IRRIGATION AND THE RICE PROBLEM OF THE PHILIPPINES

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Introduction

While there is a serious need for more rice for the Filipinos; while the dream of abundance in rice production is not realized for some errors in the interpretation of existing conditions and incapacity to implement approved measures; while agricultural prosperity is not attained by the farming group under the present course of things, we must admit that all these lie in the fact that the principal necessity of rice production and the basic foundation of agriculture which is irrigation have not been properly attended to in the last few years. We still rely upon the poor knowledge of the past and on the backwardness of our forebears. Resorting to it without innovation would mean the lagging behind of our agriculture. It is high time that we keep abreast with modern farming methods and practices . . . one of which is the use of the irrigation system.

We are rather slow in our irrigation program. We cannot put the blame entirely on the farmers. They are willing to till the land and to work hard if given the necessary incentives, like irrigation facilities. With irrigation, we can look forward to a bright future in farming because the only solution to our problem of rice shortage is a vast network of irrigation system. According to Hon. Hilarion Henares, Jr. "For the Philippines, not having enough rice may mean a despondent dependence on those upon whom we dare not depend, loss of leadership in Southeast Asia, trouble within our own frontiers and a breach in the rampants in our freedoms. Already the perennial problem of rice has beaten into sad shape the history, the economy, psychology and physiognomy of our people."

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On the basis of statistics, the Philippines is the least irrigated country in the world and comparatively therefore, has the lowest average production of rice. We have not met the increased demand for more irrigation systems. Now that rice shortage cannot be solved under the present arrangements, we are giving greater emphasis on the use of water for our farms, and we are more serious about it. The continuous importation of rice is not the right approach to the present dilemma—not that it lowers our dignity and pride as an agricultural country, but that our existence at a time of crisis is periled.

There is a need for progress; more income, more production, and the full development of our natural resources. There is the necessity to search for bigger wealth, to manufacture goods vital to the satisfaction of our wants for a better livelihood and a more meaningful life. Progress in farming, as in any other endeavor, is the essence of our existence. Progress is activity and it entails greater investments. It also embraces the channeling of man's faculties and efforts to the course where he can produce with degree of efficiency to suit his vital needs. When we can attain a steady progress, then we can compare our standard of living with that of other people.

We claim to have vast fertile lands, favorable climate, sufficient water supply and enough man power. We are ambitious and are more determined to better our economic status. We have an equally high standard of education and civilization. Yet, we do not enjoy abundance out of our efforts in the farms due to limited production. There is poverty in the barrio level and we produce far below the actual requirements.

Population Explosion

At present, there is a corrollary problem of population explosion. Our birth rate is faster than our food production rate. There is an increase of about one million individuals annually

(Table 1) and our agricultural production must necessarily meet the corresponding increase in needs . . . (Table 2). Otherwise, peace condition will be endangered. There will be hunger if not enough food is supplied. Every child must enjoy life and this will be possible only with enough farm production.

Basically, we live on the availability of food that we have at our command. The deficiency of our rice supply can be patched by minimizing the daily consumption per capita and supplementing it with vegetables or any kind of food substitute. We can even bridge the gap through a planned family life or a series of adjustments in our vital necessities for existence. However, this is tantamount to limiting the wants of our populace. In the final analysis, therefore, there is nothing like increasing rice production and this is achieved patently through the extensive use of irrigation.

The tendency of population growth to increase is of, course, an international problem. There is no better way of solving this problem than the realignment of our agricultural development and the betterment of our national yields. This is a problem of the people as it is for the government. There is therefore the need for more sacrifices to keep life going and the ingenuity of man must be perfected in order to get rid of the big problem of under-production.

Potentiality of Increasing Production

There is every indication that production can be increased at a rate that is practical and possible. But first, let us take into account the different factors that influence increased production in the order of their importance and apply them to existing local conditions. We are a growing country that falls within the group of underdeveloped ones. Thus, adjustments and improvements should be our prime concern as we have vast tracts of potential ricefields.

1. Irrigation — We may say that the rice problem is an up-shot of the problem of irrigation. Any living thing, the rice plant not excluded, cannot survive without water. Drought is the biggest factor that causes failure in our rice industry as it is the vital limiting factor to the highest level of production If it is true that only about one-fourth of the entire ricelands in the Philippines is actually irrigated and that most depend on the unpredictable rain for growth and development, we farm on a hit-and-miss method. We plant the rice crop under the mercy of nature.

We risk all along in the business of rice production in this country. The investment that we put into it in the form of labor and capital is never certain. It is for this very reason that the Filipino farmers are never induced to add more investments for improvement. It is also the reason why farming here is never thought of as profitable. After the rice harvest, the farmers are idle most of the time and few ever attempt to raise other money crops aside from rice. There is a lot of money in vegetables and rootcrops and yet we do not go into planting them at a very extensive scale because of water shortage.

2. Other methods of improvement — All other methods of improving the rice industry are dependent on water. Very often farmers do not react favorably in the application of fertilizer, not that they are not convinced of its importance but that they fear failure more due to drought. The same is true with the use of the best kind of seeds. There is not much enthusiasm in the use of scientific method of farming under similar circumstances.

Areas of Improvement

In the desire to attain sufficiency in food, other factors aside from irrigation, necessary for improvement and development must be taken into consideration. These are the use of fertilizer, selection of better seeds, pest and disease control,

improved methods of rice culture, and the opening of new lands. All these are contributory elements to the goal of increased production.

On the basis of about 27 cavanes yield per hectare, it is taken for a fact that another 30 cavanes can be produced with irrigation and that with the improved method of production propagated through agricultural extension, educational training and information services, another 18 cavanes per hectare increase is possible. The application of other factors of improvement like pest control, weeding, good tillage, etc. will add a considerable amount of 12 cavanes. (Table 3)

From the foregoing facts, there is an estimated amount of 185,247,000 cavanes that can be produced in addition to the present production which is only 88 million cavanes from a total area of 3,087,450 hectares devoted to rice as of 1964. This is just doubling the present production annually. Our economic experts have also this opinion provided, however, that the instrumentalities are furnished.

There is a lot of discussion as to what method of improvement the government should take to meet the growing need for food. Lately, extension service in agriculture has been given a big boost with the creation of the Commission on Agricultural Productivity. The Bureau of Plant Industry claims that fertilizer and pest control work offer the best approach to rice development program. So, too, other offices in the government have specific formulas on how to remedy the present crisis of food-lack. But apparently, an alleviation to the present lamentable rice situation starts with the availability of water.

Land, Labor and Water

We are fortunate to have been blessed by God with vast tracts of fertile lands. More can be opened and every piece turned to tillable lands for rice and other crops. In addition,

the Philippines is situated in the typhoon belt where rain comes at any season, thus, providing us with a favorable climate and a good weather condition. What is left for everyone is to harness this natural wealth for our own advantage and benefit.

It is also said that there is enough labor to till the land and make it productive. The Filipinos are not lazy but rather, they lack the necessary facilities or inducements to develop farming potentials. Farming should be a continuous activity, year in and year out. The planting of crops should follow a definite pattern, like vegetables after rice, rice after rice, or vegetables after vegetables. Every month of the year is favorable for a specific kind of crop. But why do we produce only one crop a given year? It is simply due to lack of appropriate incentive.

While we have the land and the labor, the water which is an essential part of production is not well provided. Everybody says that there are enough rivers as principal sources of irrigation water and the underground sources are unlimited. They, however, need to be tapped right and on time. There is, therefore, a stringent need for a massive program along this line with enough capitalization, planning and knowhow. In fact, there should be one Irrigation Master Plan for the country to be implemented seriously and efficiently.

Importance of Irrigation

The importance of irrigation water must not be underestimated. Its value to the plant is either direct or indirect. Directly, water is needed by the plant in its normal growth and development. The plant needs water to quench its thirst. Water has indirect value when its usefulness is simply secondary. The farmer, for instance, may apply water to get red of weeds or just to dilute fertilizers. In general, the real value of irrigation can be stated as follows:

1. Irrigation increases as it guarantees production.

2. It provides a favorable working condition for the farmer; it enables him to generate more untold benefits and reap advantageous results. Water is the lifeblood of plants and it is this same water that gives meaning to farming as an occupation.

3. Irrigation water motivates a farmer to further indulge in such promotion-wise ventures for bigger production like application of fertilizers, improved method of rice culture, better selection of seeds, and other requirements conducive to the normal and healthy growth of the rice plant.

Rice farming is an ancient industry in the Philippines and although irrigation was known in ancient times, it was never given much weight in increasing production. The old farmer used to depend on rain alone and content himself with his stock of grains for his family. Things have changed fast. Population has tremendously increased. Rain can no longer be depended upon as sole source of water to exact maximum production from our farms. Other sources must be tapped to insure available supply of water anytime of the year. Agricultural production must, likewise, be stepped up to cope with the rice needs of the increasing population; not only for the immediate family, but also for the whole country. At present, we are confronted with the problem of how to produce the food we need. Certainly, it is not by importation. We must work hard; invest enough in irrigation projects so that in due time, we shall have vast irrigation networks that will insure enough production for our rice requirements.

Expounding on the value of irrigation water, President Macapagal in his address before the National Federation of Pump Irrigation Association of the Philippines on January 22, 1965, declared ". . . all the assistance like proper seed selection, more crop diversification and better fertilizers — would be unavailing if the primordial thirst of the soil is left unslaked."

On low yield, he added, "One of the primary causes of poverty is the low yield of farmers. The reason why rice yield does not often go beyond 27 cavanes of palay per hectare is the inadequacy of irrigation facilities. Expand irrigation and you automatically increase rice production. Government experts may say that an irrigated piece of land will produce at least 50 cavanes, or almost double the national average. It is clear, therefore, that the moment every piece of rice land is irrigated, the national production would also almost double. This fact emphatically underscores the enormous importance of irrigation and explains the concern of the administration to give impetus to its irrigation program."

Production and Consumption

During the year 1965, the population of the Philippines will be about 32 million and in 2000, it will be about 107 million or an increase of about 75 million at the rate of 3.5% annually. This is on the assumption that things are normal. (Tables 1 & 4)

This population will have to eat rice in the amount of 114 million cavanes in 1965 and by 2000, the rice need shall be 380 million cavanes or a difference of 266 million. It seems unbelievable but 35 years in the life span of a people and a country is not long. With all the methods of increased production applied, there is a corresponding deficit in the food supply in the amount of 26 million in 1965 and 60 million cavanes in 2000. The food requirements then shall be about four times the present.

Using the 1964 figures as basis, there were approximately 3,087,450 hectares planted to rice with a total production of 87,337,700 cavanes. Actually, the area irrigated was 1,060,415 hectares while 2 million hectares were not irrigated. The average production was 27 cavanes per hectare which is the lowest in the world. There was a computed deficit of 26 million cavanes. (Tables 5a, 5b & 5c)

Our rice problem seems to be influenced by the presence of irrigation systems in general. If we dissect the country by region, it may be noted that in Central Luzon, where irrigation network is heaviest, production per hectare is 42.3 cavanes, or a total of 20,979,900 from 495,700 hectares. The lowest average is registered in Eastern Visayas which is only 19.4 cavanes per hectare, or 5,315,100 cavanes from 274,600 hectares. The development of irrigation systems in that region is way behind. The same is true in Northern and Eastern Mindanao where production per hectare is only 20.3 cavanes, or 4,582,600 cavanes from a total land area of 226,100 hectares. (Table 6)

One way of averting or minimizing the enormous deficit in rice is increasing the producton of other foodcrops like corn, rootcrops, vegetables, wheat, etc. It is possible that with the low supply of rice, rice-eating people may switch to corn or other supplements and this will trim the rice consumption to a greater extent. In the classification of land for agriculture, the capacity to provide water should be taken into consideration. One thing to consider is the fact that these foodcrops unlike rice, use moderate amount of water in their growth and development. Extensive planting of fruit trees may yet be encouraged for the same reason.

Investment in Irrigation

In general, there are two types of irrigation systems in the country — gravity and pump. Under gravity, we have the following: (1) National Irrigation under Act No. 2152; (2) Communal Irrigation Systems, a big portion of which was not financed by the government but operated by the Municipality concerned; (3) Municipal Systems which are financed by the government; (4) Friar Lands Irrigation Systems which were constructed and financed by the friars; (5) Private Irrigation Systems.

On the other hand, pump irrigation is of two kinds: (1) those installed and financed by the government, and (2) Private Pump Irrigation. (Table 7)

1. Investment in Gravity: As of 1964, the government placed into the development and construction of gravity irrigations, numbering 78 complete and operating projects, the amount of ₱145,814,191.00. There are 15 projects under construction which involve the amount of ₱18,568,150 and their completion is still uncertain. Many of them are still under study and in the investigation and survey stage. Those designed cover an area of 122,850 hectares and involved 30 projects.

2. The investment on Communal Irrigation Systems, Municipal and Private Irrigation Systems cannot be traced and ascertained but most of them are utilized only during the rainy season.

3. Investment in Pumps: The government investment on the pump irrigation program is approximately ₱14 million since 1949 and as of 1964 there were 566 units installed and irrigating 54,995 hectares. There are also many private irrigation systems installed and constructed especially in the Central Luzon provinces which irrigate approximately 7,337 hectares with 204 units.

Pump irrigation is considered a new venture although a few systems were installed as early as the start of the 19th century. This was given a big boost sometime in 1950 when ₱2 million was appropriated for the purpose. Then, in 1952, under the U.S. government aid, more were installed and constructed where the gravity irrigation did not work well. Pump irrigation, like gravity has its potentialities for bigger expansion due mostly to the impossibility of constructing gravity systems in many provinces. It is possible that ground water as a source of irrigation will in due time be explored to work very advantageously.

The fact that water is a must in the field of farming, there is no question whether we have to use irrigation or not; or whether it is by gravity or pump. The first concern is the

production of food for the people. It is however necessary to take into consideration the economy and the benefits derived from the investment and the undertaking of such a business. Let us go into the details in estimating the expenses involved in both the propeller and centrifugal pumps of different sizes. It is important to note the cost of the pump and engine, the area of the land to be irrigated, the canalization, and the cost of operation and maintenance. From the records of Irrigation Service Unit, the investment per hectare of a 10-inch pump is ₱271.20; annual cost of maintenance, etc. is ₱55.34 and the net annual benefit is ₱157.00 or a benefit cost ratio of 2.84. On an 8-inch centrifugal, the investment per hectare is ₱247.00; the annual cost of maintenance, etc. is ₱53.96; and the net annual benefit is ₱157.00 or a benefit cost ratio of 2.91. (Tables 8a & 8b)

From all indications, the above results speak of the feasibility of pump irrigation in agriculture especially in the production of rice. There will be variations in the result but taking the whole program of production for the entire country, it is a profitable venture to indulge in.

4. Future investment in pumps: To catch up with the rising need for more food, we contemplate to irrigate an area of 50 thousand hectares a year for a period of 35 years or a grand total of 1,750,000 hectares. To achieve this, there is a stringent necessity for the sum of ₱136,000,000 every 5 years. (Table 9) This is just enough to produce a possible increase to sustain the food requirements of the people. This is based on the supposition that ₱544 per hectare is needed to finance the program. It is also to be considered that in the pump irrigation program, the investment is paid back to the government and in turn used to purchase additional equipment. It is to be computed also that on the basis of 30 cavanes per hectare as a result of irrigation, the future needs of the Filipino people are well taken care of.

Another thing to consider in the huge irrigation program is the construction of reservoirs to impound water for the dry season operation. This will entail the high cost of constructing big dams. These dams should also be utilized to generate electricity for power to operate electric motors for smaller turbine pumps and other home industries. The use of engines to create the necessary power for pumps will in the end be costly and impractical.

Water Policies

In the light of our rapidly increasing population and our fast developing country, water becomes a precious commodity to the people, to plants and to most industries. At this early stage of development, it is necessary to formulate definite policies for its control and use, both in our everyday life and in projects and programs that further enhance the development of the nation. One aspect that should be emphasized is the extent and privilege of water right in the national and local scope or directly of the public and private sectors. There is also the need to up-date old laws and regulations and to establish new ones. In the formulation of such policies, the following may be considered:

1. The use and control of underground water both for irrigation and the home;

2. Irrigation water and the integrated use of land for economic values. This arrangement will always depend upon certain limitations, principally, the availability and the capacity to construct conveyances and diversions for the various farms;

3. Water conservation and utilization;

4. Repayment system in our irrigation program both for gravity and pump;

5. Financing the huge irrigation project aside from bonds and general funds. The use of some amount derived from specific income may be considered to insure a continuing irrigation program.

Irrigation Master Plan

It is also timely for the Philippines to have its Irrigation Master Plan — the primary purpose of which is to study, research on, and consolidate all existing irrigation projects and programs with the intention of drawing out a projected plan that will embody and insure the development of our water resources for our future socio-economic needs. It must be noted that the demand for water is not only confined to the production of food but also to the development of some big industries and the establishment of factories. There is also a great need for water at home as well as for other purposes.

In devising the plan, the total need of the country must be known; its distribution per month or season within a year must be controlled, taking into account the water requirements for agriculture, industries and the home.

Israel, Japan, Taiwan and other countries have a well-planned use of their water resources and are advanced along this line. The Philippines, in contrast has not even started. Any big structure for development always necessitates a well-studied plan and design. A Master Plan will work right and efficiently for the interest and benefit of the entire people of the Philippines.

Conclusion

In recapitulation, the reason why the country cannot cope up with our staple food requirements is that population increase out-paces our agricultural production. The real problem, therefore, is how to increase food production at a rate at least proportionate to the increasing demand. As has been illustrated, the basic remedy is the construction and installation of more irrigation facilities supplemented by other factors such as the application of fertilizer, better selection of seeds, improved methods of rice culture, pest and disease control, and the opening of new lands.

Considering the rice deficit to the tune of 26 million cavanes in 1965 and the magnitude of 60 million cavanes in 2000, now is the right time for us to make corrective measures. The government should give the lead by investing more capital on irrigation systems. In so doing, the national average yield per hectare of 27 cavanes can be increased by 30 cavanes. With other better farming methods, another 30 cavanes may be added. It is clear, therefore, that the possibility of doubling our farm output is not remote and food requirements will never be a problem at all.

TABLE I

NATIONAL GRAVITY IRRIGATION SYSTEMS AND PROJECTS IN THE PHILIPPINES

Proj. No.	*PROJECT*	*Location*	*Area (has.)*
1	*Bolo River Irrigation Project	Abra	1,6050
2	Pamplona Irrigation System	Cagayan	800
3	*Abulog River Irrig. Project	Cagayan	15,000
4	Pasuquin Irrigation System	Ilocos Norte	1,000
5	Laoag-Vintar Irrigation System	Ilocos Norte	2,400
6	Bonga Pump Irrigation System	Ilocos Norte	1,850
7	Dingras Irrigation System	Ilocos Norte	1,070
8	*Chico River Irrigation Project	Cagayan	3,200
9	Sta. Maria-Burgos Irrig. Sys.	Ilocos Sur	2,111
10	Tagudin Irrigation System	Ilocos Sur	1,370
11	Sta. Lucia-Candon Irrig. Sys.	Ilocos Sur	2,020
12	Amburayan River Irrig. System	La Union	3,700
13	Siffu River Irrigation System	Isabela	10,000
14	*Magat River Irrigation Sys.	Isabela	23,500
15	Masalip River Irrig. System	La Union	2.500
16	Agno River Irrigation System	Pangasinan	25,000
17	Totonquen Creak Irrig. Sys.	Pangasinan	2,600
18	Dumuloc River Irrig. System	Pangasinan	2.000
19	Butista Pump Irrig. System	Pangasinan	700
20	Pampanga-Bongabon R. Irrig.	Nueva Ecija	12,000
21	San Agustin Ext. Irrig. Sys.	Nueva Ecija	1.000
22	Talavera R. Irrig. System	Nueva Ecija	9,120
23	Pampanga R. Irrig. System	Nueva Ecija	12,000
24	Lower Talavera R. Irrig.	Nueva Ecija	3,200
25	*Disalit R. Irrig. Project	Quezon	1.000
26	Peñaranda R. Irrig. Sys.	Nueva Ecija	17,670
27	Pampanga R. Irrig. System	Nueva Ecija	6.000
28	Pamaldan Cinco-Cinco	Nueva Ecija	1.450
29	Bical-Bical Cr. Irrig. Sys.	Nueva Ecija	1,050
30	O'Donnel R. Irrig. System	Tarlac	3.270
31	San Miguel Irrig. System	Tarlac	6,000
32	Tarlac R. Irrigation System	Tarlac	10.000
33	Camiling R. Irrig. System	Tarlac	10.000
34	Vaca Creek Irrigation Sys.	Nueva Ecija	2,400
35	Sto. Tomas R. Irrig. Sys.	Zambales	6.000
36	*Caulaman R. Irrig. Project	Bataan	3.000

TABLE I (Continued)

Proj. No.	*PROJECT*	*Location*	*Area (has.)*
37	Porac Gumain R. Irrig. Sys.	Pampanga	6,000
38	Maasim R. Irrig. System	Bulacan	2,500
39	Angat R. Irrigation System	Bulacan	26,980
40	Colo R. Irrigation System	Bataan	2,500
41	Miray-Aca Irrigation System	Bataan	150
42	San Juan R. Irrigation Sys.	Bataan	400
43	Kalawan-tipaz Pump Irrig. Sys.	Rizal	600
44	Sta. Maria R. Irrig. System	Laguna	1,800
45	Agos R. Irrigation System	Quezon	2,000
46	Mayor R. Irrigation System	Laguna	800
47	*Balanac R. Irrigation Project.	Laguna	1,400
48	Sta. Cruz-Mabacan R. Irrig.	Laguna	4,800
49	Malaunod R. Irrig. System	Laguna	280
50	Lagnas R. Irrigation Sys.	Quezon	600
51	Hanagdong R. Irrig. System	Quezon	270
52	Dumacas R. Irrig. System	Quezon	3,000
53	Palico R. Irrig. System	Batangas	1,800
54	Daet-Talisay R. Irrig. Sys.	Camarines Norte	5,620
55	Cagaycay R. Irrig. System	Camarines Sur	2,300
56	Inarihan R. Irrig. System	Camarines Sur	1,300
57	Tambangan R. Irrig. Project	Marinduque	380
58	Pula River Irrig. System	Oriental Mindoro	2,500
59	Hibiga R. Irrig. System	Albay	500
60	Mahaba-Nasisi R. Irrig.	Albay	2,200
61	Ogson R. Irrig. Sys.	Albay	800
62	Camalig-Catmon Irrig. Sys.	Albay	100
63	Pili River Irrig. System	Sorsogon	1,800
64	Bulan (San Ramon R.) Irrig.	Sorsogon	800
65	Cantingas R. Irrig. Sys.	Romblon	600
66	Sibalom-San Jose Irig. Sys.	Antique	4,430
67	Suague R. Irrig. System	Iloilo	3,860
68	Jalaur R. Irrig. System	Iloilo	11,400
69	Sta. Barbara Irrig. System	Iloilo	4,600
70	Aganan R. Irrigation System	Iloilo	5,520
71	Bao River Irrigation Proj.	Leyte	6,000
72	Binahaan River Irrig. Sys.	Leyte	2,260
73	Tibak River Irrig. System	Leyte	500
74	Soong Lake Irrig. System	Leyte	630
75	Guinarona River Irrig. Sys.	Leyte	1,000
76	Hindan Hilongos Irrig. Sys.	Leyte	800

TABLE 1 (Continued)

Proj. No.	*PROJECT*	*Location*	*Area (has.)*
77	Camunga-an Irrig. System	Leyte	250
78	Quinapundan River Irrig.	Samar	200
79	*Bago River Irrigation Proj.	Negros Occidental	20,000
80	Pangiplan R. Irrig. System	Negros Occidental	2,800
81	*Hilabangan R. Irrig. Proj.	Negros Occidental	7,200
82	*Tanjay R. Irrig. Project	Negros Oriental	1,000
83	*Dumaguete-Sibulan Irrig.	Negros Oriental	500
84	Labangan R. Irrig. Sys.	Zamboanga del Sur	4,000
85	Roxas Irrigation System	Bukidnon	1,300
86	*Kabacan River Irrig. Proj.	Cotabato	5,300
87	Libunagan R. Irrig. System	Cotabato	11,000
88	Padada R. Irrig. System	Davao	3,000
89	Siluay R. Irrig. System	Albay	450
90	*Camalig-Catmon (East Side)	Leyte	3,600
91	*Binahaan South & Dapdap Irrig.	Abra	1,800
92	*Abra River Irrigation Proj.	Mt. Province	3,000
93	*Tabuk (Gubgub-Laya)	Leyte	700
94	*Das-av R. Irrig. Project	Aklan	7,000
95	*Aklan River Irrig. Project		
		Total	399,511 (has.)

*National Irrigation Projects Under Construction as of December 1964

TABLE 1

POPULATION PROJECTION BY REGION[1]
1965 to 2000

REGIONS	1965 [2]	1970	1975	1980	1985	1990	1995	2000
REGION 0 (Manila)	1,356,000	1,610,928	1,931,316	2,271,300	2,698,440	3,204,228	3,806,292	4,520,904
REGION I (Ilocos & Mt. Prov.)	1,752,000	2,081,376	2472,072	2,934,600	3,486,480	4,139,976	4,917,864	5,841,168
REGION II (Cagayan Valley)	1,237,000	1,469,556	1,745,407	2,071,975	2,461,630	2,923,031	3,472,259	4,124,158
REGION III (Central Luzon)	4,408,000	5,236,704	6,219,688	7,383,400	8,771,920	10,416,104	12,373,256	14,696,272
REGION IV (Southern Luzon)	5,063,000	6,014,844	7,143,893	8,480,525	10,075,370	11,963,869	14,211,841	16,880,042
REGION V (Bicol)	2,823,000	3,353,724	3,983,253	4,728,525	5,617,770	6,670,749	7,924,161	9,411,882
REGION VI (W. Visayas)	3,828,000	4,547,664	5,401,308	6,411,900	7,617,720	9,045,564	10,745,196	12,762,552
REGION VII (E. Visayas)	5,437,000	6,459,156	7,671,607	9,106,975	10,819,630	12,847,631	15,261,659	18,126,958
REGION VIII (S.W. Mindanao)	3,918,000	4,654,584	5,528,298	6,562,650	7,796,820	9,258,234	10,997,826	13,062,612
REGION IX (N.W. Mindanao)	2,523,000	2,997,324	3,559,953	4,226,025	5,020,770	5,961,849	7,082,061	8,411,682
PHILIPPINES —	32,345,000	38,425,860	45,656,795	54,177,875	64,366,550	76,431,235	90,792,415	107,838,230

[1] Computed on the basis of 3.5% annual increase.

[2] The 1965 population was based from the Bureau of the Census and Statistics projection.

TABLE 2

PROJECTED RICE REQUIREMENT BY REGION[1] FOR 1965 TO 2000
(In Cavans of 56 kilos milled rice)

REGIONS	1965	1970	1975	1980	1985	1990	1995	2000
REGION 0 (Manila)	2,442,427	2,901,603	3,478,687	4,091,066	4,860,431	5,771,455	6,855,894	8,143,052
REGION I (Ilocos & Mt. Prov.)	3,155,702	3,748,974	4,452,696	5,285,802	6,279,847	7,456,925	8,858,058	10,521,112
REGION II (Cagayan Valley)	2,228,084	2,646,964	3,143,828	3,732,041	4,433,889	5,264,962	6,254,234	7,428,434
REGION III (Central Luzon)	7,939,690	9,432,351	11,202,903	13,298,980	15,799,983	18,761,486	22,286,708	26,470,925
REGION IV (Southern Luzon)	9,119,476	10,833,938	12,867,579	15,275,122	18,147,756	21,549,322	25,598,367	30,404,331
REGION V (Bicol)	5,084,788	6,040,728	7,174,636	8,517,020	10,118,727	12,015,354	14,272,998	16,952,682
REGION VI (W. Visayas)	6,894,994	8,191,253	9,728,835	11,549,114	13,721,038	16,292,870	19,354,247	22,987,908
REGION VII (E. Visayas)	9,793,124	11,634,231	13,818,100	16,403,483	19,488,318	23,141,152	27,489,299	32,650,277
REGION VIII (S.W. Mindanao)	7,057,102	8,383,836	9,957,570	11,820,646	14,043,633	16,675,931	19,809,285	23,528,376
REGION IX (N.W. Mindanao)	4,544,428	5,398,780	6,412,188	7,611,917	9,043,410	10,738,483	12,756,208	15,151,122
PHILIPPINES —	58,259,815	69,212,658	82,237,022	97,585,191	115,937,032	137,667,940	163,535,298	194,238,219

[1] Computed on the basis of 2.28 cavans of rice per capita consumption and 79% of the total population are rice eating.

TABLE 3

ESTIMATED INCREASE IN RICE PRODUCTION DUE TO IRRIGATION AND OTHER FACTORS OF PRODUCTION

REGIONS	AREA [1] Devoted to Rice (Has.)	FACTORS OF PRODUCTION			
		Irrigation (30 Cav per Ha.)	Improved Methods (18 Cav/Ha)	Others (12 Cavs/Ha)	BY REGION TOTAL
REGION 0 (Manila)					
REGION I (Ilocos & Mt. Prov.)	120,080	3,602,400	2,161,440	1,440,960	7,204,800
REGION II (Cagayan Valley)	289,710	8,691,300	5,214,780	3,476,520	17,382,600
REGION III (Central Luzon)	495,700	14,871,000	8,922,600	5,948,400	29,742,000
REGION IV (Southern Luzon)	414,080	12,422,400	7,453,440	4,968,960	24,844,800
REGION V (Bicol)	305,370	9,161,100	5,496,660	3,664,440	18,322,200
REGION VI (W. Visayas)	396,310	11,889,300	7,133,580	4,755,720	23,778,600
REGION VII (E. Visayas)	274,600	8,238,000	4,942,800	3,295,200	16,476,000
REGION VIII (S.W. Mindanao)	226,100	6,783,000	4,069,800	2,713,200	13,566,000
REGION IX (N.W. Mindanao)	565,500	16,965,000	10,179,000	6,786,000	33,930,000
PHILIPPINES —	3,087,450	92,623,500	55,574,100	37,049,400	185,247,000

1 Source — Bureau of Agricultural Economics, Department of Agriculture and Natural Resources (1964).

TABLE 4

POPULATION AND PRODUCTION REQUIREMENTS — FROM 1965 TO 2000

	1964	1965	1970	1975	1980	1985	1990	1995	2000
Population		32,345,000	38,425,860	45,656,795	54,177,875	64,366,550	76,431,235	90,792,415	107,838,230
Rice Requirement:									
Milled Rice —		58,259,815	69,212,658	82,237,022	97,585,191	115,937,032	137,667,940	163,535,298	194,238,219
Rough Rice —		114,189,237	135,656,809	161,184,563	191,266,974	227,236,582	269,829,162	320,529,184	380,706,909
Production									
Rough Rice —	87,337,700	87,337,700	114,189,237	135,656,809	161,184,563	191,266,974	227,236,582	269,829,162	320,529,184
Deficit (Rough Rice)		26,851,537	21,467,672	25,527,754	30,082,411	35,969,608	42,592,580	50,700,022	60,177,725
TOTAL PRODUCTION REQUIREMENT		114,189,237	135,656,809	161,184,563	191,266,974	227,236,582	269,829,162	320,529,184	380,706,909

TABLE 5-a
POPULATION AND PRODUCTION REQUIREMENTS FROM 1965 TO 2000

	1965	1970	1975	1980	1985	1990	1995	2000
Population	32,345,000	38,425,860	45,656,795	54,177,875	64,366,550	76,431,235	90,792,415	107,838,230
Production (Rough rice — Cavans of Palay)	114,189,237	135,656,809	161,184,563	191,266,974	227,236,582	269,829,162	320,529,184	380,706,909
Deficit (Rough rice — Cavans of Palay)	26,851,537	21,467,672	25,527,754	30,082,411	35,969,608	42,592,580	50,700,022	60,177,725

TABLE 5-b
ACTUAL PRODUCTION AS OF 1964

Area Planted (Hectares)	3,087,450
Actual Production (Cavans of Palay)	87,337,700
Deficit for 1965 (Cavans of Palay)	26,851,537
Area Irrigated (Hectares)	1,060,415
Unirrigated Area (Hectares)	2,027,035

TABLE 5-c

AREA DEVELOPMENT TO MEET PRODUCTION REQUIREMENTS — 1965 TO 2000

	1965	1970	1975	1980	1985	1990	1995	2000	Remarks
Deficit	26,851,537	21,467,672	25,527,754	30,082,411	35,969,608	42,592,580	50,700,022	60,177,725	Cav. of palay
Area of Development									
Irrigation [1] Area (Hectares) ..	550,000	550,000	550,000	313,420	550,000	550,000	550,000		
Production	16,500,000	16,500,000	16,500,000	9,402,600	16,500,000	16,500,000	16,500,000		Cav. of palay
Improved Methods [2]									
Area (Hectares)	220,425	501,541	550,000	313,420	550,000	550,000	550,000		
Production	4,967,672	9,027,754	9,900,000	5,641,560	9,900,000	9,900,000	9,900,000		Cav. of palay
New Lands: [3] Area (Hectares)	—	—	136,385	775,016	599,725	900,000	1,251,026		
Production	—	—	3,682,411	20,925,448	16,192,580	24,300,022	33,777,725		Cav. of palay

1 Based on 30 cavans of palay increase per hectare due to irrigation.
2 Based on 18 cavans of palay increase per hectare due to improved methods.
3 Based on 27 cavans of palay increase per hectare due to opening of new lands.

SUMMARY

Total Area Irrigated (Hectares)	3,613,420
Total New Lands Opened (Hectares)	3,662,152
Sub-Total	7,275,572
Irrigated as of 1964 (Hectares)	1,060,415
GRAND TOTAL	8,335,987

TABLE 6

PALAY: AREA, PRODUCTION AND YIELD PER HECTARE BY REGION, PHILIPPINES, 1964

Region	Area (Hectares)	Production (44 kgm. sack)	Yield per Hectare (44 kgm. sack)
Philippines	3,087,450	87,337,700	28.3
Ilocos	120,080	3,306,400	27.5
Cagayan Valley	289,710	3,306,400	25.8
Central Luzon	495,700	20,979,900	42.3
Southern Tagalog	414,080	10,420,800	25.2
Bicol	305,370	8,397,000	27.5
Eastern Visayas	274,600	5,315,100	19.4
Western Visayas	396,310	10,712,500	27.0
Northern & Eastern Mindanao	226,100	4,582,600	20.3
Southern & Western Mindanao	565,500	16,160,900	28.6

Source of data: Bureau of Agricultural Economics

TABLE 7

IRRIGATION SYSTEM IN THE PHILIPPINES

Category	Hectares Area In	Percentage
I. Pump Irrigation		
a. ISU	54,995	5.19%
b. Private	5,421	0.51%
II. Gravity Irrigation		
a. Communal System		
— with government aid	105,199	9.92%
— without government aid	551,378	52.00%
b. Friars Lands	25,711	2.42%
c. National Gravity	317,711	29.96%
Total	1,060,415	100.00%

TABLE 8 (a)

ECONOMIC FEASIBILITY OF THE CENTRIFUGAL TYPE

ITEM	PUMP SIZE 4"ø	5"ø	6"ø	8"ø
A. *General Data*				
(1) Capacity, GPM	320	600	960	1500
(2) Ave. Area Coverage, Ha.[1]	10	20	30	50
(3) Total Cost of Project	₱5,200	₱6,950	₱8,900	₱12,350
a) Pump & Engine[2]	4,400	5,450	6,900	9,350
(b) Construction & Administration	800	1,500	2,000	3,000
(4) Investment Per Hectare	520.00	347.50	295.70	247.00
B. *Annual Cost*				
(1) Interest & Depreciation[3]				
a) For pump & engine:				
Interest —	₱ 198.00	₱ 245.25	₱ 310.50	₱ 420.75
Depreciation —	375.11	464.62	588.24	797.10
(b For canal network and structures:				
Interest —	36.00	67.50	90.00	135.00
Depreciation —	15.50	29.07	58.76	58.14
(2) Operation & maintenance[4]	₱ 443.80	₱ 720.20	₱1,000.50	₱ 1,287.00
(Per Hectare Basis)	(44.38)	(36.01)	(33.35)	(25.74)
(3) Total Annual Cost	₱1,068.41	₱1,626.64	₱2,029.00	₱ 2,697.99
ANNUAL COST PER HECTARE	₱ 106.84	₱ 81.32	₱ 67.97	₱ 53.96

TABLE 8 (a) (Continued)

ITEM	PUMP SIZE 4"ø	5"ø	6"ø	8"ø
C. *Annual Benefit Per Hectare*				
(1) Income from irrigated land				
Gross Income [5]	₱ 417.00	₱ 417.00	₱ 417.00	₱ 417.00
Less: Farm Operation [6]	136.00	136.00	136.00	136.00
Net Income	₱ 281.00	₱ 281.00	₱ 281.00	₱ 281.00
(2) Income from Unirrigated land				
Gross Income [7]	₱ 245.00	₱ 245.00	₱ 245.00	₱ 245.00
Less: Farm Operation [6]	121.00	121.00	121.00	121.00
Net Income	₱ 124.00	₱ 124.00	₱ 124.00	₱ 124.00
(3) Net Annual Benefit due to irrigation per hectare	₱ 157.00	₱ 157.00	₱ 157.00	₱ 157.00
D. Benefit-Cost Ratio	1.48	1.93	2.31	2.91
E. Cost per Cavan of Increased Production [8]	₱ 6.75	₱ 5.19	₱ 4.30	₱ 3.42

1 Figures rounded.
2 Based on current (1963) market price and based on the estimates of the ISLU.
3 Based On:
(a) 41/2% interest rate on capital investment.
(b) 3 1/2% earning rate for sinking fund depreciation at (i) 10-year life w/zero salvage value for pump and (ii) 30-year life for canal network.
4 Cost of fuel, oil, grease, replacement part, etc.; salaries of operators, water-tenders and including annual repairs as based on ISLU records.
5 Based on 41.7 cavan per hectare production of ISLU-irrigated fields at ₱10/cavan.
6 Farm operation excludes "care of crop" such as pest control measures and fertilization.
7 Based on 24.5 cavans per hectare average production before pump unit was installed.
8 Based on ₱10/cavan.

TABLE 8 (b)
ECONOMIC FEASIBILITY OF THE PROPELLER TYPE

ITEM	PUMP SIZE 10"ø	12"ø	16"ø	
A. *General Data*				
(1) Capacity, GPM	2,400	3,400	6,000	10,000
(2) Ave. Area Coverage, Ha.[1]	80	110	200	300
(3) Total Cost of Project	₱21,700	₱45,500	₱71,500	₱94,500
a) Pump & Engine[2]	16,500	37,000	56,500	72,000
b) Constructon & Administration	5,200	8,500	15,000	22,500
(4) Investment Per Hectare	271.20	413.60	357.50	313.00
B. *Annual Cost*				
(1) Interest & Depreciation[3]				
a) Pump & Engine:				
Interest —	₱ 742.50	₱ 1,665.00	₱ 2,542.50	₱ 3,240.00
Depreciation —	1.406.65	3,154.31	4,816.71	6,138.11
(b For canal network and structures:				
Interest —				
Depreciation —	100.78	164.73	290.70	436.05
(2) Operation & maintenance[4]	₱ 1,942.40	₱ 3,349.50	₱ 5,094.00	₱ 6,912.00
(Per Hectare Basis)	(24.28)	(30.45)	(25.47)	(23.04)
(3) Total Annual Cost	₱ 4.426.33	₱ 8,716.04	₱13,418.91	₱17,738.66
ANNUAL COST PER HECTARE	₱ 55.34	₱ 79.23	₱ 67.09	₱ 59.13

TABLE 8 (b) (Continued)

ITEM	PUMP SIZE 10"ø	12"ø	16"ø	
C. *Annual Benefit Per Hectare*				
(1) Income from irrigated land				
Gross Income [5]	₱ 417.00	₱ 417.00	₱ 417.00	₱ 417.00
Less: Farm Operation [6]	136.00	136.00	136.00	136.00
Net Income	₱ 281.00	₱ 281.00	₱ 281.00	₱ 281.00
(2) Income from Unirrigated land				
Gross Income [7]	₱ 245.00	₱ 245.00	₱ 245.00	₱ 245.00
Less: Farm Operation [6]	121.00	121.00	121.00	121.00
Net Income	₱ 124.00	₱ 124.00	₱ 124.00	₱ 124.00
(3) Net Annual Benefit due to irrigation per hectare	₱ 157.00	₱ 157.00	₱ 157.00	₱ 157.00
D. Benefit-Cost Ratio	2.84	1.98	2.34	2.65
E. Cost per Cavan of Increased [8] Production	₱ 3.51	₱ 5.05	₱ 4.28	₱ 3.78

1 Figures rounded.
2 Based on current (1963) market price and based on the estimates of the ISLU.
3 Based On:
(a) 41/2% interest rate on capital investment.
(b) 3 1/2% earning rate for sinking fund depreciation at (i) 10-year life w/zero salvage value for pump and (ii) 30-year life for canal network.
4 Cost of fuel, oil, grease, replacement part, etc.; salaries of operators, water-tenders and including annual repairs as based on ISLU records.
5 Based on 41.7 cavan per hectare production of ISLU-irrigated fields at ₱10/cavan.
6 Farm operation excludes "care of crop" such as pest control measures and fertilization.
7 Based on 24.5 cavans per hectare average production before pump unit was installed.
8 Based on ₱10/cavan.

TABLE 9

ESTIMATED CAPITALIZATION FOR PUMP IRRIGATION — FROM 1965-2000

	1965	1970	1975	1980	1985	1990	1995	2000
Increase in Area Irrigated by Pumps (Hectares) —	—	250,000	250,000	250,000	250,000	250,000	250,000	250,000
Estimated Capitalization* In P1,000)	—	136,000	136,000	136,000	136,000	136,000	136,000	136,000

*Based on P544 estimated nvestment per hectare (Source: Economics of Pump Irrigation — by Teofilo Mendoza)