,439	56,983	1,634	19,253	(	(	(
Area of potential irrigation							
Class I	508,000	387,000	75,600	266,600	87,200	900	1,325,300
Class II	208,000	600	3,200	139,900	—.—	59,400	411,100
Class III	109,000	400,000	20,100	592,500	166,000	66,000	1,353,600
Not irrigable	835,000	1,242,000	213,100	975,500	873,400	83,700	4,222,700
Unclassified	240,000	780,500	—.—	55,500	23,400	—.—	1,099,400

a Basic references are reports on basins prepared by the U.S. Department of Interior, Bureau of Reclamation. Final reports include Upper Pampanga River Project (September 1966), Cotabato River Basin (November 1966), and Cagayan River Basin (December 1966). Preliminary reports include, Central Luzon Basin (April 1966), Ilog-Hilabangan River Basin (November 1966), Agusan River Basin (September 1966), and Bicol River Basin (October 1966).

b Includes Pampanga River Basin and Agno River Basin

Table C4

Philippines: **Area Planted, Production and Yields of Irrigated and Non-irrigated, Second Crop, Palay, Crop Year 1960** [a]

	Area Irrigated, second crop Palay (Has.)	*Area Non-irrigated, second crop Palay* (Has.)	*Production Irrigated, second crop Palay* (MT)	*Production Non-irrigated, second crop Palay* (MT)	*Yield Irrigated, second crop Palay* (Kg./Ha.)	*Yield Non-irrigated second crop Palay* (Kg./Ha.)
Bulacan	8,343	1,853	12,218	3,402	1,464	1,836
Nueva Ecija	4,821	881	8,097	1,221	1,680	1,386
Pampanga	14,308	1,107	21,292	1,377	1,488	1,244
Pangasinan	5,791	1,811	7,830	1,845	1,369	1,019
Tarlac	5,791	743	8,467	906	1,462	1,219
Central Luzon Basin	38,982	6,395	57,904	8,751	1,485	1,368
Laguna	9,598	820	16,122	789	1,680	962
Cavite	3,001	212	4,745	169	1,581	797
Cotabato	2,359	11.476	2,374	11,119	1,006	969
Agusan	1,001	2,739	1,072	2,475	1,071	904
Camarines Sur	10,015	9,596	12,179	8,460	1,216	882
Cagayan	4,678	22,357	6,365	25,583	1,361	1,144
Isabela	3,294	1,168	4,564	1 400	1,386	1,199
Above listed provinces	73,128	54,763	105,325	58,746	1,440	1,073
Total, Philippines	187,046	164,001	251,020	161,436	1,342	984

a Bureau of Census and Statistics, Agricultural Census, Summary, Table 18.

Table C5

Philippines: National (Gravity) Irrigation Systems; Summary of Harvest Reports, Crop Year 1965-66 [a]
(Hectares)

Province	*No. of Systems*	*Design Area*	*Irrigated Land Under Cultivation* *1st Crop*	*Ratio to Design Area*	*2nd Crop*	*Ratio to Design Area*
Cagayan	1	400	261	65.3	242	60.5
Isabela	2	30,900	27,792	90.0	17,275	55.9
		31,300	28,053	89.6	17,517	60.0
Nueva Ecija	9	57,780	55,050	95.3	10,354	17.9
Bulacan	2	29,130	28,887	99.2	12,936	44.4
Pampanga	1	5,400	4,799	88.9	3,616	67.0
Pangasinan	4	22,520	19,074	84.7	7,428	33.0
Tarlac	4	29,940	20,760	69.3	2,144	7.2
Other provinces of		144,770	128,570	88.8	36,478	25.2
Northern Luzon	13	21,240	17,697	83.3	8,127	38.3
Southern Luzon	23	28,593	21,849	76.4	18,460	64.6
Visayas	15	34,170	29,366	85.9	9,760	28.6
Cotabato	2	11,500	5,592	48.6	5,248	45.6
Other provinces of Mindanao	3	4,300	3,097	72.0	1,770	41.2
Total	79	275,873	234,244[b]	84.9	97,360[c]	35.3

a National Irrigation Administration, Annual Report, FY 1965-1966 (Quezon City, August 17, 1966).
b Planted to rice except for 2,766 hectares in sugar cane in Tarlac, Negros Occidental and Negros Oriental provinces and vegetables in Nueva Ecija.
c Including 9,206 hectares planted to crops other than rice. Largely tobacco in Northern Luzon

Table C6

Philippines: **Systems of National Irrigation Projects, June 30, 1966**

Period in which Projects were completed	*Number of Projects*	*Potential Area Irrigated* (Has.)	*Cost of Projects* (₱ 000)	*Cost Per Hectare* (₱)
1910-1919	1	5,640	789	140
1920-1929	9	59,890	11,574	193
1930-1940	2	22,400	5,941	265
1945-1949	4	4,161	714	172
1950-1954	14	36,462	17,690	485
1955-1959	33	106,080	74,890	706
1960-1965	16	48,010[b]	34,515	785
Total	79	282,643	146,114	517

a National Irrigation Administration, **Annual Report, FY 1965-1966**, Table I.
b Includes 4,030 hectares which were formerly in communal systems or were included in the cost of other systems. Cost for this period covered systems totaling 43,980 hectares.

CHAPTER V

ESTIMATED REQUIREMENTS OF SOME "MODERN INPUTS" FOR DEVELOPMENT OF THE RICE ECONOMY, 1965-1990

Introduction

Chapter V presents a series of projections of future requirements of "modern inputs" necessary to increase palay output to levels meeting rice requirements for 1990 in the alternative *Low* and *High Rice Projections.* The term "modern inputs" refers to more productive rice varieties, fertilizers, pesticides, herbicides and fungicides, and working capital provided by modern financial institutions as opposed to traditional sources of credit such as landlords, money lenders, and middlemen.[1] Although the analysis of this chapter considers the requirements of the various modern inputs in isolation, in fact, they represent a "package" which must be introduced into rice production to realize the yield potential of recent technological advances in rice research.[2]

To estimate 1990 requirements of those modern inputs for which quantification is meaningful, it is assumed that recommended applications of fertilizers and agricultural chemicals, in combination with improved rice varieties, are applied to all of the irrigated area planted to lowland rice in alternative *Irrigation Projections I and II.* The resulting estimates of requirements of fertilizers and agricultural chemicals in 1990 are used to support estimates of the required expansion in the productive capacity of the fertilizer industry and the capital costs (1965 prices) of such expansion. Subsequently, the market values (1965 prices) of requirements of fertilizers and agricultural chemicals are calculated. Finally, data on cash outlays for irrigation charges and labor are combined with estimates of the market value of fertilizer and agricultural chemical requirements to estimate needs of farm working capital and credit in 1990.

The projected (a) increase in the geographic area under cultivation and the area planted to rice and (b) expansion in the area irrigated under *Irrigation Projections I and II,* result in the estimate that these factors, in and of themselves, can increase palay production by 2,484,000 or 3,707,000 metric tons by 1990, depending upon the irrigation projection used. If the foregoing projections prove valid, it means that either 35 per cent or 57 per cent of increment in palay requirements in 1990 in the *Low Rice*

1 Hereinafter, pesticides, herbicides and fungicides will be referred to as "agricultural chemicals".
2 Obviously the productivity of the "package" will be greatly influenced by greater availability and better control of irrigation water.

Projection (depending upon the irrigation projection used) will have to be provided by other inputs into rice production. Similarly, either 62 per cent or 74 per cent of estimated palay requirements in 1990 in the *High Rice Projection* will have to be obtained through other inputs.

Because of the importance of adequate water supply and control to the cultivation of the most promising new varieties of rice such as IR-8 and BPI-76, the projections of the total irrigated area planted to lowland rice in 1990 in *Irrigation Projections I and II* are used to estimate the yield increases necessary to meet projected requirements.[3]

If all of the area under irrigation and planted to lowland rice in 1990 in *Irrigation Projection I* should be planted with new high yielding varieties which receive recommended applications of "modern inputs", the average yield increment from such plantings (over yields obtained from irrigated palay plantings in the mid-1960's) necessary to fill the "gap" remaining in the *Low* estimate of palay requirements in 1990, would be 1,237 Kg. per hectare.[5] This is one measure of the yield increase which must be provided by new varieties, improved cultivation and "modern inputs". Similarly, to fill the "gap" in the *High* projection of palay requirements in 1990, would require that the average yield from irrigated plantings increase by 2,741 Kg. over the mid-1960's level. Alternatively, if the area planted to irrigated rice in 1990 should be that in *Irrigation Projection II*, the increase in the average yield from such plantings necessary to fill the "gap" in the *Low* projection of palay requirements would be 578 Kg. per hectare and to fill the "gap" in the *High* projection, 1,703 Kg.[6] The fact that the irrigation projections are estimates of potential rather than probable development emphasizes the critical role of "modern inputs" in meeting future Philippine rice requirements.

The DANR has estimated that the average yield from plantings of irrigated palay for the crop years 1964-1966 was 1,700 Kg. per hectare. If the increments of palay output attributable to the extension of cultivation and to the targets in *Irrigation Projection I* should materialize, to meet the *Low* projection of rice requirements in 1990 would require an average increase in yields from irrigated palay plantings of 73 percent; to meet the *High* projection of requirements yields would have to increase by an average of 161 percent. Alternatively, if the targets in *Irrigation Projection II* should materialize, the average yield increases from irrigated palay plantings in 1990 necessary to meet the *Low* and *High* estimates of palay requirements, would be 34 percent and 100 percent, respectively.

3 According to the evidence presently available, the returns from improved technology applied to traditional varieties cannot close the projected "gap" in future requirements. See International Rice Research Institute, Department of Agricultural Economics, **Annual Report for 1966** (Los Banos, 1967), pp. 15-18.

4 Additional plantings of irrigated rice plus average annual irrigated plantings for crop years 1964-1966.

5 Assumes that incremental output materializes which is attributable to (a) projected expansion in land under cultivation and (b) completion of targets in **Irrigation Projection I**. For irrigated plantings in crop years in 1964-66 and projected for 1990, see Table 3.

6 Assumptions used are those in footnote 5 plus the assumption that the storage irrigation targets in Projection II are completed.

Table 23

Philippines: Increments of Palay Output Attributable to "Modern Inputs" Needed to Meet Estimated Rice Requirements in 1990

	Low Rice Projection			
	Irrigation Projection I		*Irrigation Projection II*	
	(000 MT, Palay)	*Ratio*	*(000 MT, Palay)*	*Ratio*
Increment in palay required in 1990 over average annual production, 1964-1966	5,745	1.000	5,745	1.000
Increment in palay output attributable to expansion of geographic area under rice cultivation ...	1,210	.212	1,210	.212
Increment of palay output attributable to achievement of irrigation targets	1,274	.222	2,497	.437
Increment of palay output which must be provided by "modern inputs" in combination with irrigation targets	3,261	.566	2,038	.351
	5,745	1.000	5,745	1.000

	High Rice Projection			
	Irrigation Projection I		*Irrigation Projection II*	
Increment in palay required in 1990 over average annual production, 1964-1966	9,712	1.000	9,712	1.000
Increment in palay output attributable to expansion of geographic area under rice cultivation	1,210	.125	1,210	.125
Increment of palay output attributable tc achievement of irrigation targets	1,274	.131	2,497	.257
Increment of palay output which must be provided by modern inputs in combination with irrigation targets	7,228	.744	6,005	.618
	9,712	1.000	9,712	1.000

New rice varieties promise yield improvements of the required magnitude. The basic problems remaining to be solved, however, are those of (a) mobilizing of the obvious national capability for the required irrigation development, and (b) developing institutional arrangements appropriate to the transformation of the rice economy from a tradition-bound, subsistence-oriented sector, to a dynamic, market-oriented sector, capable of realizing the potential gains from technological advances in rice research.

The foregoing calculations of required yield increases do not provide for yield increases that may be obtained from non-irrigated plantings. In fact, substantial increments in output can be expected from new varieties and other modern inputs on plantings of rain-fed lowland rice. Somewhat less certain is the potential for yield improvement from upland and kaingin plantings, but even here, modest yield improvements may result.[7] As an indication of the magnitudes involved, it may be noted that each improvement in yield of ten per cent (over average annual yields reported for the three crop years ending with 1966) when applied to the estimated areas planted to non-irrigated rice in 1990, would result in an output increment of 188,000 metric tons under *Irrigation Projection I* and 133,000 metric tons under *Irrigation Projection II*. Yield improvement averaging 10 percent from non-irrigated rice plantings in 1990, therefore, would reduce by 71 Kg. the average yield increments per hectare from irrigated palay plantings under *Irrigation Projection I* necessary to meet estimated rice requirements (*High* or *Low*) in 1990. Under *Irrigation Projection II*, the required yield increments per hectare from irrigated palay plantings would be reduced by 39 Kg. if the average yield from non-irrigated plantings in 1990 should increase by 10 percent over the mid-1960's level. The Philippines may receive significant benefits from yield improvements from plantings of non-irrigated rice. To the extent that this occurs, the estimates in this study of required yield increases from irrigated plantings under the alternative irrigation projections will be overstated.

NITROGENOUS FERTILIZER REQUIREMENTS

Estimates of fertilizer requirements are confined to nitrogenous fertilizers, and more specifically to requirements in terms of nitrogen equivalent. No estimates are made of requirements of other fertilizer ingredients, such as potassium and phosphate, because their contribution to rice production depends upon local conditions, varies widely, and is much less important than that of nitrogen. To estimate future fertilizer requirements, we assume that all irrigated plantings of lowland rice are planted to

7 The projections in Chapter III assume that the principal part of increments in area under rice cultivation will be planted to upland and kaingin rice. Because of the shifting proportions between non-irrigated, lowland rice plantings and those of upland and kaingin rice, the average yield from aggregate plantings of non irrigated rice may decline in the future at the same time that yield improvements are being realized from each category of plantings of non-irrigated rice.

high yielding varieties by 1990, with the fertilizer input per hectare at the level recommended for the IR-8 rice variety by the *Rice and Corn Productivity Coordinating Council* in 1967.[8] The analysis is confined to estimating levels of required fertilizer inputs in 1990 and no attempt is made to establish the path through which fertilizer use will expand over the next 25 years.

The RCPCC recommends that 70 kg. of fertilizer (nitrogen equivalent) be applied per hectare of irrigated land planted to the high-yielding IR-8 variety in the first crop season, and 100 kg. per hectare in second crop plantings.[9] Combining these recommendations with the assumption that the entire irrigated area planted to rice in 1990 is planted to the IR-8 variety results in the estimate that 204,000 metric tons (nitrogen equivalent) of nitrogenous fertilizer will be required in 1990 for the irrigated area under *Irrigation Projection I* and 283,000 metric tons under *Irrigation Projection II*.

Currently, Philippine fertilizer requirements are provided by imports and domestic production. Over the five years 1961 through 1965, imports of manufactured fertilizers averaged 201,216 metric tons and varied from a low of 72,663 metric tons to a high of 293,538 metric tons. Nitrogenous fertilizers accounted for 55 per cent of imports by volume with the remaining imports divided roughly between phosphatic and potassic fertilizers. Insufficient information exists to establish the precise nitrogen equivalent of fertilizer imports in recent years. Ammonium sulphate (nitrogen content, 20-21 per cent by weight), however, accounted for 69 per cent of imports of nitrogenous fertilizers, and provided an average of 15,600 metric tons of nitrogen equivalent annually over the five years 1961-65.[10] If we assume that the remaining imports of nitrogenous fertilizers included mixed fertilizers and nitrogen-rich fertilizers (e.g., Urea of 45-46 per cent nitrogen) such that the average nitrogen content was 25 per cent, it results in the estimate that imports of fertilizers over the five years 1961-65 provided 24,300 metric tons of nitrogen equivalent annually.

8 To assume complete transformation of the projected irrigated area to modern inputs is unrealistic. On the other hand, output increments from the use of new varieties, more fertilizer and other modern inputs on non irrigated land will tend to offset the short fall in output from irrigated areas which may result when recommended application levels of modern inputs are not used

9 Rice Information Cooperative Effort, **Rice Production Manual** (Los Banos, University of the Philippines, College of Agriculture, 1967), p. 180.

10 Bureau of Census and Statistics, **Foreign Trade Statistics of the Philippines.**

Table 24

Philippines: **Estimated Nitrogenous Fertilizer Requirements in 1900 for the Production of Improved Rice Varieties on the Area Irrigated Under Irrigation Projections I and II**

Season	*Average Irrigated Area Harvested, Crop Years 1964-1966*[a] (Ha.)	*Increment in Irrigated Area* (Hectares) *Projection* I[b]	*Projection* II[c]	*Estimated Irrigated Area Harvested, 1990* *Projection* I	*Projection* II	*Fertilizer Input Per Hectare*[d] *(MT, Nitrogen Equivalent)*	*Total Fertilizer Required (MT, Nitrogen Equivalent)* *Projection* I	*Projection* II
Wet	661,800	1,230,000	1,630,000	1,891,800	2,291,800	.070	132,426	160,426
Dry	287,700	457,500	948,000	745,200	1,235,700	.100	74,520	123,570
Combined	949,500	1,687,500	2,578,000	2,637,000	3,526,500		206,946	283,996

a DANR estimates. Republished in International Rice Research Institute, Department of Agricultural Economics, **Compilation of Statistical Data, Rice**, Table 10.
b See Table 18
c See Table 20.
d Rice Information Cooperative Effort **Rice Production Manual** (University of the Philippines, College of Agriculture, Los Banos, 1967), p. 180.

Table 25

Philippines: **Fertilizer Imports, 1955-1964**[a]
(Metric Tons)

	Nitrogenous	*Phosphatic*	*Potassic*	*Others*	*Total*
1955	70,515	20,530	47	16,992	108,084
1956	37,295	14,441	5,516	10,727	67,979
1957	69,031	49,568	14,717	24,899	158,215
1958	66,884	22,738	11,102	5,952	106,676
1959	128,793	33,283	18,343	10,046	199,465
1960	87,958	29,487	16,757	5,275	139,477
1961	94,890	42,617	33,894	8,413	179,814
1962	140,911	74,696	44,460	34,472	294,539
1963	41,956	12,644	13,831	4,224	72,655
1964	148,791	41,909	39,383	3,871	233,954

Available statistics on local production of fertilizer indicate that production increased from about 55,000 metric tons in 1960 to 110,000 metric tons to 1964. In the latter years, 54,000 metric tons of ammonium sulphate were produced, equivalent to 11,000 metric tons of nitrogen. Of the remainder of domestic production, about 1,000 metric tons consisted of superphosphate and 55,000 tons of mixed fertilizers. Although the composition of mixed fertilizers, in the aggregate cannot be precisely determined, the nitrogen content of such fertilizers marketed in the Philippines ranges from 5 to 16 per cent, with the bulk of such mixtures ranging from 12 to 14 per cent. If we attribute an average of 13 per cent nitrogen to mixed fertilizers produced in 1964, the estimated nitrogen equivalent of domestic production of such fertilizers would be 7,150 metric tons. Combining this estimate with the nitrogen equivalent of domestic production of ammonium sulphate results in an estimate of domestic production of nitrogen equivalent in 1964 of about 18,000 metric tons which was about three quarters of the nitrogen equivalent provided by imports.

a Data provided by National Economic Council See San Miguel Corporation, Market Research Department, **The Fertilizer Industry of the Philippines** (Manila, December 1965), Table 17, p. 40. Totals conform to data reported in Bureau of Census and Statistics, **Foreign Trade Statistics of the Philippines.**

Table 26

Philippines: **Domestic Production of Fertilizers**[a]

(000 Metric Tons)

	Maria Cristina (Ammonium Sulphate)	*Chemical Industry of the Phils (Super-phosphate)*	*Mixed*	*Atlas Fertilizer Corp (Super-phosphate)*	*Mixed*	*Total*[b]
1960	33.1	.9	1.0	6.6	12.5	54
1961	30.0	.7	2.3	.2	34.5	68
1962	35.5	5	2.0	2.0	53.9	94
1963	44.9	4.4		53.4		103
1965	53.9	2.9		55.0		112

In the mid-1960s, only a minor part of Philippine fertilizer absorption was used in rice production. Sugar production, relatively capital-intensive and large-scale, was the principal consumer of fertilizers, accounting for about half of estimated consumption in 1964 with rice production consuming 27 per cent.

To obtain an impression of the nitrogen equivalent in fertilizer applied to rice production in the mid-1960s, we assume that such fertilizer was distributed among nitrogenous fertilizers (both imports and domestic production) with an average content of nitrogen equivalent of 25 per cent and mixed fertilizers with an average content of nitrogen equivalent of 12 per cent in the proportions, 60 per cent and 40 per cent, respectively. These assumptions result in the estimate that the nitrogen content of fertilizer applied to rice production in 1964 was about 15,000 metric tons. To the extent that this estimate is valid, it means that the application of the recommended levels of nitrogen equivalent on the total irrigated areas in 1990 under *Irrigation Projections I and II* would be about fourteen and nineteen times respectively, the estimated level of nitrogen equivalent applied to rice cultivation in 1964.

Implicit in this study is the belief that population growth over the next quarter century together with promising technological improvements in rice production presently in sight, will maintain relatively high priority

a San Miguel Corporation, Market Research Department, **The Fertilizer Industry in the Philippines**, Table 9, p 22

b Republic of the Philippines, Program Implementation Agency, **Fertilizer Industry (Demand and Supply Analysis)**, (Manila, January 1966), reports "local production" (000 metric tons) as follows: 1960, 38 6 1961, 75 6, 1962, 97 9, 1963, 102 6, and 1964, 105 3

Table 27

Philippines: **Estimated Breakdown of Fertilizer Consumption in 1964 by Type of Fertilizer** [a]

(Metric Tons)

Type of Fertilizer	*Total*	*Nitrogen Equivalent*
Ammonium Sulphate	140,153	28,731
Urea	20,462	9,102
Mixed, 16-20-0	28,422	4,548
Mixed, 12-24-12	11,934	1,432
Mixed, 12-12-12	33,007	3,961
Other nitrogenous[b]	7,264	944
Total nitrogenous fertilizers	241,242	48,718
Other fertilizers	53,045	n.a.
Total fertilizers	294,287[c]	48,718

for development of the rice economy. Over this period, the proportion (a) of the land area irrigated and (b) of the fertile alluvial soil resources allocated to rice production almost certainly will increase. Similarly, the returns to fertilizer in rice production are likely to improve relative to the returns to fertilizer in alternative uses and the proportion of fertilizer absorbed which is applied to rice production will increase. If this proportion should increase from 27 per cent, which prevailed in the mid-1960s, to 50 per cent, it would mean that total fertilizer absorption (nitrogen equivalent) in 1990, would range from about 400,000 to 600,000 metric tons.[11] This level of fertilizer requirements in 1990, would represent from 22 to 33 times the domestic production (nitrogen equivalent) in 1964 and from 10 to 14 times estimated total nitrogenous fertilizer availability (nitrogen equivalent) in 1964.

a Estimates based on sample survey made by the Esso Fertilizer and Chemical Company (Phils) and reported in San Miguel Corporation, Market Research Department, **The Fertilizer Industry of the Philippines** (Manila, December 1965), Appendix D

b Assumes average nitrogen content of 13 per cent.

c Estimated consumption of manufactured fertilizers derived from the Esso sample survey exceeded total imports and domestic production in 1964 by 50,000 tons, or 20 per cent of availability (exclusive of inventory changes) This discrepancy may be explained by the propensity of the farmers interviewed, to inflate their estimates of fertilizer used because they felt it would reflect credit on them as good farm managers

11 Assuming that all of the increment in irrigated acreage is planted to rice, and that recommended levels of fertilizer application for IR 8 are applied to all irrigated rice plantings in **Irrigation Projections I and II.**

Table 28

Philippines: Estimated Consumption of Commercial Fertilizers by Crop. 1964 [a]

	Metric Tons	*Per Cent of Total*
Sugar Cane	143,977	49.0
Rice	97,363	27.0
Corn	13,913	4.7
Tobacco	7,407	2.5
Pineapple	7,398	2.5
Citrus	9,248	3.1
Vegetables	10,659	3.6
Other Crops	22,322	7.6
	294,287	100.0

Only tenuous estimates of the investment required to expand fertilizer capacity can be provided since the magnitudes will depend on such factors as the number and scale of plants and the technology used. In the official Philippine Four-Year Economic Plan for fiscal years 1967-70,[12] an expansion in fertilizer capacity of either 100,000 metric tons of ammonium sulphate or 65,000 tons of urea is described.[13] The financing required for either increment in capacity is estimated to be ₱71,400,000, including preoperating costs, land, plant and equipment, and working capital. The same rate of capital expenditure (1965 prices) projected for the increment in nitrogen equivalent required for irrigated rice plantings in 1990, as compared to estimated total of nitrogen equivalent applied to rice plantings in the mid-1960s of 15,000 metric tons, results in an estimate of total required investment of either ₱540 million or ₱757 million.[14] This is a substantial amount of capital but, inasmuch as it will be spread over two decades, it is a challenge that the Philippine private sector is clearly capable of meeting.

AGRICULTURAL CHEMICALS

No estimates are made of (a) the quantities of insecticides, herbicides and fungicides required to meet rice production targets, or (b) the

a San Miguel Corporation, Market Research Department, **The Fertilizer Industry in the Philippines**, Appendix D.

12 Office of the President of the Philippines, **Four-Year Economic Program for the Philippines, Fiscal Years 1967-70**, pp 34, 35, and 38

13 The nitrogen equivalents in 100,000 tons of ammonium sulphate and 65,000 tons of urea are 21,500 tons and 29,250 tons respectively. The capital cost per ton (nitrogen equivalent) of productive capacity used in the estimates of capital requirements is the average of the two types of fertilizer

14 Depending upon the irrigation projection used and assuming that incremental production is divided equally between ammonium sulphate and urea. To expand the Philippine chemical fertilizer industry existing in 1964 (output 18,000 MT, nitrogen equivalent) to an industry capable of producing estimated total nitrogen required in 1990 for all uses (408,000 MT or 566,000 MT depending on irrigation Projection used) would require total investment (1965 prices) of ₱1,096 million in the case of **Irrigation Projection I**, or ₱1,542 million if **Irrigation Projection II** is used.

investment required to expand Philippine productive capacity (presently negligible) to levels necessary to provide requirements of the above chemicals. Agricultural chemicals are marketed under trade names and data on imports, production and consumption are inadequate to make meaningful estimates of quantities required.

The quantities of agricultural chemicals required to meet projected rice requirements from irrigated plantings of high yielding varieties will be large. Adequate protection against insects, diseases, and weeds must be provided if the yield potentials in new varieties in conjunction with irrigation and nitrogenous fertilizers are to be realized. Indeed, the budgeted cash outlays for agricultural chemicals (1965 prices) recommended by the International Rice Research Institute for the cultivation of IR-8 are greater than the current cost of recommended levels of fertilizer application.

FARM CASH OUTLAYS AND CREDIT REQUIREMENTS

Changes in techniques of cultivation recommended for improved rice varieties, such as IR-8 and BPI-76, will require substantial increases in cash outlays by rice farmers and thus, major requirements of additional credit for working capital. The principal increments in cash outlays will be for fertilizers and agricultural chemicals, but additional expenditures will also be required to meet labor, irrigation charges, and interest expense.

The estimates of fertilizer requirements developed in the previous section call for the application in 1990 of 207,000 and 284,000 metric tons, respectively, of nitrogenous fertilizer (nitrogen equivalent) on the area planted to irrigated rice in *Irrigation Projections I and II.* To compute the cash outlays farmers must make to purchase fertilizer, these estimates of fertilizer requirements are valued at the retail price of ammonium sulphate in 1965, of ₱140 per 100 kg. of nitrogen equivalent.[15] This procedure results in the estimate that in 1990 rice farmers will pay ₱290,000,000 or ₱398,000,000 (1965 prices), respectively, for recommended levels of fertilizer applied to irrigated plantings of rice under *Irrigation Projections I and II.*

In computing the cash outlay for agricultural chemicals, we assume, as we did in the case of fertilizers, that the irrigated area planted to rice in *Irrigation Projections I and II* receives applications of agricultural chemicals at levels recommended for irrigated plantings of IR-8.[16] Using the cash outlay for agricultural chemicals of ₱190 per hectare budgeted by the In-

15 FAO, **Production Yearbook**, 1965, Table 185. Price converted from dollars at a rate of ₱3 90 — $1 00. Ammonuim sulphate is typically more expensive than an equivalent amount of nitrogen in other fertilizers, such as urea. However, the increment in estimated fertilizer outlays attributable to the use of the higher price of nitrogen equivalent in ammonium sulphate probably will be more than offset by outlays that will be made in 1990 for non nitrogenous fertilizers.

16 See R. Barker. "Cost of Producing Traditional and Improved Varieties of Rice" (paper prepared for Training Course of District Production Supervisors of the Rice and Corn Productivity Coordinating Council, December 9, 1966) Appendix Table 4.

ternational Rice Research Institute results in the calculation that farmers will pay ₱501,000,000 or ₱670,000,000, respectively, for the requirements of agricultural chemicals called for under *Irrigation Projections I and II.*

Total cash outlays for labor will depend on (a) the amount of labor required, (b) the degree to which the required labor is provided by the family, and (c) the means by which hired labor is paid (i.e., cash or in kind). Firm figures on the labor requirements of cultivating the new rice varieties using modern methods are not yet available. It seems clear, however, that the traditional stages of rice cultivation will continue with additional labor being required for transplanting (in straight rows) weeding, harvesting, and maintenance of on-farm irrigation.[17] While it is difficult to generalize for the Philippines as a whole, the major cash outlay for labor under current methods of cultivation is for transplanting. Hired harvest labor is usually paid on a share basis while weeding and irrigation maintenance are usually carried on by family labor. It is probable that as the commercialization of Philippine agriculture proceeds, more hired labor will be paid in cash rather than in kind. On the other hand, the rapid rate of population growth on the limited supply of land will tend to increase the supply of family labor per farm.

Because of these and similar considerations, the following estimate of cash labor outlays, is based on levels of cash labor used and wage rates prevailing in the mid-1960s. Assuming that a cash payment of ₱60 per hectare for 20 days of transplanting labor at ₱3 per day [18] will apply to each hectare of irrigated lowland rice plantings in 1990, total outlays would be ₱158,000,000 in the case of *Irrigation Projection I* and ₱212,000,000 for *Irrigation Projection II.*

Irrigation fees differ with the ownership of the facilities and with the crop season. When current (1966-67) rates of irrigation fees are applied to projected areas planted to first and second crop irrigated rice in 1990 and serviced by government and private and communal irrigation systems, it results in the estimate that total irrigation charges in 1990 will be ₱114,000,000 under *Irrigation Projection I* and ₱140,000,000 under *Irrigation Projection II.*[19]

17 The application of fertilizer and agricultural chemicals does not require much labor.

18 Data obtained from a study of farms in Rizal Province as reported in L. Mears, **Project Studies** (Case No. 4), Table 2.

19 Current (1966-67) irrigation fees for government-administered systems are ₱25 per hectare for first crop plantings and ₱35 for second crop. The National Irrigation Administration estimated in 1967 that the average fees charged for operators of private irrigation systems were ₱72 per hectare for first crop plantings and ₱108 for second crops.

Table 29

Philippines: **Estimated Total Irrigation Charges in 1990**

		1990	
	Mid-1960s	*Irrigation Projection I*	*Irrigation Projection II*
Total area irrigated, first crop, lowland rice (has., annual average, 1964-1966)	662,000	1,891,800	2,291,800
Total area irrigated, second crop, lowland rice (has., annual average, 1964-1966)	288,000	745,200	1,235,700
Total area of first crop, lowland rice, irrigated by government systems (has.)	234,000[a]	999,000[b]	1,399,000[c]
Total area of second crop, lowland rice irrigated by government systems (has.)	97,400[a]	412,400[b]	902,400[c]
Total area of first crop, lowland rice irrigated by private and communal systems (has.)[d] ...	428,000	892,800	892,800
Total area of second crop, lowland rice irrigated by private communal system (has.)[d] ...	190,600	332,800	332,800
Estimated total irrigation fees due in 1990 at current (1966-67) rates of irrigation charges[e] (₱)	n.r.	139,600,000	166,800,000

a Area actually irrigated by NIA systems in crop year 1964-65.

b Assumes that all of area irrigated in category "NIA and communal gravity irrigation targets", in fact, is in systems administered by the government. See Table 17.

c Assumes all of design area of storage irrigation is in systems administered by the government. See Table 20.

d Residual obtained by subtracting area under irrigation in government systems from total area planted to crop categories of irrigated rice Assumes that all of area irrigated by ISU pump units is in private systems

e Current charges for irrigation in government systems are ₱25 per hectare for first crops and ₱35 for second crops Average fees charged by operators of private pump systems in 1966-67, were ₱72 per hectare for first crops and ₱108 for second crops. (Estimates of average fees charged by private operators provided by National Irrigation Administration) The fees charged by private pump operators have also been applied to the hectarage irrigated by communal systems. To the extent the actual fees charged by the latter are lower, the total irrigation charges are overstated. The upward bias in the estimate of total fees cannot be large, since the hectarage irrigated by private pump operators and communal systems combined accounts for only 24 to 33 per cent of the total irrigated area projected for 1990.

Table 30

Philippines: Estimated Cash Outlays Required by Farmers for the Cultivation of New Rice Varieties by Improved Methods on Irrigated Lands, 1990

Type of Outlay	*Irrigation Projection I*	*Irrigation Projection II*
Fertilizer	₱ 290,000,000	₱ 398,000,000
Other agricultural chemicals	501,000,000	670,000,000
Irrigation fees	139,600,000	166,800,000
Labor	158,000,000	212,000,000
TOTAL[a]	₱1,088,600,000	₱1,446,800,000

Altogether, the estimated cash outlays required by farmers in 1990 for cultivation of new rice varieties by improved methods on irrigated land planted to rice in *Irrigation Projections I and II* total ₱1.1 billion and ₱1.4 billion, respectively. Although farm cash balances will increase as per capita farm income rises, it is obvious that a substantial portion of these cash outlays will have to be financed by credit.

A number of other factors will operate to increase credit requirements. Total interest charges on production credit extended to the rice sector will rise by some multiple of the levels of the mid-1960s. Additional requirements of cash for current operations also will arise as (a) tenure arrangements shift from share tenancy to leaseholds or owner-cultivated holdings, (b) mechanization occurs, and (c) taxes increase. Hopefully, the agricultural development necessary to provide the rice requirements projected in this study will be accompanied by an appropriate modernization of the agricultural credit system. Commercial banks, rural banks, credit cooperatives and other modern institutions must provide an increasing share of total credit requirements as compared to that provided by traditional sources — money lenders, middlemen and landlords.

To obtain an impression of the expansion in working capital and credit — formal and informal — necessary to support the estimated levels of inputs of fertilizer, agricultural chemicals, irrigation fees and cash labor in 1990, the procedures described in this section have been used to estimate cash outlays by farmers in the mid-1960s. The retail value of the estimated 15,000 metric tons of nitrogen equivalent used in rice cultivation in 1964, would be ₱21 million. Applying the ₱60 per hectare for cash

a Excludes interest on farm debt

labor to the average annual irrigated plantings of rice during 1964-1966 results in a total of ₱57 million. Applying the current (1965-66) irrigation fees to the average annual irrigated plantings of rice during 1964-66 results in a total of ₱55 million.[20]

To these amounts must be added the retail value of imports of agricultural chemicals.[21] In 1965, the value of imports (f.o.b.) of agricultural chemicals was no more than ₱7.8 million. Transportation and other charges plus the commercial mark-ups probably were equal to their landed value and we estimate the retail value of 1965 imports of agricultural chemicals to be ₱16 million. Combining these four estimates of cash outlays for various inputs results in a total of ₱149 million, which is only one-seventh and one-tenth, respectively, of estimated total cash outlays for these categories of inputs in 1990 on rice plantings under *Irrigation Projections I and II.*

20 On government administered systems, the fee (1965 66) was ₱12 per hectare irrigated with no additional fee for second crop plantings No data were available on the fees charged by private pump operators in 1964 1966, so the available estimates of average rates (₱72 for first crop, and ₱108 for second crops) in 1966-67 were used

21 Domestic production was negligible