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Assessment of Physical Resource Capability in Philippine Agriculture

Luis Rey Velasco and Liborio Cabanilla

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Abstract

The study assessed Philippine physical resources (i.e., land, water and weather pattern) with focus on rice, corn and coconut production systems. It specifically: 1) described the country's agricultural capabilities and defined boundaries/interactions among resources that influence agricultural production; 2) mapped out major agricultural production areas and determined possible relationships between performance and resources; 3) compared the Philippines' physical resources and agricultural performance with countries such as Thailand (rice and corn), Indonesia (rice and coconut) and Malaysia (coconut versus oil palm); and, 4) identified some policy issues on effective and efficient resource use for agricultural development. Findings on identified suitable land for agricultural land showed a Philippine potential to produce rice and corn enough to supply a projected 10-year increase in population demand, thus a current capability to produce at a surplus and compete globally. Several moderating variables to this potential were identified: climate (typhoon-prone for Luzon and Visayas), small area covered by irrigation facilities, small landholdings, and low incentives to use modern technologies due to the low benefit-cost ratio. Nevertheless, the study proposes that investment in R&D and policy changes could balance out the negative effects of these moderating factors. In addressing Philippine agricultural production requirements while competing globally, the study also forwarded the following considerations: 1) expansion of agricultural land can only help to a limited extent since the Philippines has the smallest land area among the four countries; 2) the country does not need to advocate for increased transfer of labor forces towards agriculture since our land to agricultural population ratio is already low compared to Thailand and Malaysia; 3) Philippine growth rates are comparable but remain the lowest in terms of absolute yield/ha, thus a need to look at diversification. Overall, the study pointed out a need to reconcile national food security policy and the drive against poverty based on technical and socio-economic contexts.

Executive Summary

The study assessed the physical resources (i.e., land, water and weather pattern) of the Philippines, with focus on rice, corn and coconut production systems as compared to other agricultural countries in Asia. It specifically: 1) described the country's agricultural capabilities and defined boundaries/interactions among resources that influence agricultural production; 2) mapped out the major agricultural production areas and determined the possible relationships between performance and resources; 3) compared the Philippines' physical resources and agricultural performance with countries such as Thailand (rice and corn), Indonesia (rice and coconut) and Malaysia (coconut versus oil palm); and, 4) identified some policy issues regarding the effective and efficient use of resources for agricultural development.

To accomplish the above objectives, the study presented and analyzed data on Philippine agricultural resources, focusing on the three main crops produced by the country --- rice, corn and coconut. The study framework defined agricultural performance as productivity level against the desired national production requirements. This meant effective performance or the ability of the country, based on historical data vis-à-vis its potential (research-determined) to supply production requirements. Efficient performance, on the other hand, was viewed as how well the physical resources are managed so that its utilization would result to maximum productivity without undue consequences to the sustainability of the physical resources. Operationally, the indicator used in this study was actual productivity per unit area against potential productivity per unit area.

For global competitiveness, the study focused on the country's three closest competitors in agricultural products --- Thailand, Malaysia and Indonesia. In terms of sheer land mass, Indonesia is by far the largest followed by Thailand and Malaysia. The Philippines, in this regard, is smallest. The same trend goes for the land area devoted to agriculture except for Malaysia which has the smallest agricultural land area. Despite this, Malaysia has the largest per capita land as indicated by the ratio of agricultural land to agricultural population. Trailing behind are Thailand, Philippines and Indonesia, respectively.

Trade patterns in terms of major agricultural imports/exports indicate that the Philippines is the only net importer among these countries in terms of overall agricultural imports versus exports in 1998. Malaysia and Thailand exported rice from 1988 to 1998 while Indonesia started exporting (in minor quantities) rice in 1996. The Philippines, however, has been a consistent net importer of rice in the same period. As to why this is so, the study pointed out the fact that their physical resources, in terms of rice area, are 3-4 times larger compared to that of the Philippines.

With the abovementioned general agricultural performance, can the Philippines really compete? Do we have the resources to do so?

The assessment showed a Philippine potential, particularly in terms of currently used land area, to produce rice and corn that is enough to supply increasing population demands for the next ten years. The study thus forwarded that if current suitable land areas can support rice and corn demands for a projected population increase, then there is also a current potential to produce at a surplus and compete in the global market for both products. However, there are several moderating variables that limit the use of available agricultural resources and affect the country's actual production outputs, namely: climate (typhoon-prone for Luzon and Visayas), small area covered by irrigation facilities, small landholdings, and low incentives to use modern technologies due to the low benefit-cost ratio. Nevertheless, the study proposes that investment in R&D and policy changes could balance out the negative effects of these moderating factors, specifically: a) R&D on typhoon-tolerant varieties; b) expansion of irrigation facilities; c) reducing cost of inputs through policies; etc.

In addressing agricultural production requirements while competing with other Asian agricultural producers, major differences in terms of respective characteristics of the agricultural sector must be considered:

- Among the four countries, the Philippines is the smallest followed by Malaysia. This implies that the country's approach to compete production-wise through the expansion agricultural areas can only help to a limited extent since Thailand, Indonesia and Malaysia have greater potentials for expansion.

- In terms of the ratio of land to agricultural population, the country's closest "competition" is Indonesia. Both Thailand and Malaysia's increasing man-land ratios for the same period may be attributed to the negative change in agricultural population. This indicates that the country does not really need to advocate for the increased transfer of labor forces towards agriculture (ex. "Back-to-the-Province" projects for urban areas) but instead must diversify into other entrepreneurial activities.

- Our agricultural land is predominantly planted to rice, corn and coconut. In terms of rice, our growth rates are comparable to those of our Asian neighbors. While the growth of our corn yield level is also comparable to Thailand and Indonesia, ours remain the lowest in terms of absolute yield/ha. On the other hand, the Philippines reported the highest growth rate of coconut production area. The latter however was explained by the other countries' apparent interest in oil palm production, where the Philippines registered the lowest production area growth rate. All of the above provide the rationale for shifting towards the production of other crops instead of continuously seeking for the expansion of rice, corn or coconut production areas.

It must also be noted that while the study found that there is not much room for expansion of agricultural land, the identified suitable land areas for agricultural production in the Philippines are more than enough to produce the country's food requirements. Thus, food security is not really an issue. However, the country does suffer from lower yield levels due to limitations imposed by weather conditions and inadequate irrigation systems.

The study also pointed out that in all approaches to agricultural development, support services play an important role. These support services (i.e., a more efficient marketing system which would bring down costs of distributing products) must be put in place in order to fully realize gains in agricultural resource utilization. This is highlighted by the cost of distribution of corn in the Philippines. In Thailand the cost is only US$ 15/mt, while in the Philippines it is US$62/mt. While our country's relatively smaller landholdings contribute to the disparity in marketing and distribution costs, other factors include inefficiencies of marketing processes. Thus, there is an urgent need to transform our transportation and marketing system into an efficient and globally competitive system.

Likewise, the study forwarded that there is little incentive for farmers to grow food crops because of the low return of investments. This can be attributed to small landholdings that result to very low net incomes from rice, corn or coconut. As net incomes from these crops are rarely enough for decent lifestyles, encouraging farmers to plant these crops would be tantamount to asking them to remain poor. Thus, while food security approaches may prescribe increased production of these crops, such may not be compatible with development goals of increasing farmers' incomes. Related this is the fact that Filipino farmers were found to derive substantial incomes from non-farm activities. Thus, it becomes doubly hard to encourage them to invest on necessary inputs (i.e. fertilizers) for increased agricultural production when they are able to obtain higher absolute incomes from non-farm opportunities. Any development initiative/policy must therefore be made within the context of these socio-economic concerns.

Diversification, which may include shifting production to high value crops, was raised as an option that could increase farm-level incomes. Other options could include shifting land use away from agriculture to agri-based enterprises. Whatever the case, the study noted a great need to reconcile national food security policy with the country's policies on poverty eradication.

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I. Introduction

The implementation of trade liberalization policies among national economies, including the Philippines, should be viewed as a necessity rather than a result of political agreements. Trade must be looked upon as a window of opportunity rather than as a threat to development. Global trends show that inward-looking countries have stagnated while outward-looking states prospered. It must be pointed out, however, that to take full advantage of the opportunities in a globally oriented economy, appropriate adjustments must be undertaken in the domestic scene. Often, the full benefits of trade are not realized due to the defects in the domestic system.

A basic philosophy towards a liberalized economy, especially in agriculture, would be to rationalize the use of natural resources. It is important to understand and determine how natural resources (i.e., land and water) should be used to promote food security, poverty alleviation, global competitiveness and health of the environment for sustained development.

In terms of food security, there is a need to look at whether or not our agricultural physical resources can support our current population's demand for agricultural products. Can it support the future demands of an ever-increasing populace despite the fact that agriculture's main resource (i.e. land) is relatively fixed? Does the current agricultural resource utilization support the country's bid to increase rural incomes and alleviate poverty? Given these resources, can the Philippines compete with other countries in terms of agricultural production levels? Will it enable the agriculture sector to supply products at competitive prices?

[*] a research project funded by the Philippine APEC Study Center Network (PASCN)

For global competitiveness, it is important to note that our three closest competitors in agricultural products are Thailand, Malaysia and Indonesia. In terms of sheer land mass, Indonesia is by far the largest followed by Thailand and Malaysia. The Philippines, in this regard, is smallest. The same trend goes for the land area devoted to agriculture except for Malaysia which has the smallest agricultural land area. Despite this, Malaysia has the largest per capita land as indicated by the ratio of agricultural land to agricultural population. Trailing behind are Thailand, Philippines and Indonesia, respectively.

Trade patterns in terms of major agricultural imports/exports indicate that the Philippines is the only net importer among these countries in terms of overall agricultural imports versus exports in 1998. Malaysia and Thailand exported rice from 1988 to 1998 while Indonesia started exporting (in minor quantities) rice in 1996. The Philippines, however, has been a consistent net importer of rice in the same period. In this instance, it is quite valid to question why our Asian neighbors are able to export rice when their technologies and experts have often been (and continue to be) trained in the Philippines, particularly at the University of the Philippines Los Baños. The obvious answer lies in the fact that their physical resources, in terms of rice area, are 3-4 times larger compared to that of the Philippines.

With the abovementioned general agricultural performance, can the Philippines really compete? Do we have the resources to do so?

These are issues that have to be answered if the country is to chart its course towards sustainable agricultural development. Whatever the case, there is a pressing need to identify what interventions are needed to ensure that the above issues are addressed positively. Given the country's physical resource capabilities, what then are the requirements (e.g. human/expertise, infrastructure, policies, etc.) that would enable the country to provide current and future agricultural demands of the population as well as ensure global competitiveness of the agriculture sector?

Objectives of the Project

The general objective of this study was to assess the physical resources (i.e., land, water and weather pattern) of the Philippines as compared to other agricultural countries in Asia. Of particular interest are the rice, corn and coconut production systems.

The specific objectives were as follows:

1. Describe the physical characteristics of the country in terms of agricultural capabilities and define the boundaries and interactions among resources that influence agricultural production.

2. Map out the major agricultural production areas and determine the possible relationships between performance and resources.

3. Compare the Philippines' physical resources and agricultural performance with countries such as Thailand (rice and corn), Indonesia (rice and coconut) and Malaysia (coconut versus oil palm).

4. Identify some policy issues regarding the effective and efficient use of these resources for agricultural development.

5. Prepare an abridged version of the research report that may be used specifically for advocacy work related to more efficient allocation of agricultural resources.

Analytical Framework of the Study

Illustrated below is the analytical framework of the study to determine the relationship between agricultural physical resources and performance. This is also the framework followed to compare agricultural physical resources and performance of selected countries in Southeast Asia.

Agricultural performance in this study refers to productivity level against the desired national production requirements. In a sense this can mean effective performance or the ability of the country, based on historical data vis-à-vis its potential (research-determined) to supply production requirements. Production requirements are thereby influenced by increasing population levels, global market demands as opportunities for market participation and local/global policies.

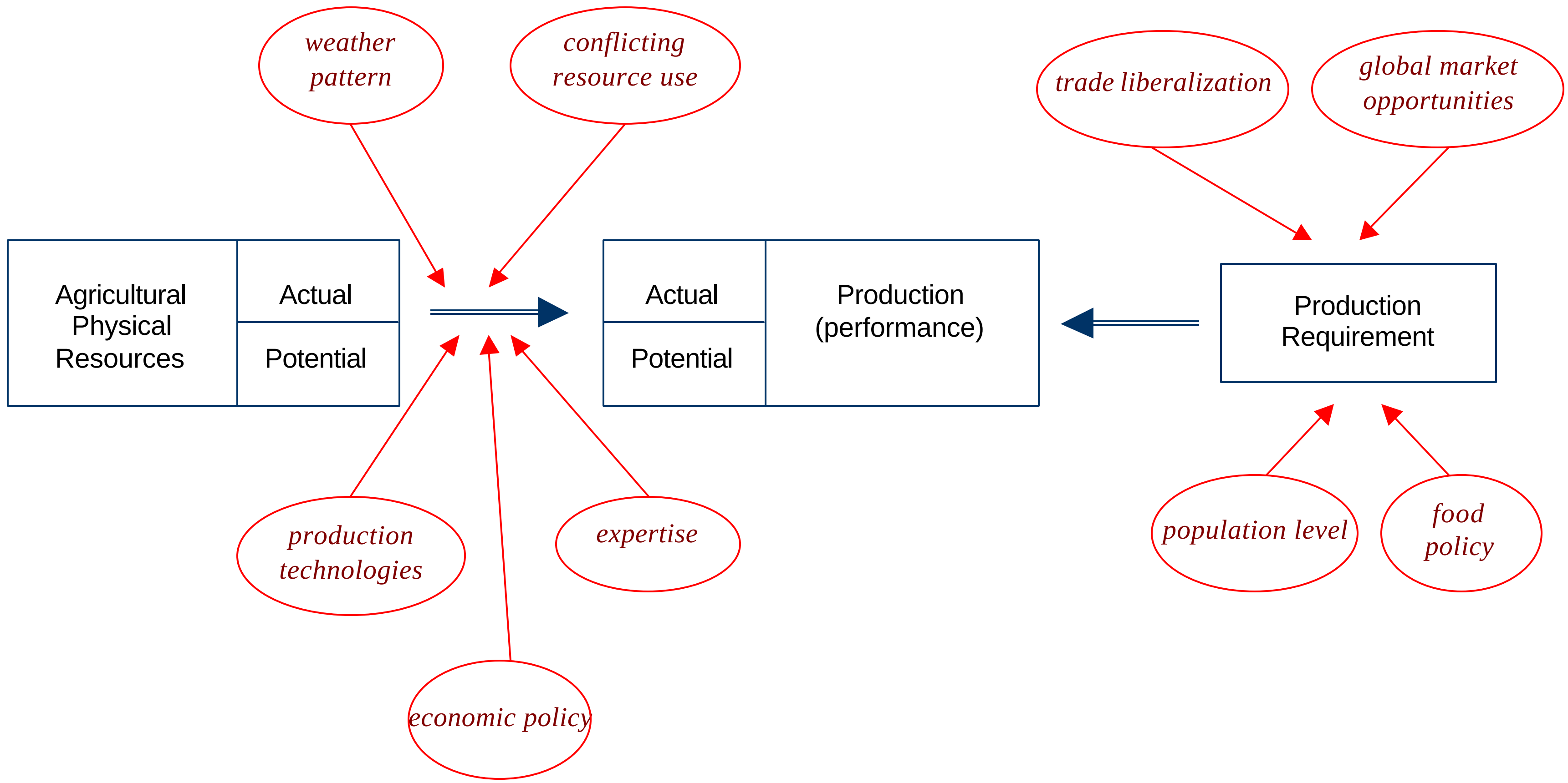
Efficient performance, on the other hand, refers to the how well the physical resources are managed so that its utilization would result to maximum productivity without undue consequences to the sustainability of the physical resources. Optimum physical resource use is likewise influenced by other factors --- weather pattern, conflicts in resource use, production technologies, agricultural human resource/expertise and sector-specific economic policies.

Operationally, the indicator used in this study is actual productivity per unit area against potential productivity per unit area. The latter is based on field trials managed by researchers.

Agricultural physical resources (i.e., land area, land suitability and available water for irrigation) are finite resources that determine the potential productivity level of a country. There are moderating variables that tend to contribute to either increased or decreased use of these resources, and to the level of agricultural productivity. An important moderating variable is weather pattern. It may either have an increasing or decreasing effect on productivity depending on the weather element and on the crop. For example, occurrence of rainfall may contribute to increased productivity for a particular crop. However, if rainfall will occur continuously for a prolonged period, coinciding with the critical stage (e.g., fruiting) of the crop, the effect will be a decrease in productivity. In a similar vein, typhoons with strong winds would most likely decrease productivity for most crops. Recently, there have been significant changes in global weather patterns. Thus, indicative changes in agricultural productivity can be expected.

The use of production technologies (e.g., fertilizer, high yielding modern varieties) tends to increase productivity. Likewise, expertise can contribute to increased productivity and counter the possible negative influence of weather. Another moderating variable is the conflicting use of physical resources for agriculture and non-agriculture activities such as loss of our prime agriculture areas to urbanization. The economic policy environment is also another moderating variable. By design, policy should contribute to higher productivity.

For the purposes of this study, attention was focused on the following moderating variables: weather pattern and use of production technologies. Limited reference was also made regarding some economic policies that may have affected productivity.



Analytical Framework

II. Characterization of Philippine Agricultural Land and Weather Pattern

The Philippines is said to be an agricultural country with bountiful natural endowments and an ideal tropical climate for agriculture. However, this is only one side of the story. While the country has much physical resources to boast of, global perspectives on agricultural profiles of other countries may indicate that there is much to be desired. Of particular note are neighboring countries (with their respective resource and production performance profiles) that the Philippines compete with in terms of global market participation. Also, while internal analyses of physical resource may provide an overview on the country's capacity to address food security, there is a need to look at how the Philippines fares with respect to global competitiveness. Part III of the paper details a comparative of analysis of Philippine physical resources and production performance with selected Asian countries --- Thailand, Indonesia and Malaysia.

This portion of the paper thus details the country's agricultural physical resources, providing us data on whether or not these resources can support current and future requirements of the populace.

Suitable Land for Agricultural Production

Suitable land for agricultural production in the Philippines is very limited and there is very little room for expansion. In fact, a substantial proportion of agricultural land has high soil acidity (Figures 2a to 2c). Already about 10 million hectares out of its total land area (~ 30 million hectares) is already devoted to agriculture (arable lands) and this figure is almost the limit for ideal lands for agriculture (terrain slope < 1%).

Of this agricultural area, rice, corn and coconut are the predominant crops planted. Only less than 1.5 million hectares are devoted to other crops.

Table 1. General land use in the Philippines, 1990 *(de Jesus, 2001)*.

	Luzon	Visayas	Mindanao	Total Land Area (has.)
Agricultural Areas	4,383,980	2,512,324	3,439,437	10,335,741
Grassland/Shrubland	4,023,003	2,020,839	2,951,337	8,995,179
Woodland	4,780,661	895,927	3,269,274	8,945,862
Wetland	275,692	164,215	333,895	773,802
Miscellaneous	676,156	85,230	205,947	967,333

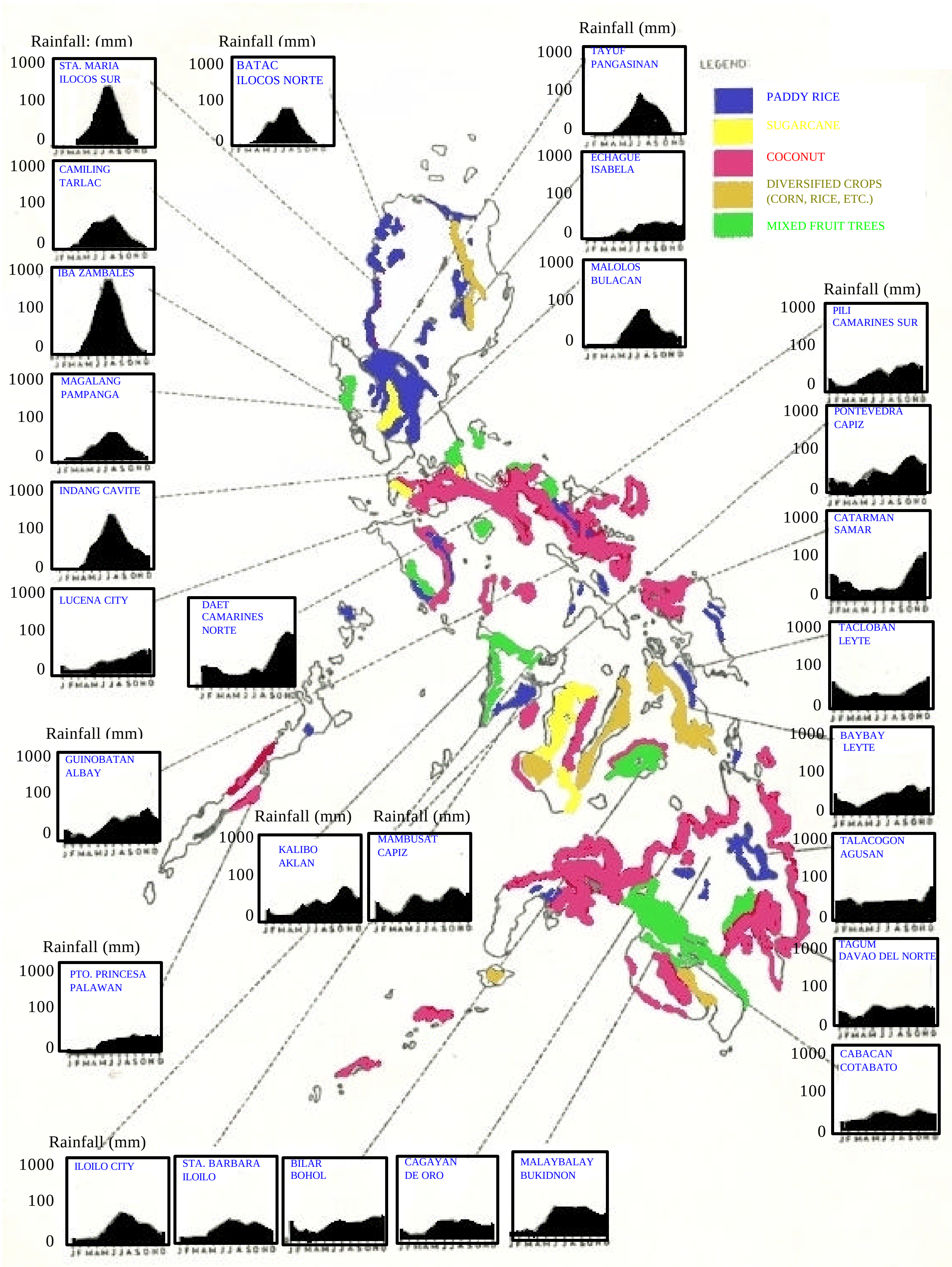
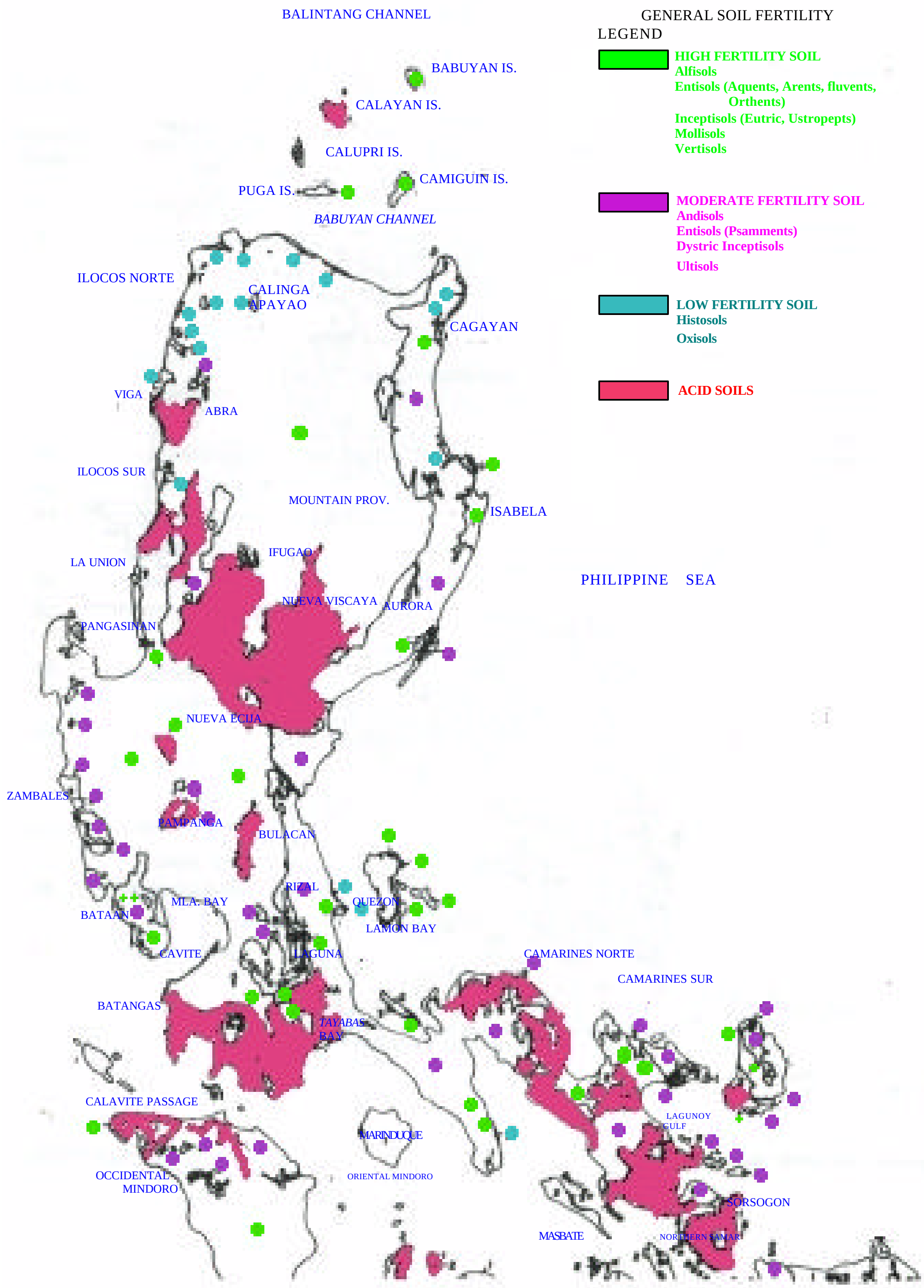


Fig. 1. Land use and rainfall patterns of the Philippines (Source: PCARRD, 1977).



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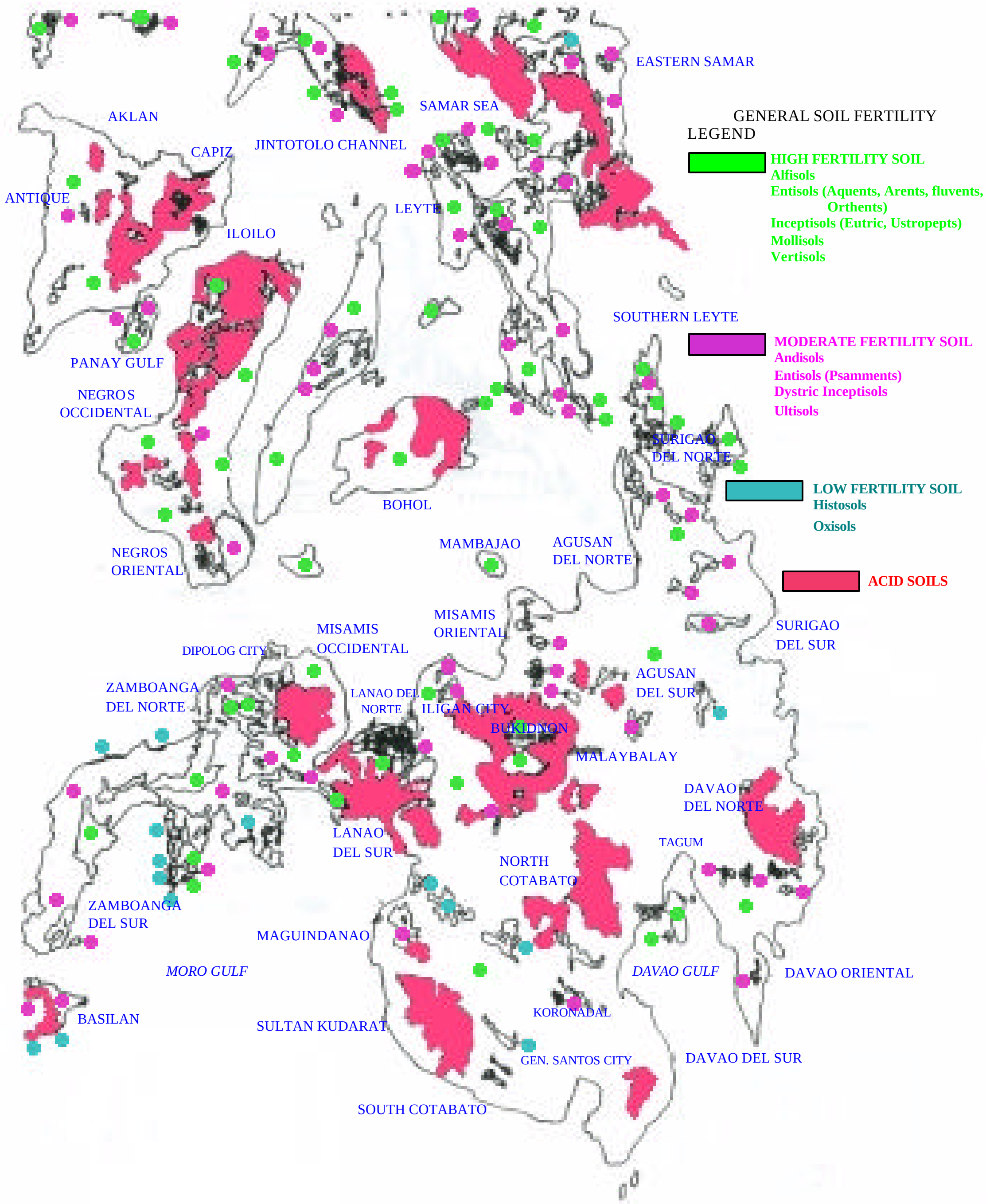

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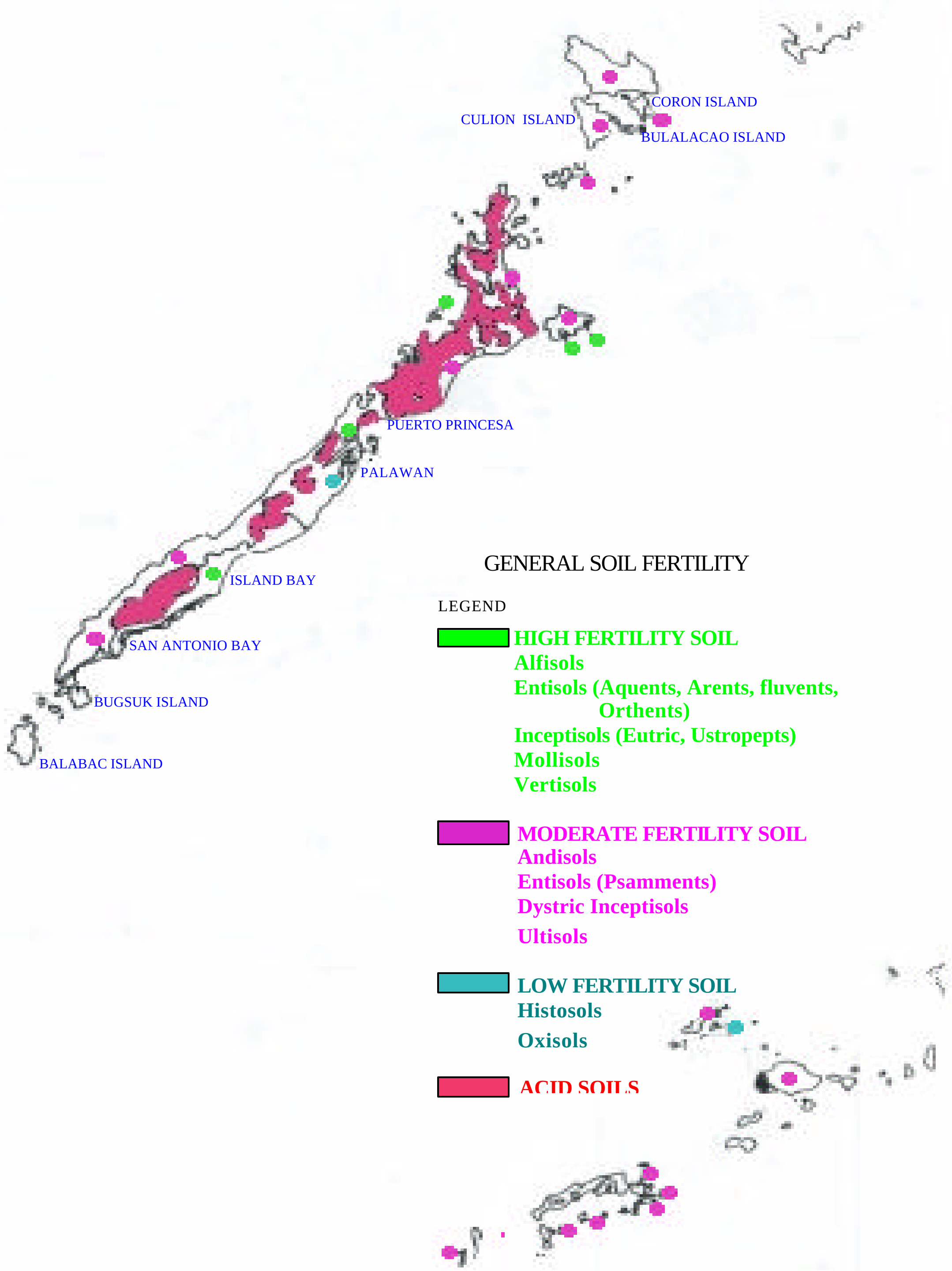


Fig. 2c. General Soil Fertility in the Philippines (PCARRD, 1999).

Irrigation Facilities

Despite having a large potentially irrigable area (3 million hectares), the total agricultural area covered by irrigation has not increased since the 1970s. The reported agricultural land covered by irrigation facilities owned by the government in 1990 was reported at 1.5 million hectares.

However, in terms of overall effectiveness of service, probably only 0.6 million hectares of agricultural land can be considered as having good and reliable irrigation all year round. Most of the areas covered with good irrigation facilities are also in Luzon. Only 0.3 million hectares are irrigated land in Mindanao, which is the most ideal region for agriculture in the Philippines.

Table 2. Extent of Irrigated Lands in the Philippines, 1990 *(de Jesus, 2001)*.

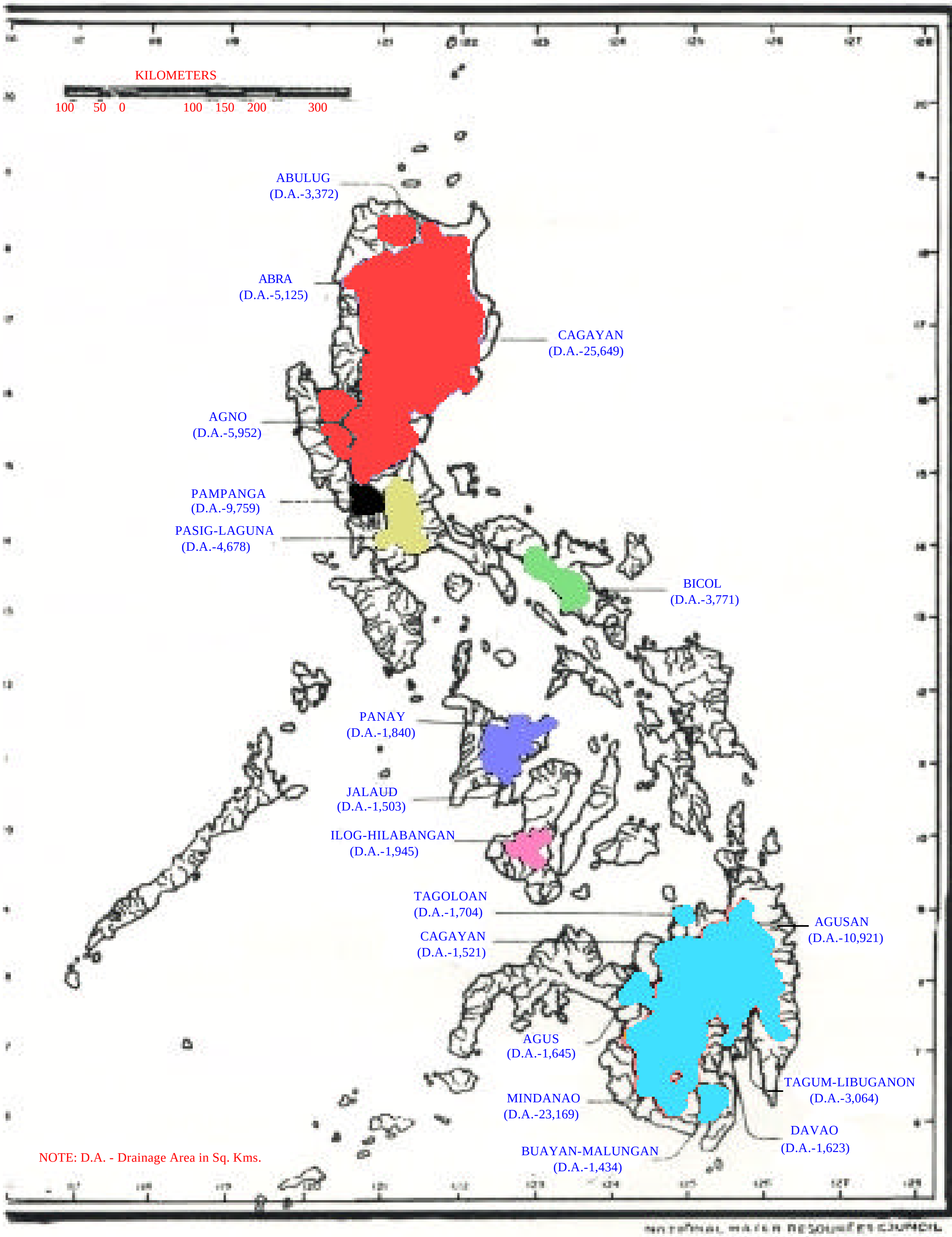
	Present Riceland	Potential Irrigable Area	Presently Irrigated	
			Government Assisted	Private
Philippines	2,895,923	3,068,739	1,414,248	1,107,308
Luzon	2,049,560	1,897,195	994,961	1,107,308
Visayas	541,915	350,381	184,168	no data
Mindanao	304,448	821,163	235,119	no data

This problem in irrigation is compounded the country's highly variable weather pattern and climate.

Climate Types and Location

The Philippines has four climate types. Type I is characterized by having two pronounced seasons --- dry season from November to April and wet season for the rest of the year. Luzon, Negros, Mindoro and Palawan are of this type. Type II climate has no dry season with a pronounced rainy period during November to January. With Type III, the seasons are not very pronounced. The dry months last only from one to three months. On the other hand, Type IV has an even distribution of rainfall all year round.

Our country is visited by an average of 19 typhoons every year during the wet months. Crop performance in general is very low during the wet season because more often than not the crop is affected by the strong winds and water logging brought about by the successive typhoons. In some areas, however, the problem is prolonged dry months which restricts cropping only during the wet months. The only region in the Philippines that may be considered safe from typhoons and/or prolonged drought is Mindanao. Mindanao and Palawan have a Type IV climate, characterized by even rainfall distribution all year round and both are rarely visited by typhoons. But a different problem, one could say man-made constraints, is present in most municipalities of Mindanao.



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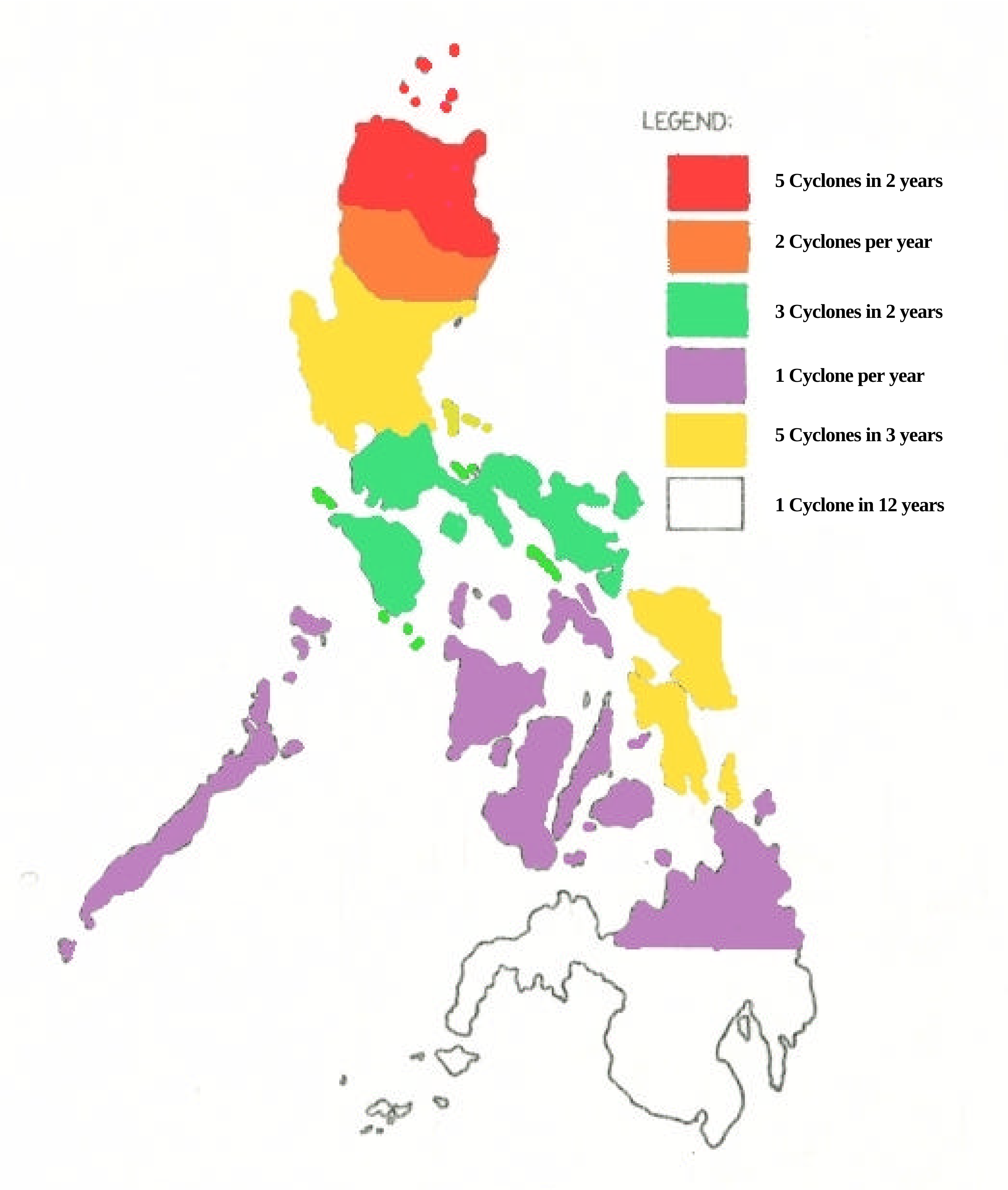

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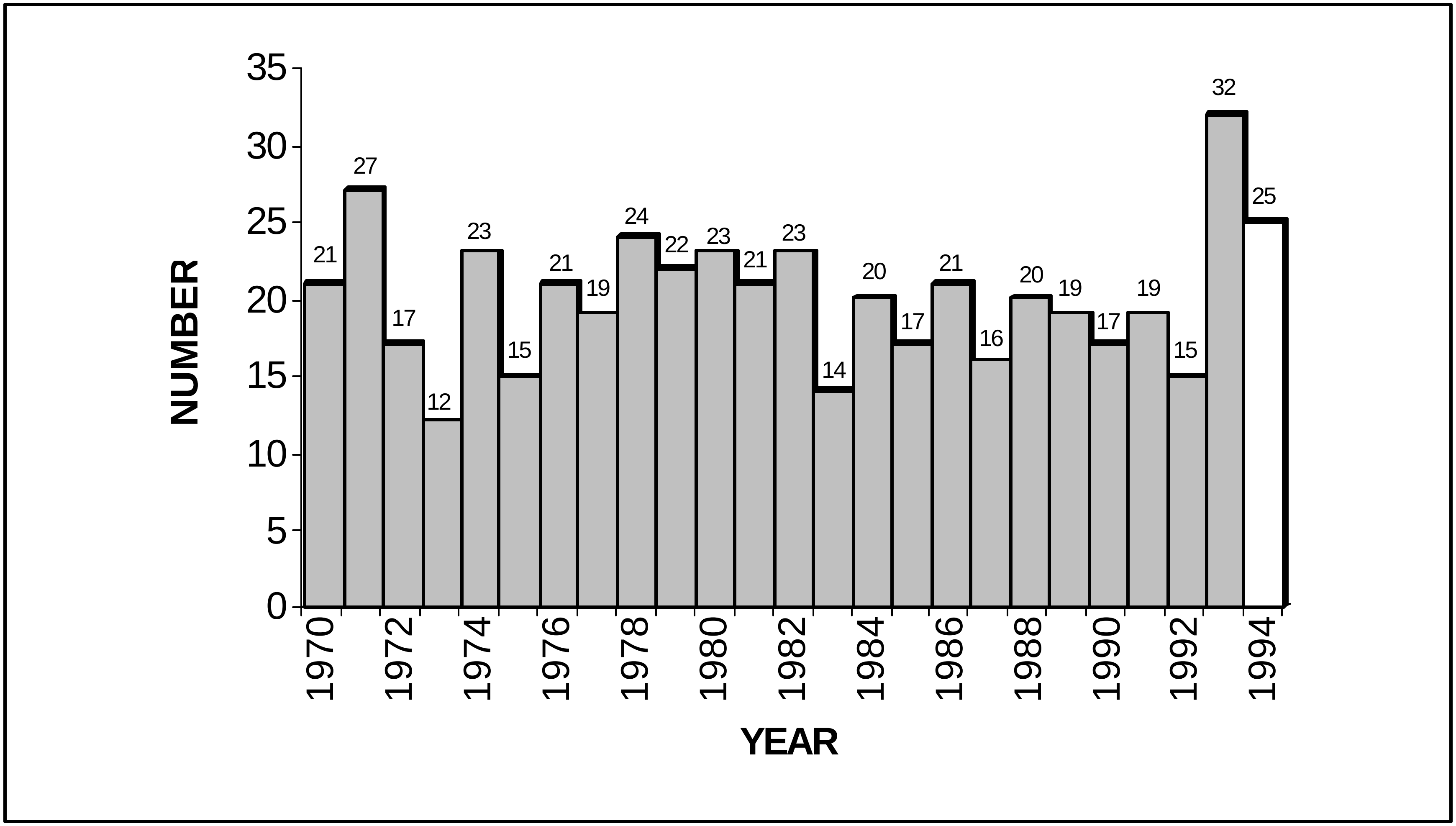

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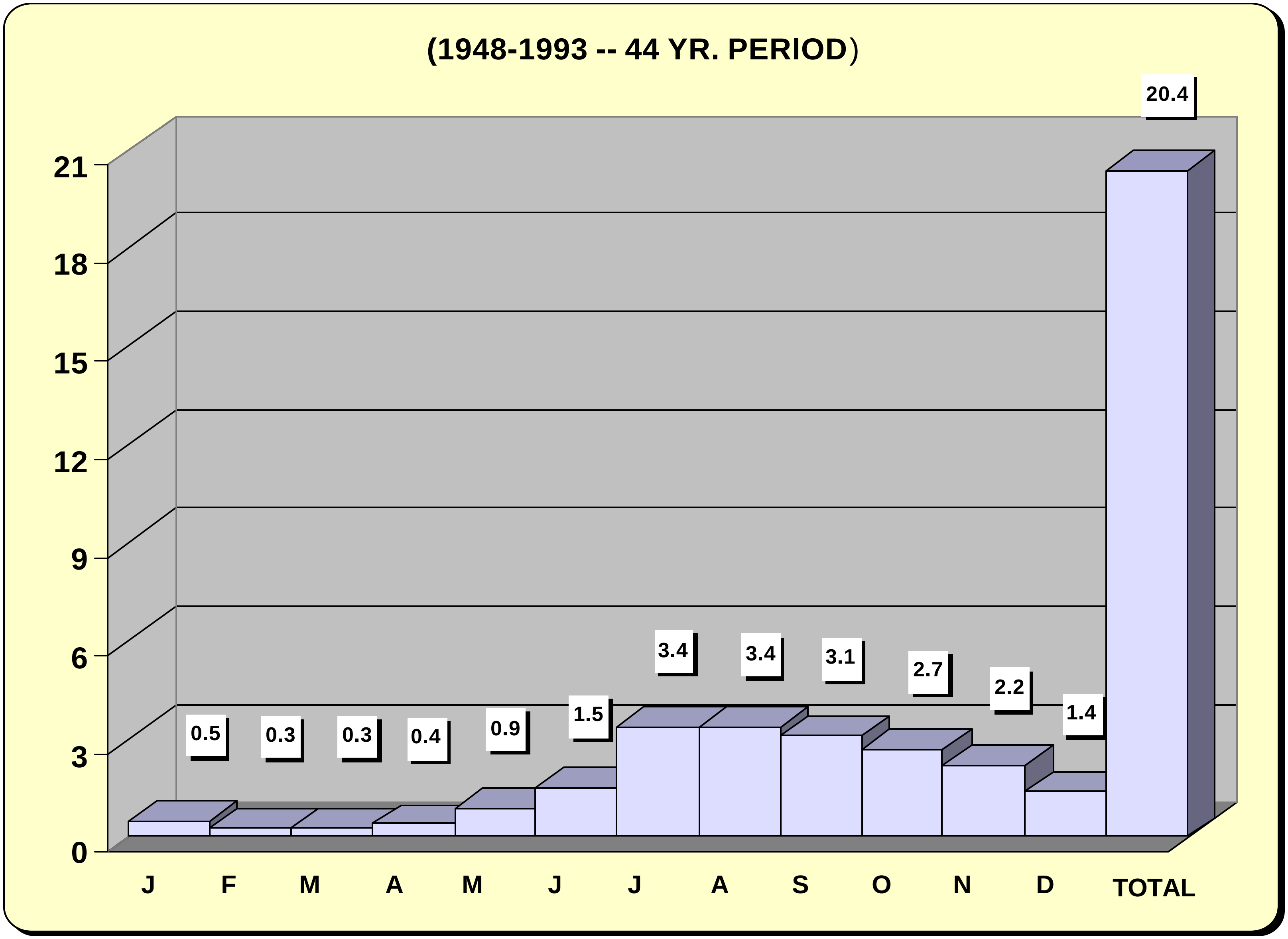

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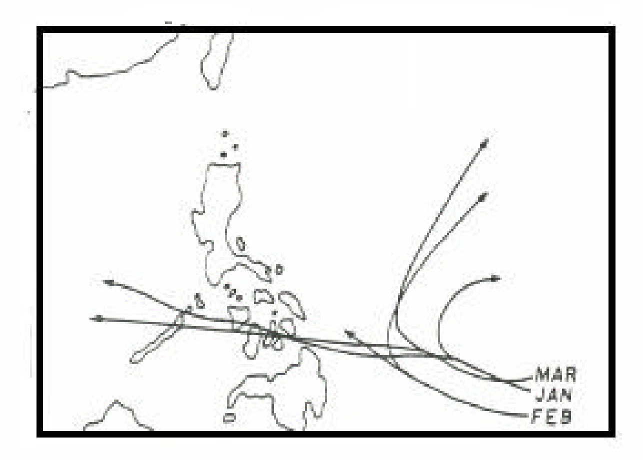
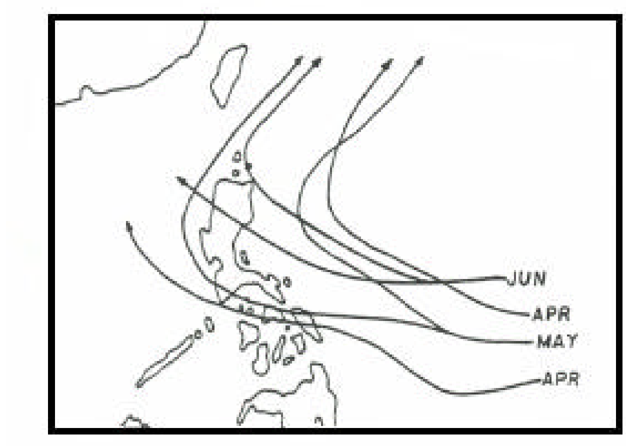


Fig. 7a. Average monthly paths of tropical cyclones entering the Philippine Area of Responsibility (PAR) - 1st Quarter (Valenzuela, 1989 as cited by Gonzales, 1994).



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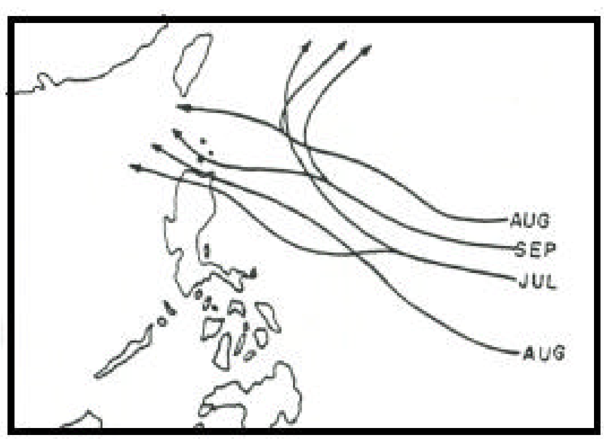

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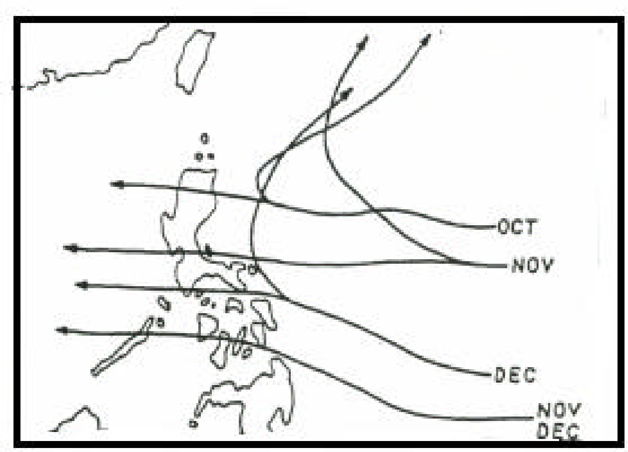


Fig. 7d. Average monthly paths of tropical cyclones entering the Philippine Area of Responsibility (PAR) - 4th Quarter (Valenzuela, 1989 as cited by Gonzales, 1994).

II.A. Rice Area

II.A.1 Physical Characteristics and Production Potential

Suitable Land for Rice Production

Wetland rice generally grows well in clayey and less permeable soil with a slope of less than one (<1) percent to maintain a flooded condition in the paddy. The ideal areas for wetland rice culture would be depositional landforms and associated landforms that are drainage areas of river basins (or watersheds). In the Philippines, there are 421 principal river basins, of which 20 are major, each with a minimum drainage area of 1,400 km^2. Of these major river basins, 7 are in Luzon, 3 in Visayas and 10 are in Mindanao (PCARRD, 1991).

The gross area of depositional landforms associated with wetland rice soils in the lower basin areas of the country is estimated to be 4.17 million hectares (Fernandez, 1999). Of this gross land area, only about 2.33 million hectares can be classified as highly and moderately suitable for wetland rice production. Regions I, II and III in Luzon with a combined land area of 1.5 million hectares (44% classified as highly and moderately suitable); and, Regions X, XI and XII in Mindanao with a combined land area of 0.98 million hectares (65% classified as highly and moderately suitable), are the biggest contiguous depositional areas identified for wetland rice.

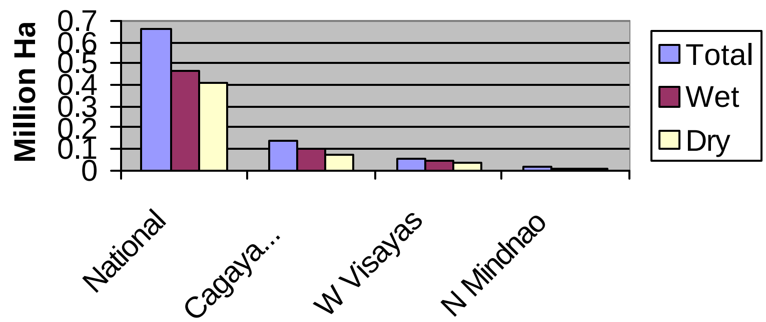
Table 3. Soil Suitability for Wetland Rice Production of Major River Basins in the Philippines (Fernandez, 1999).

RIVER BASINS	SOIL SUITABILITY			
	High	Moderate	Marginal	Unsuitable
Cagayan-Abulug	397132	47375	221003	7812
Abulug-Upper	17640	4865	7290	135
Abra	14075	0	795	0
Pampanga	142476	8590	172565	125206
Agno-Pampanga	23436	0	230705	68356
Bicol	89071	18182	35574	3810
Pasig-Laguna	22699	1570	18494	0
Ilog-Hilabangan	67468	31049	96541	28034
Jalaud	73752	0	41853	3810
Panay	73997	0	3336	0
Buayan-Malungon	178290	27500	141951	45625
Tagum-Libganon-Dav	254143	0	0	0
Agusan	50253	24837	76001	0
Agus	62119	9576	54771	0
Tagoloan-Cagayan	36133	5577	0	13463
TOTAL	**1502684**	**179121**	**1100879**	**296251**

Current Agricultural Land Devoted to Rice and Expansion Areas

The total land area traditionally devoted to rice in the Philippines is about three (3) million hectares (Fernandez, 1998). In general, the rice producing regions are identified as Central Luzon, Cagayan Valley, Western Visayas, Southern Tagalog, and Ilocos. These regions contribute about 63 percent to the national rice production (PhilRice-BAS, 2000).

Fig.8. Irrigation Service Area, 1997.
(data source: PhilRice-BAS, 2000)



From the total area traditionally devoted to rice, 1.6 million hectares are covered by irrigation, 1.4 million hectares are rainfed and 0.2 million hectares constitute upland rice areas (Fernandez, 1998). About 2.3 million hectares are in Luzon and only about 0.5 million hectares are in Mindanao. Only about 0.3 million hectares are classified as irrigated in Mindanao.

Table 4. Traditional Rice Areas in the Philippines (Fernandez, 1998).

	Irrigated	*Rainfed*	*Upland*
CAR	111203	27369	189
Region 1	79397	266294	1352
Region 2	325046	95581	19610
Region 3	300341	244409	2073
Region 4	175257	142071	39893
Region 5	116064	63628	44206
Region 6	83721	174845	22774
Region 7	18590	57410	500
Region 8	69660	104699	9716
Region 9	51844	30586	31937
Region 10	42392	38701	11171
Region 11	85135	81344	2365
Region 12	144913	80818	7808
Total	**1603563**	**1407755**	**193594**

From the above figures, it appears that there are very limited expansion areas in Luzon. There is, however, still some 0.5 million hectares for rice expansion in Mindanao suitable for wetland rice but irrigation facilities are inadequate. Another one million hectares located in small valleys of tributaries in the upper reaches of river systems can also be used for expansion (Fernandez, 1999). However, the projected yield levels in these areas are only about 2-3 tons/ha. Furthermore, these areas may be difficult to manage as these are composed of small fragmented pockets of land.

Rice Production Potential

Fernandez (1999) projected that in terms of potential production, considering a projected yield average of 5.4 tons/ha (highly suitable) and 4.2 tons/ha (moderately suitable), the 2.33 million hectares of prime wetland rice can translate to about 12.17 million metric tons of rough rice for one cropping, or 24.34 million metric tons for two cropping seasons. I believe these yield average estimates are reasonable figures. The yield potential of current high yielding varieties is 10 tons/ha, and reported actual yield potential under field conditions managed by experts is about those estimated by Fernandez (1999). This production projection based on suitable land areas for rice production can easily satisfy our current national requirement of about 12.5 million tons of rough rice per year.

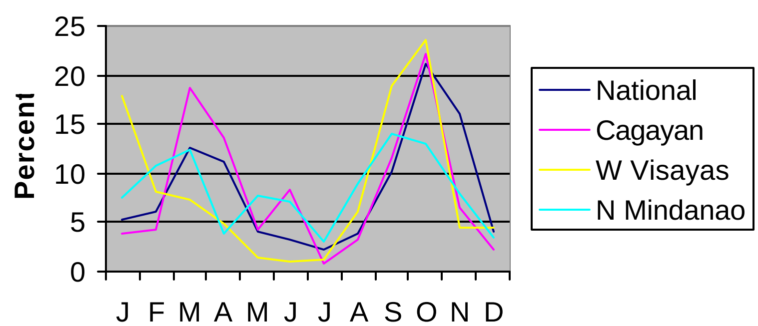
The above projection is of course under conditions wherein there is irrigation and that weather patterns are ideal for wetland rice production to practically allow two cropping seasons per year.

II.A.2. Current Production Level and Food Requirements

Rice Production

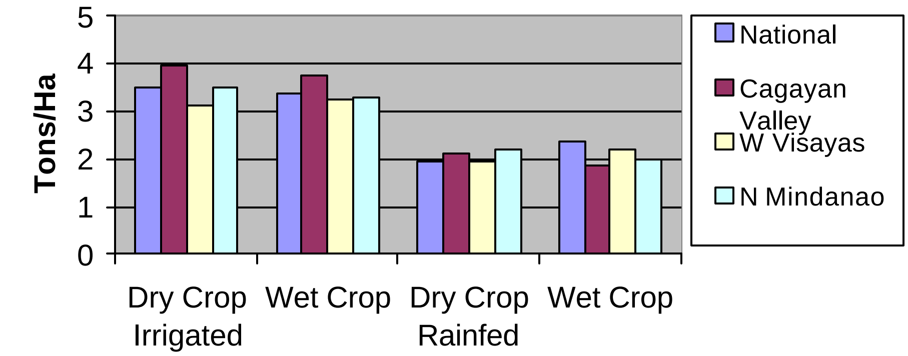
Some 2.22 million hectares were used for rice production in the Philippines for the year 1999 (PhilRice-BAS, 2000). Some 1.35 million hectares were classified irrigated, and 0.8 million hectares were rainfed. Of the total area planted with rice, about 0.6 million hectares were planted with a single crop, largely in the rainfed areas. Figure 9 shows that at the national level, based on harvested areas for three major rice producing areas, there are two "peaks" or harvest seasons in 1997 --- March and October.

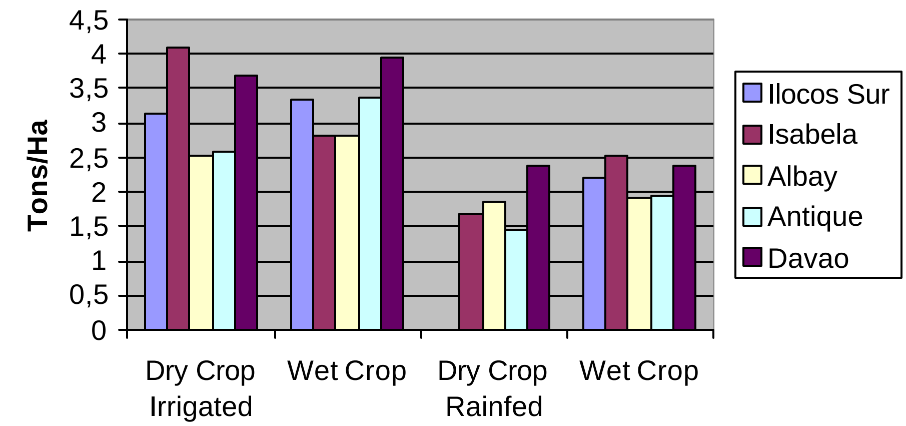
Fig.9. Monthly Harvested Area, 1997.
(data source:PhilRice-BAS, 2000)



Annual rough rice production was estimated at 11.78 million metric tons at an average yield of 2.9 tons/ha for a harvest area of 3.99 million hectares. This average yield is way below the earlier discussed projected yield averages of 5.4 tons/ha for highly suitable and 4.2 tons/ha for moderately suitable land. Nevertheless, a little more than 90 percent of the total land was planted to modern varieties.

Fig.10. Rice Yield Levels.
(data source: PhilRice-BAS, 2000)





Local Demand for Rice

In terms of food requirements, the annual per capita consumption of milled rice in the Philippines is estimated at 99.2 kg milled rice. For the year 1999, the country had a total demand of 8.4 million metric tons with a population of about 75 million. To be self-sufficient in rice, projections thus indicate a need to increase our rough rice production by about 80 percent by the year 2025, when we hit the population level of 115 million people.

II.A.3. Constraints to Rice Production

While it seems that we have enough land suitable for wetland rice to satisfy our national requirements for the next 25 years, our current production levels are not at par with what is potentially attainable.

Factors Affecting Rice Production

Three interrelated factors appear to seriously affect our rice production levels. These are: (1) inadequate irrigation services, (2) the high incidence of typhoons, and (3) lack of incentive for rice farmers to implement modern farm management.

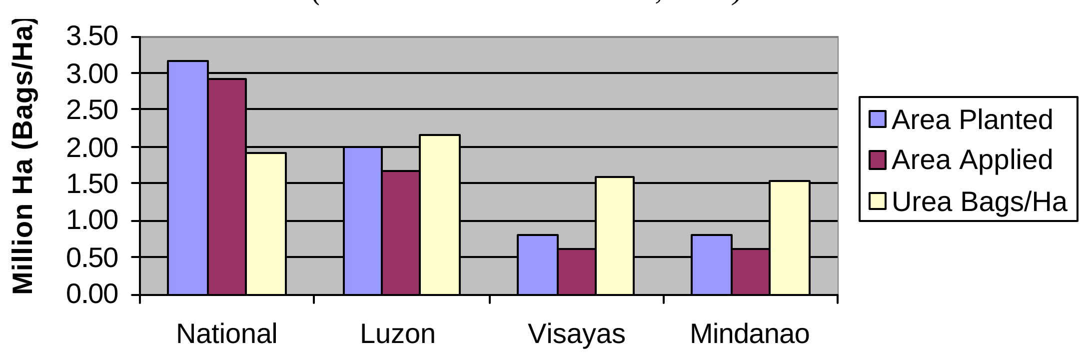
To obtain a good yield, rice requires continuous water and full sunlight from seedling to grain filling growth stages. Rice grows well in slightly water-submerged conditions. Towards the harvest stage when most of the panicles had fully filled, heavy and continuous rainfall can seriously reduce harvest. Of the rice land in the Philippines, only about 0.6 million hectares have reliable irrigation services. The rest of the rice lands are dependent on rain.

Availability of water, which can be controlled, has a pronounced effect on yield. Consistently, higher average yields are obtained in irrigated fields than rainfed fields regardless of cropping season. On the average, yield levels are 3-4 tons/ha in irrigated while in rainfed fields yields are only 2-3 tons/ha and lower during the dry cropping season. In some provinces, like Ilocos Sur, wetland rice is restricted to the wet season because of drought during the dry season. Typhoons with strong winds, particularly during the harvest stage of rice, and the continuous overcast cloudy conditions can significantly affect yields.

It is a wonder why farmers still plant rice! It is also a wonder why their yields are much lower than those obtained in farmers' fields managed by researchers. In terms of cash returns, rice farmers have a net income of only about 10,000 to 15,000 pesos per hectare for over a period of 4-5 months. This could be the net effect of the government policy of maintaining rice market price at an affordable level to city consumers. In response, rice farmers tend to save on the cost of production and this can result to lower yield levels. For instance, it is known that our level of nitrogen fertilization is only at the level of 100 kg/ha (2 bags) when other countries are using 200kg/ha.

Fig.11. Average Fertilization in Rice, 1988-1997.

(data source: PhilRice-BAS, 2000)



Options for Rice Self-Sufficiency

For the Philippines to be self-sufficient in rice, there are two options available --- to expand rice areas and/or to improve yield per unit area. Both options require a need to improve irrigation facilities nationwide. Apparently, the country's major river basins can provide the necessary irrigation to supply some 2 million hectares of rice fields for two (2) cropping seasons.

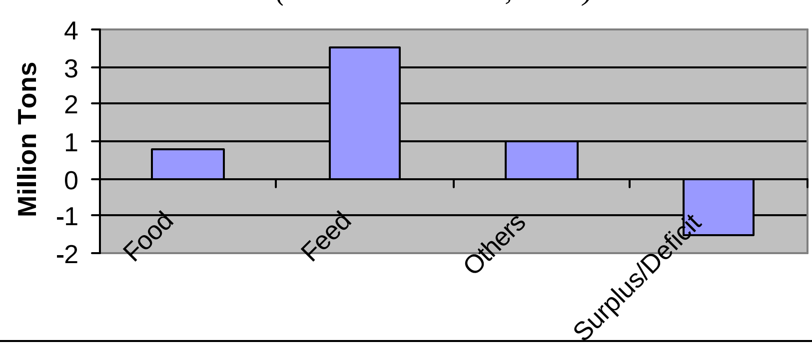
At our current level of yield in irrigated fields of 3 tons/ha, we would need to have at least 2 million hectares of irrigated rice area which should be planted to two crops/year. This is nearing the total land area identified in the country as highly and moderately suitable for wetland rice production. The area requirement can be reduced if yields can be improved by proper farm management like urea fertilization in terms of amount and timing of application (and, also use of good seed materials). Meeting the rice requirement in the next several years, however, presents the bigger challenge as the population increases with almost insignificant available areas for rice expansion. The only viable option would thus be to increase rice yield per unit area.

II.B. Corn Areas

Corn is second to rice in terms of economic importance. Some 12 million Filipinos prefer white corn as their staple food while yellow corn accounts for 70 percent of livestock mixed feeds.

Fig.12. National Corn Utilization, 1998.

(data source: BAS, 2000)



II.B.1 Physical Characteristics and Production Potentials

Ideal Soil Conditions for Corn Production

Corn grows well in soil with the following conditions: slope not more than 60 percent, in almost any kind of soil except sandy and heavy clay, good to moderate soil drainage property, with soil depth less then or equal to 50 cm, soil pH from slightly acidic to neutral (5.0 – 7.3), and with available moisture during the growing period. On the other hand, corn is very susceptible to strong winds and water logging.

Suitable Land for Corn and Expansion Areas

In terms of soil suitability, some 6.5 million hectares can be classified as highly suitable for corn production. Davao, Cotabato, Samar and Nueva Ecija as well as Region XI are the leading locations with the largest land areas suitable for corn.

Another 2.46 million hectares are available for corn production expansion but the soil series in these areas are only moderately suitable. Specifically, soil depth, drainage, texture and pH are the limiting factors in these areas. Thus, there are substantial areas for expansion to meet our national requirement.

Table 5. Provinces with highly suitable soil series for corn production and its equivalent areas (Orno-Coladilla and Rocamora, 2001).

Province	Area (has)	Province	Area (has)
Abra	10,136	La Union	24,712
Agusan	317,495	Laguna	34,650
Albay	110,672	Lanao	345,204
Antique	32,192	Leyte	93,597
Bataan	85,625	Marinduque	20,944
Batanes	1,155	Masbate	298,097
Batangas	51,344	Misamis Occ.	111,756
Bohol	230,873	Misamis Or	126,231
Bukidnon	355,623	Negros Occ	295,283
Bulacan	24,600	Negros Or	73,650
Cagayan	56,983	Nueva Ecija	409,687
Camarines S	36,359	Nueva Viscaya	17,174
Capiz-Aklan	45,625	Palawan	35,200
Catanduanes	16,052	Pampanga	21,569
Cavite	40,322	Pangasinan	101,666
Cebu	82,360	Quezon	304,747
Cotabato	624,229	Rizal	57,520
Davao	674,112	Romblon	33,875
Ifugao	3,865	Samar	629,131
Ilocos N	8,248	Sorsogon	33,970
Ilocos S	1,432	Sulu	56,091
Iloilo	134,763	Zambales	84,937
Isabela	180,592	Zamboanga N	129,930
Kalinga-Apayao	30,453		

Given the large area suitable for corn production, even at a low yield level of 2.0 tons/ha for yellow corn, the Philippine potential in terms of physical resource (i.e. land) to produce its national requirement is more than enough even with a single cropping per year.

Table 6. Total area (ha) of highly and moderately suitable soil series by region for corn production (Orno-Coladilla and Rocamora, 2001).

Region	Highly Suitable	Moderately Suitable
CAR	44,454	41,071
Region I	136,058	299,328
Region II	255,904	88,564
Region III	626,418	270,295
Region IV	578,602	381,981
Region V	495,150	51,001
Region VI	507,863	408,806
Region VII	386,883	50,710
Region VIII	722,728	270,633
Region IX	129,930	109,574
Region X	911,105	139,844
Region XI	1,298,341	285,508
Region XII	345,204	68,631
ARMM	56,091	904
Total	**6,494,731**	**2,466,850**

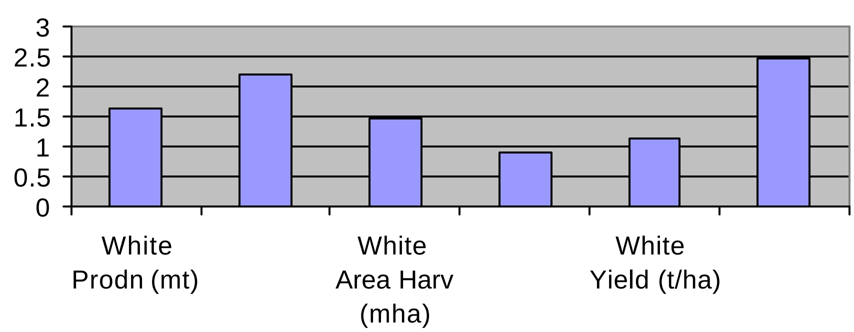
II.B.2. Current Production Level and National Requirements

Corn Production Levels

Total corn production had been in the level of above 4 million metric tons per year from 1989 to 1999 (FAO, 1999). However, beginning in the mid-1990, production slightly declined from 4.5 million metric tons in 1989 to as low as 3.8 million metric tons in 1998. An increase to the 1989 levels was posted in 1999. Overall, annual growth was 1.2 percent.

Fig.13. National Corn Production Statistics

(data source: BAS, 2000)



National average yield levels per unit area, however, indicated a steady improvement from 1.2 tons/ha in 1989 to 1.7 tons/ha in 1999 --- an overall annual growth of 3.4 percent. This can be attributed to the widespread adoption of modern high yielding varieties. Still, the country's yield levels are way below those of other countries like Indonesia and Argentina.

Area Harvested to Corn

In terms of area harvested to corn, a declining trend similar to corn production statistics was recorded from 3.6 million hectares of harvested area in 1989 to as low as 2.3 million hectares in 1998. A slight increase was posted in 1999. Overall, annual growth rate of area harvested to corn was -4.4 percent. The declining areas planted to corn could possibly be explained by the net benefits derived by farmers from planting corn. Similar to rice production, the net income derived from corn production is relatively low. This low income would help explain why farmers would opt for shifting to other agricultural land uses instead of corn production.

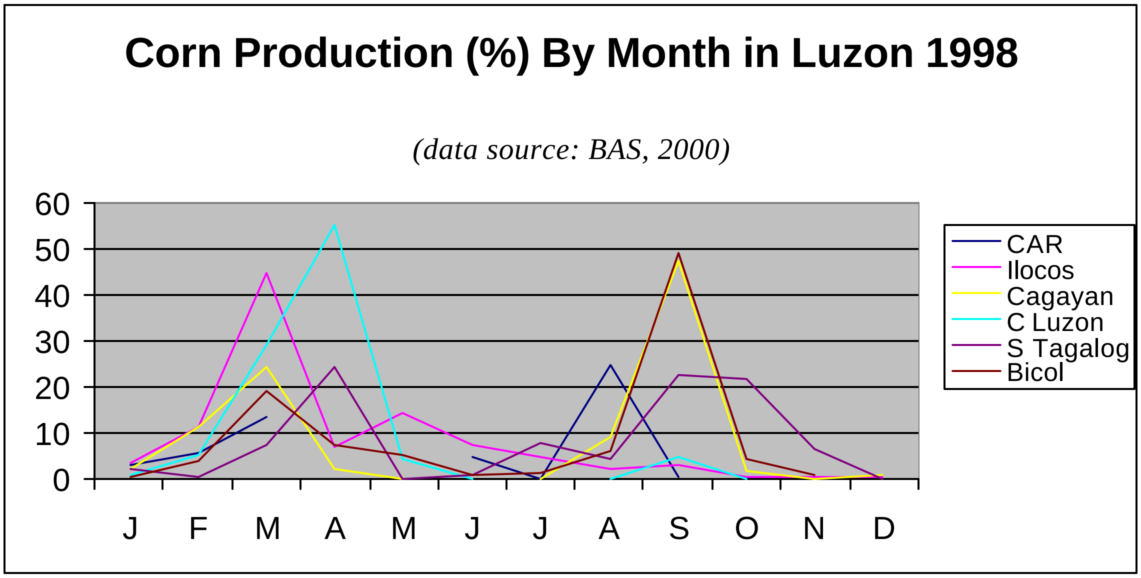
On a regional level, the highest hectarage and production of yellow corn is in Mindanao; Northern Luzon (Ilocos and Cagayan) is only second. There are generally two cropping seasons for corn --- the dry season crop (January-June) and the wet season crop (June–December). In Mindanao, the main cropping season is June to December, with white and yellow corns equally produced in hectarage and production levels. In Northern Luzon, the area planted to corn is almost equal for the two cropping seasons. White corn is not extensively grown in this region. In Visayas, planting is mainly from July to December.

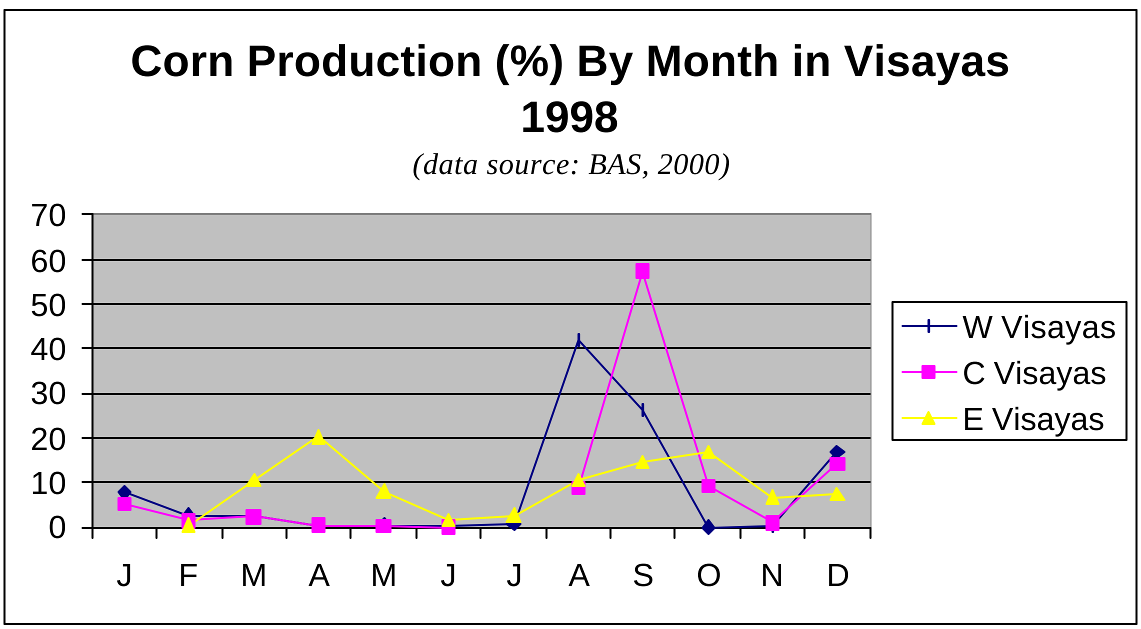
Table 7. Corn Production by Region, 1998 (data source: BAS, 2000).

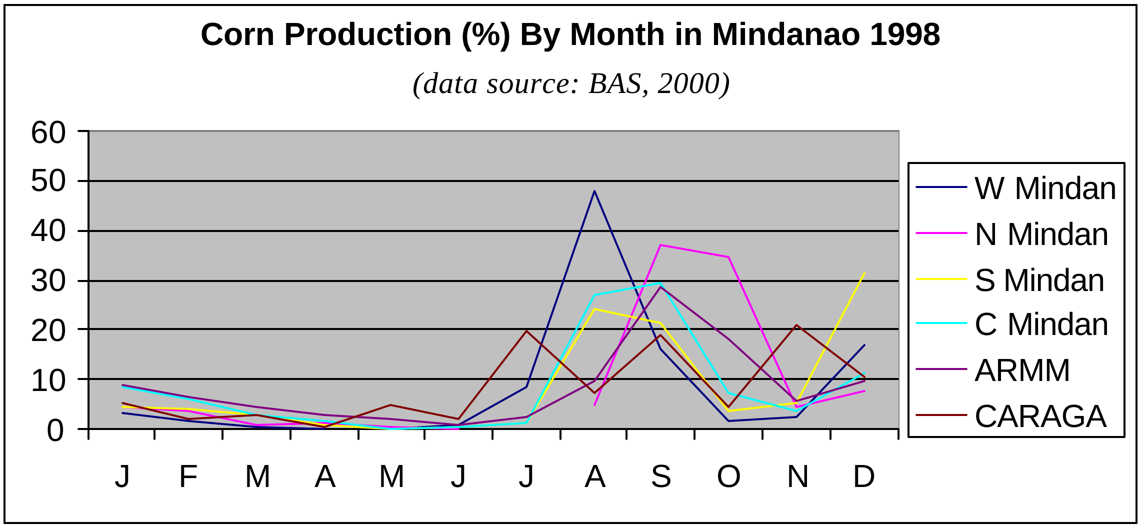
	Production (tons)		Area Harvested (ha)		Yield (t/ha)	
	White	Yellow	White	Yellow	White	Yellow
CAR	17601	22697	12944	9969	1.36	2.28
Ilocos	32697	181772	16964	53013	1.94	3.43
Cagayan V	23864	547344	23297	214233	1.02	2.55
Central Luzon	6666	110835	5865	26967	1.14	4.11
S Tagalog	6262	60347	7344	51736	0.85	1.17
Bicol	17882	57201	38786	61376	0.48	0.93
W Visayas	28429	49190	28383	37827	1	1.3
C Visayas	133896	7292	211506	11426	0.63	0.64
E Visayas	32283	1066	51734	1222	0.62	0.87
W Mindanao	194568	3726	217132	3126	0.9	1.19
N Mindanao	140640	452634	108385	147331	1.3	3.07
S Mindanao	288083	274179	274176	105824	1.05	2.59
C Mindanao	351677	243456	214893	102655	1.64	2.37
ARMM	286600	178722	191806	71122	1.49	2.51
CARAGA	59317	12258	48144	5132	1.23	2.39
National	1620485	2202719	1451249	902959	1.12	2.44

Local Demand for Corn

To date, our national corn production does not satisfy our national demand. This has been the situation for the last 20 years. In 1998, we had a deficit of 1.5 million metric tons. This was mainly due to the high demand for yellow corn used for poultry and swine feeds.







I.B.3 Constraints to Corn Production

While the total land area identified as highly and moderately suitable for corn production in the country is extensive - almost 90 percent of the total arable lands available – the area planted to corn has been only about 3 million hectares of harvested area. Translating this into physical area, this is only about 1.5-2 million hectares. Thus, there is still much land for expansion of corn. However, an issue of concern is why corn has not been much widely planted despite a shortage in supply.

The basic problem is the low yield levels we obtain, especially for yellow corn, despite the widespread acceptance of modern high yielding varieties. There is wide variation in yields from crops grown across regions and seasons. The difference on the average is about one ton/ha.

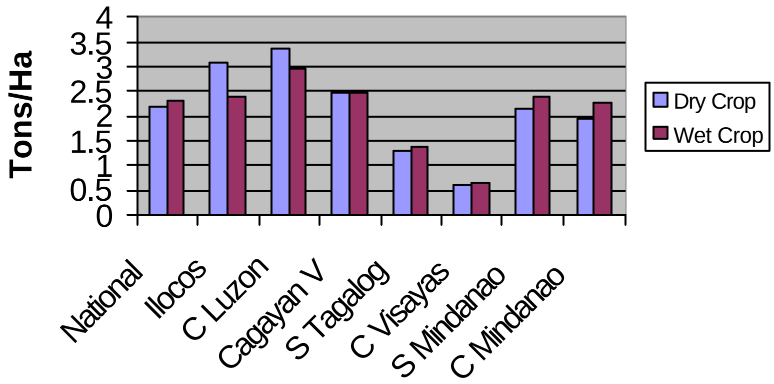
Among the factors contributing to low yield levels and the very limited area planted to corn, the following are the more important ones: (1) climatic conditions (2) low levels of fertilization, and (3) low income derived from corn planting.

Table 8. Yield of white and yellow corn in different regions of the Philippines,1998 *(data source:BAS,200)*.

Region	Yield (kg/ha)	
	White Corn	Yellow Corn
CAR	1360	2280
Ilocos	1940	3430
Cagayan Valley	1020	2550
Central Luzon	1140	4110
Southern Tagalog	850	1170
Bicol	460	930
Western Visayas	1000	1300
Central Visayas	630	640
Eastern Visayas	620	870
Western Mindanao	900	1190
Northern Mindanao	1300	3070
Southern Mindanao	1050	2590
Central Mindanao	1640	2370
ARMM	1490	2510
CARAGA	1230	2390

Fig.15. Yield of Yellow Corn, 1994-98.

(data source: BAS, 2000)



Climate

Production and yield levels are restricted to a large extent by climatic conditions. The Visayas regions are restricted to a single crop in the wet season because the drought conditions during summer cannot support corn growth. On the other hand, because of high frequency of typhoons passing these areas during the wet months yield is very low. Apparently, the yield reducing effect of typhoons is not evident in northern Luzon. Potentially, it is only in Mindanao that double cropping is realistic because of the even rainfall distribution all year round and the very low incidence of typhoon. Yield levels in Mindanao in both cropping seasons, however, are significantly lower compared to Ilocos and Central Luzon.

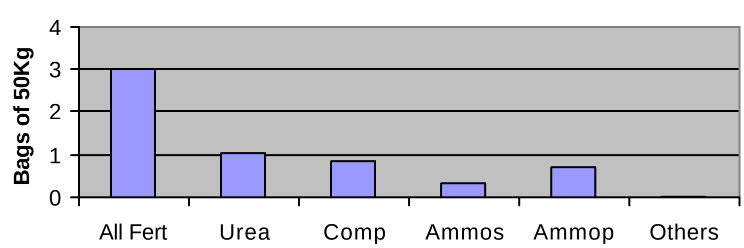
(data source: BAS, 2000)

Low Fertilizer Application Rates

Another factor contributing to low yield levels is the low levels of fertilizer application.

The average application rate for all types of fertilizers for corn production is only three 50-kg-bags per hectare. Only about one bag of urea fertilizer is applied per hectare.

Fig.16. Fertilizer Application Rate in Yellow Corn, 1997.



This seeming resistance of farmers to invest more in corn production through the provision of needed inputs such as fertilizers may be a reaction to a third problem which is the low income derived from corn.

Low Farmer Income from Corn

Corn production costs for an average corn farm was posted at ₱ 8,655 per hectare in 1999. Generally, white corn production is cheaper compared to yellow corn production. In contrast, the estimated average cost per kilogram of corn produced in 1999 was the reverse --- higher for white corn at ₱ 6.61 per kilogram and lower for yellow corn at ₱ 3.84 per kilogram (BAS, 2000).

In the same study, the Bureau of Agricultural Statistics calculated corn production returns above cash costs at a mere ₱ 7,622 per hectare. Figures were expectedly lower for white corn. Factoring in non-cash costs, the study also found out that white corn farmers had an average net loss of ₱ 326 per hectare.

These accounts show why farmers are less motivated to produce corn and have implications on their investments (i.e. production inputs and land use) for corn production.

Table 9. Net benefit of corn production at different market areas in different regions of the Philippines, 1998 (data source: BAS, 2000).

Region	Net Benefit of Corn Production (₱)					
	White Corn			Yellow Corn		
	Farmgate	Wholesale	Retail	Farmgate	Wholesale	Retail
CAR	564.20	2332.20	4331.40	5312.77	5312.77	16781.17
Ilocos	9768.36	10233.96	14269.16	8876.71	11277.71	25032.01
Cagayan Valley	394.33	1975.33	5341.33	5505.62	7112.12	19428.62
Central Luzon	1135.90	1135.90	8545.90	15065.10	15065.10	50822.10
S Tagalog	-4390.35	-148.85	1126.15	-2528.80	2432.00	4678.40
Bicol	-4640.77	-4640.77	-1429.97	-1713.29	-1713.29	2667.01
W Visayas	290.40	350.40	8630.40	1525.87	3462.87	6946.87
C Visayas	-2845.76	-1409.36	-647.06	-4090.69	-4090.69	-1018.69
E Visayas	-2755.79	-1689.39	567.41	5480.00	5480.00	7585.40
W Mindanao	-2311.81	469.19	2377.19	-981.81	4718.29	5694.09
N Mindanao	-1860.85	3807.15	10502.15	5912.30	20863.20	27525.10
S Mindanao	-847.72	13.28	1693.28	7170.64	8077.14	12091.64
C Mindanao	1630.56	3303.36	11618.16	2660.07	5456.67	14865.57
ARMM	-466.29	1262.11	18620.61	1393.63	3502.03	34626.03
CARAGA	-1173.63	-1481.13	4176.87	6610.38	6610.38	15764.08

II.C. Coconut Areas

Coconut is produced mainly for its versatile oil (lauric acid oil). Coco shell charcoal and copra meal are also some of the more important materials extracted from coconut. Coco coir and coco water are also promising products. In 1997 the total value of exports from coconut products (copra, oil, desiccated coconut, and copra meal) amounted to US$ 811.14 million.

<u>II.C.1 Physical Characteristics</u>

Ideal Conditions for Coconut Production

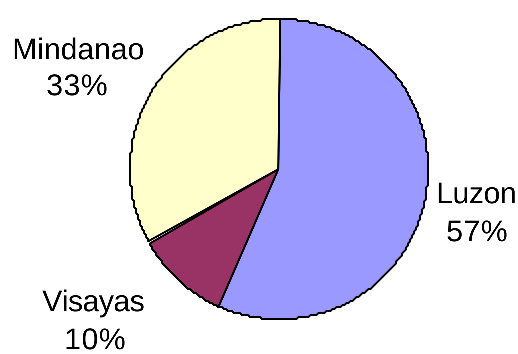
Coconut grows well between latitudes 20^0N and 20VS at altitudes of 600 meters or below. The optimum temperature range for coconut growing is from 24 to 29 ^{0}C with a relative humidity requirement of 80 to 90%, and an annually distributed rainfall requirement of 1500 to 2300 mm. High production can also be expected: in soil with pH of 6-7 (neutral); in soil that is rich in organic matter and is fertile; and in deep (minimum of 75 cm), well drained, light- to medium-textured (sand-clay) soil with a high water holding capacity (at least 30% clay content).

However, most inland and coastal soils planted to coconut are severely deficient in sodium and chloride as well as inadequate in potassium, phosphorous, boron and sulfur.

Land Areas Suitable for Coconut Production

In terms of the above environmental requirements, only nine (9) provinces can be considered as highly suitable for coconut production. Its total aggregate land area (0.124 million hectares) is only seven percent of the country's total potential coconut area. The biggest area identified to be highly suitable is in Luzon. Quezon Province, followed by Albay, has the largest highly suitable lands in Luzon --- wherein more than 70 percent of the identified most suitable areas for coconut production can be found.

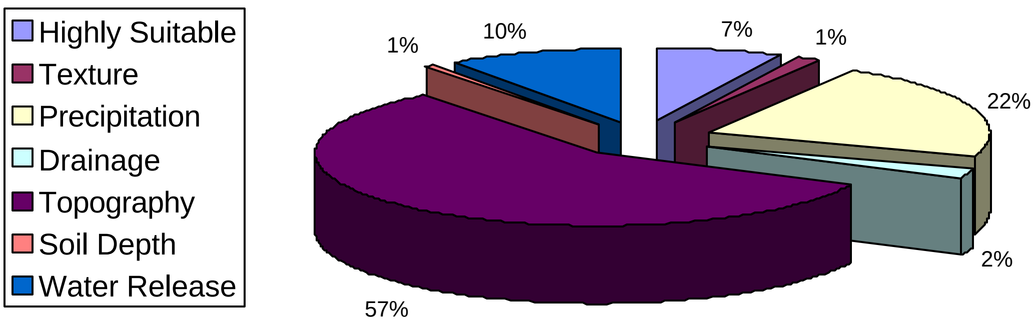
Fig.17. Regional Land Distribution Suitable for Coconut.



(data source: Monreal and Victorio, 2001)

Some 1.56 million hectares were also identified as moderately suitable for coconut. With topography being the most widespread constraint in the land, more than 50 percent of these identified suitable land for coconut production can be found in areas that are sloping and most of these are in Luzon.

Fig.18. Land Suitability for Coconut *(indicated are the soil problems)*.



(data source: Monreal and Victorio, 2001)

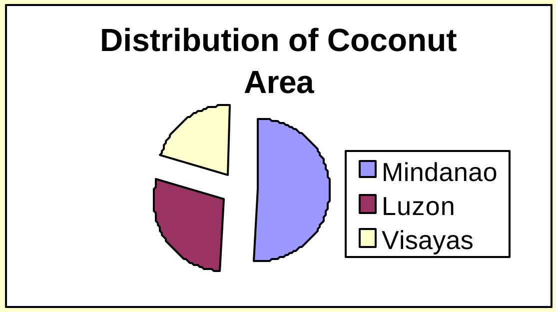
Table 10. Highly and moderately suitable potential areas for coconut production in the Philippines.

Province	Highly Suitable	Moderately Suitable (With Limiting Factor)						Total (ha)
		Soil Texture	*Precipi tation*	*Soil Drainage*	*Topo-graphy*	*Soil Drainage*	*Water Release*	
Luzon	**105409**	**21296**	**15583**	**12645**	**768790**	**450**	**30954**	**955127**
Abra	0	0	0	0	0	0	3180	
Batanes	213	0	0	0	0	0	0	
Ifugao	0	0	237	0	0	0	0	
Tarlac	0	0	0	0	0	0	19487	
Cavite	0	0	14714	0	0	0	8287	
Quezon	64630	3704	0	7165	56863	0	0	
Camarines	0	0	0	0	94020	0	0	
Albay	29150	0	0	0	5338	450	0	
Sorsogon	1210	0	0	5480	1030	0	0	
Samar	10206	17592	0	0	611539	0	0	
Marinduque	0	0	632	0	0	0	0	
Visayas	**10393**	**0**	**18606**	**1163**	**124709**	**10834**	**3692**	**169397**
Masbate	0	0	0	0	0	0	3692	
Leyte	0	0	8945	0	0	0	0	
Bohol	0	0	470	0	0	0	0	
Negros Occ	0	0	9191	1163	0	0	0	
Capiz-Aklan	6375	0	0	0	18717	10834	0	
Antique	4018	0	0	0	105992	0	0	
Mindanao	**7640**	**0**	**331490**	**19302**	**68474**	**0**	**131762**	**558668**
Agusan	5626	0	0	19302	59099	0	0	
Lanao	2014	0	37025	0	0	0	0	
Davao	0	0	244629	0	0	0	0	
Cotabato	0	0	21250	0	0	0	27500	
Misamis Occ	0	0	23877	0	0	0	2011	
Misamis Or	0	0	4709	0	0	0	0	
Zamboanga Norte	0	0	0	0	9375	0	102251	
Total	**123442**	**21296**	**365679**	**33110**	**961973**	**11284**	**166408**	**1683198**

(data source: Monreal and Victorio, 2001)

II.C.2. Current Production Level

Coconut planting in the country used to cover some 8.8 million hectares (Fernandez and de Jesus, 1980). However, in the 1991 Census of Agriculture survey, only 2.73 million hectares remained planted to coconut. The area planted to coconut, however, appears to have again expanded to 3.07 million hectares in 1999. About 60 percent of this remaining coconut area is either not suitable or only marginally suitable for coconut production.

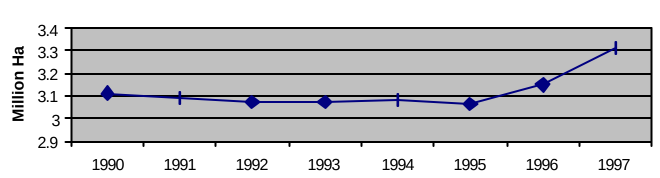


(PCA, 2000)

Coconut production from 1989 to 1999 has shown a growth rate of 2.9 percent, from 7.8 to 11.0 million tons. Mindanao, Southern Tagalog and Visayas were the top producing regions in 1999. Production in 1999 was 10,505 million nuts harvested from 3.077 million hectares. This current yield level, however, is quite low. On the average, this is estimated to be only 25 percent of the coconut yield potential.

Mindanao has the largest coconut area in the country and it also recorded the highest average yield level of 40.6 nuts/tree/yr. The lowest yield level was recorded in Luzon and a contributing factor may be the relatively older trees (<50 yrs old) in this region. In fact, about 25 percent of coconut bearing trees are over 60 years old (PCA, 1995).

Fig.20. Coconut Area.



Fi.21. Number of Bearing Trees.

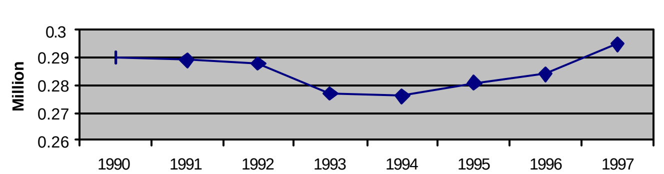


Fig.22. Coconut Production.

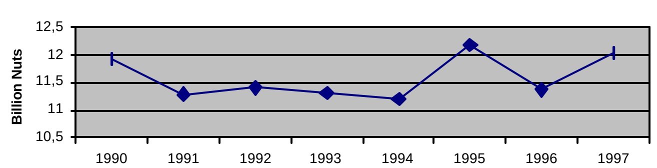
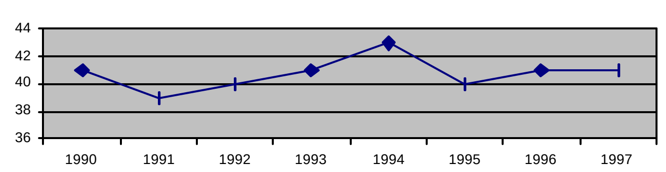


Fig.23. Nut Production Per Tree.



Figures 20-23 data source: PCA, 2000

Table 11. Top Coconut Producing Regions in the Philippines, 1999 (UCAP, 2000).

Region/Province	Hectarage ('000)	No. Bearing Trees (millions)	Nut Harvest per Year (millions)	Yield/Tree per Year (Nuts) 1990-1997
Luzon	**860**	**88**	**2088**	**31**
S Tagalog	472	61	1522	
Bicol	365	23	459	
Others	23	4	107	
Visayas	**662**	**66**	**2273**	**30**
Mindanao	**1555**	**151**	**6144**	**41**
W Mindanao	340	35	1257	
N Mindanao	227	15	401	
S&C Mindan	988	101	4486	
Philippines	**3077**	**305**	**10505**	**41**

II.C.3 Production Constraints

The Department of Agriculture Bureau of Agricultural Research (DA-BAR) National RDE Network, headed by the Philippine Coconut Authority, identified several production constraints confronting our coconut industry.

1. Senility of coconut trees especially in Luzon.
2. Poor or low-yielding coconut varieties. More than 98 percent of the current total coconut land area is planted to tall varieties which bear fruit after seven years and reach senility after 60 years. This indicates that there is a lack of quality coconut seedlings in the country (Magat, 1999).
3. Poor agronomic or farm management practices by coconut farmers (Magat, 1999). Most coconut areas are rainfall dependent, and only one percent of the coconut areas are fertilized regularly (Manicad, 1993). A PCA study (1991) indicated that there are widespread deficiencies in nitrogen, chloride, sulfur and potassium in many areas and that these can result to substantial reduction in yield.
4. Presence of the "cadang-cadang" disease in Luzon, which has reduced yield significantly. At an advance stage of the disease, the plant usually dies.
5. Natural calamities, particularly the El Nino and La Nina weather disturbances.

Important factors contributing to very low and declining yield levels are aging trees, poor fertilization and weather. Only the southern and western Mindanao areas are showing good yield levels at 41 nuts/year versus an average of 31 nuts/year in Luzon and Visayas.

Perhaps the most important factor affecting production levels at the farm level is the low income from coconut. Why should farmers fertilize and practice good farm management when they do not make much money from it? Why should farmers replace their old tall coconut varieties with high-yielding hybrid varieties when they earn so little from coconut?

Still, coconut is an important renewable resource of the country that should not simply be ignored. Perhaps coconut areas should be given importance in terms of benefits from its role in preventing soil erosion and its impact to the environment. A large percentage of coconut is planted in sloping areas. Perhaps we should also look at coconut as a "tree of life". It is a resource from where we can derive other raw materials (e.g. coco-water, coco-coir, coco-charcoal, etc.).

III. Comparative Analysis of Philippines with Selected Asian Countries

Of particular interest in this study are the countries Thailand, Indonesia and Malaysia because they are the Philippines' adjacent agricultural neighbors. These countries are thus most likely our main competitors.

Compared with the above countries, the Philippines is less endowed with physical land areas. In terms of availability of water for agricultural purposes, the area covered by irrigation in the Philippines is a far third. This is not to mention that more frequent natural calamities, especially typhoons, visit the Philippines. These should be major indicators for considering Philippine approaches to global competitiveness.

Land Areas and Land Use Across Countries

The Philippines and Malaysia have the smallest total land area --- 29.8M and 32.8M hectares, respectively. Indonesia has a land area six times that of the Philippines, while Thailand is almost twice as big as the Philippines. This is also the trend in terms of land area devoted to agriculture.

Indonesia has the largest area devoted to agriculture and this is three times bigger than that of the Philippines. Thailand has a total agricultural area twice that of the Philippines, and Malaysia has the smallest land area for agriculture.

In terms of percentage of agricultural land used for crop production, the Philippines ranked second to Thailand. However, in absolute hectarage values, Thailand had the largest, followed by Indonesia while the Philippines still ranked third.

Table 12. Land Use Across Selected Countries, 1998 (FAO, 2000).

	Total Land 1000Ha	Agriculture Land 1000Ha	% Land Use Distribution		
			Arable/ Permanent Crops	*Permanent Pasture*	*Forest Woodland*
Philippines	29,817	10,000	33.5	4.3	45.6
Thailand	51,089	20,375	39.9	1.6	28.4
Indonesia	181,157	30,987	17.1	6.2	61.7
Malaysia	32,855	7,605	23.1	0.9	67.7

Agricultural Land and Population

Table 13. Ratio of Land to Agricultural Population Across Selected Countries, 1989 and 1998 (FAO, 2000).

	1989 (ha/capita)	1998 (ha/capita)	2000 Total Population (M) IRRI 1998	% Population Change (89 – 99)
Philippines	.36	.34	77	0.8 %
Thailand	.65	.67	65	- 0.5 %
Indonesia	.34	.33	206	0.1 %
Malaysia	1.40	1.86	22	- 1.6 %

In terms of total population, Indonesia is the most populated followed by the Philippines, Thailand and Malaysia. The Philippines has almost the same population size as that of Thailand, but the agricultural land of the Philippines is only half that of Thailand. The Philippines and Malaysia have about the same agricultural land but Malaysia's population is only a quarter of the Philippine population.

Isolating each country's agricultural population and getting its ratio with their respective total agricultural land (Table 13), it is shown that except for Indonesia, the Philippines is trailing behind its competitors. The ratio of land to agricultural population in 1989 and 1998 for Thailand was almost double than that of the Philippines, while the same ratio for Malaysia in 1998 was more than five times the registered Philippine ratio in the same year. It should also be noted that Malaysia's ratio of land to agricultural population is the biggest among developing countries (FAO, 2000). The implication is that, farmers in Malaysia and Thailand have the advantage of economies of scale over Philippine farmers that only operate with small land areas.

As also shown in Table 13, the increasing ratio of land to agricultural population in Malaysia and Thailand as opposed to Indonesia and the Philippines may be attributed to the decline in agricultural population of Thailand and Malaysia from 1989 to 1998. This indicates that in Malaysia and Thailand, agricultural labor is shifting towards non-farm or non-agricultural activities. As Malaysia is considered as one of the more advanced economies among developing countries, this movement of labor from agriculture to other activities bears taking into account.

Water Resource Across Countries

Aside from land, the availability and accessibility of water is a major consideration in a country's capability to produce crops such as rice. Thailand and Indonesia are in the top 10 irrigators worldwide, each having over 4 million hectares of irrigated farmlands. It is worthy to note that India and China are the top two irrigators worldwide. It should also be noted that Thailand, India and China have within their access the great rivers in Asia, which originate from the Himalayas.

Table 14. Average Annual Growth Rate of Net Irrigated Areas Across Selected Countries (FAO, 2000).

	Irrigated Area ('000 hectares)					Annual Growth Rate 1988-1998
	1988	1995	1996	1997	1998	
Philippines	1510	1550	1550	1550	1550	0.1 %
Thailand	4121	4590	4642	4714	4749	1.5 %
Indonesia	4300	4687	4760	4815	4815	1.2 %
Malaysia	334	363	363	365	365	1.1 %

Weather/Climate Across Countries

The Philippines is also the country most visited by typhoons. As discussed earlier, we are visited by an average of 19 typhoons during the wet season. This has implications on the viability of producing crops for the global market where competition places high premium on stability of supply.

The southern part of Thailand is also visited by typhoons but these are without strong winds. Malaysia and Indonesia, on the other hand, are relatively free from typhoons. Thus, it can be said that while our competitors get the rain, we get the winds.

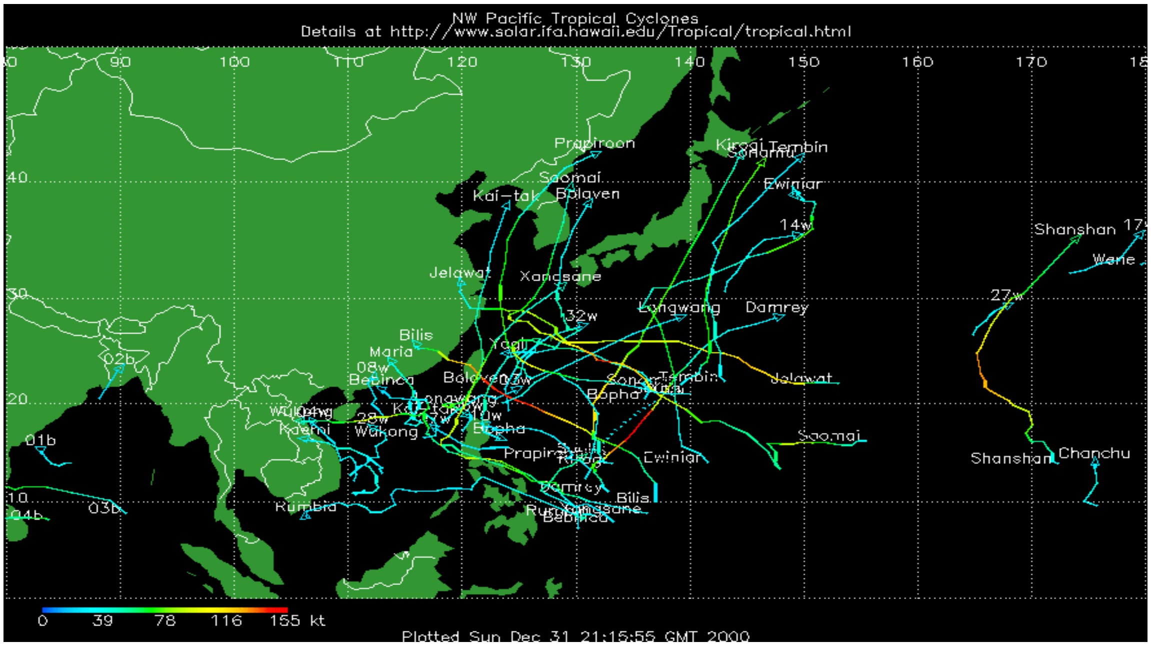


Figure 24a. Northwest Pacific Tropical Cyclones.

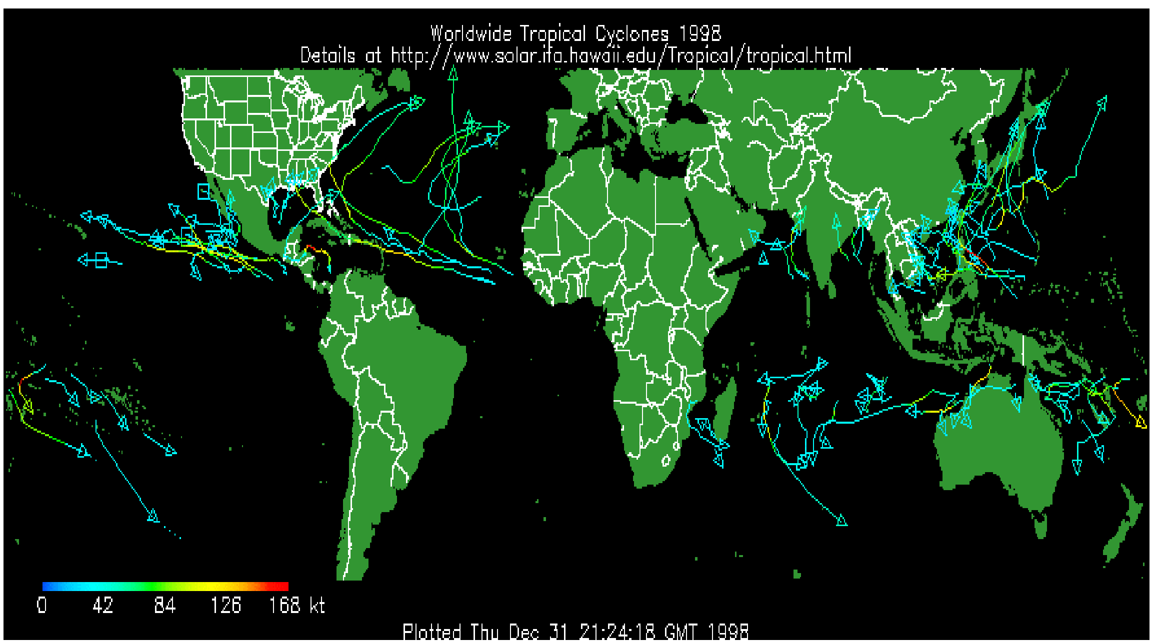


Figure 24b. Worldwide Tropical Cyclones.

III. A. Rice Area (vis-a-vis Thailand and Indonesia)

Characteristics of Area Harvested to Rice

The Philippines has the smallest area of harvested rice compared to Thailand and Indonesia. The current area harvested to rice in each of the two countries is about 10-11 million hectares. This is bigger than the Philippines by as much as 300 percent.

Table 15. Area Harvested to Rice across Countries, 1989 to 1999 (FAO, 2000).

	1988	*1995*	*1996*	*1997*	*1998*	**Annual Growth Rate 88-98**
Philippines	3.4973	3.9511	3.8423	3.1700	3.978	**1.2 %**
Thailand	9.8790	9.2672	9.9128	10.000	10.000	**0.9 %**
Indonesia	10.5312	11.5697	11.1406	11.7303	11.6241	**1.2 %**

Also, nearly half of the area harvested to rice in these countries is classified as irrigated. By extrapolation, this implies that two cropping per year is possible in about 2.0 million hectares of irrigated physical areas in each country. In comparison, the Philippines has only 0.6 million hectares. Moreover, unlike the Philippines, the two countries have a low incidence of typhoons.

Rice Production Levels

The above trend in land area devoted to rice production is also reflected in the rice production levels of the three countries. Thailand's production is twice, and Indonesia four times, that of the Philippines. Garnering the highest rice production growth rate from 1989 to 1999, Thailand is now a net exporter of rice while the Philippines and Indonesia remain net importers.

Table 16. Growth of Rice Production across Countries, 1989 to 1999 (FAO, 2000).

	1989 (000)mt	*1999 (000)mt*	**Production Growth**	**2000 Total Population (millions) IRRI 1998**	**Status of Rice National Supply**
Philippines	9,458	11,388	**1.8 %**	77	*Net Importer*
Thailand	20,601	23,271	**2.4 %**	65	*Net Exporter*
Indonesia	44,725	49,533	**1.2 %**	206	*Net Importer*

Here, we must again point out the curious situation wherein agricultural technologies come from the Philippines and agricultural scientists in Asia come to the Philippines for training while the country remains a net importer of rice. Indicating a logical answer, the previous discussion on the characteristics of rice areas across countries highlight the main fact that our country's physical resources compare poorly to that of Thailand and Indonesia.

Rice Yield Levels

National average yield levels are also much higher in Indonesia than the Philippines by 2 tons/ha. This is probably because in Indonesia, a higher level of fertilization rate (200kg/ha) is practiced. Their wet season crop yield is also higher due to the low incidence of typhoons. In the Philippines, the crop yield during the wet season planting is much lower than the summer cropping season by at least one ton/ha in irrigated fields, and by at least two tons/ha in rainfed fields. This is largely due to the effects of typhoons in the country.

Table 17. Rice Yields across Countries, 1989 to 1999 (FAO, 2000).

	1989	*1996*	*1997*	*1998*	*1999*	Growth
Philippines	2.705	2.856	2.933	3.229	2.813	**0.6 %**
Thailand	2.085	2.410	2.379	2.278	2.327	**1.5 %**
Indonesia	4.247	4.417	4.432	4.197	4.261	**0 %**

Thailand has a slightly lower yield than the Philippines despite their higher level of fertilization rate and comparatively lesser incidence of typhoons. This is because they are not partial to the use of high yielding varieties. It has been the national policy of Thailand to breed rice varieties with good eating quality rather than higher yield. Nevertheless, Thailand has a significant surplus in rice because its production is twice the production of the Philippines largely due to the bigger land area harvested to rice. Thailand's population is also smaller (by 12 million) than the Philippines, contributing to their country's ability to produce surplus.

III. B. Corn Area (vis-a-vis Thailand)

Area Harvested and Production Performance in Corn

The Philippines has twice the area harvested to corn compared to Thailand, but the national production levels of the two countries are almost the same. This is because the yield level of corn in Thailand is twice that of the Philippines.

Despite improvements in corn yield from 1988 to 1999, yield levels in the Philippines is still below those obtained in other similar countries. Even the yield of yellow corn alone is still at an uncompetitive level.

Table 18. Area Harvested, Production and Yield of Corn, 1989 and 1999 (FAO, 2000).

	Area Harvested (million ha)			Production (millions)			Yield (tons/ha)		
	1988	*1998*	*Growth*	*1989*	*1999*	*Growth*	*1989*	*1999*	*Growth*
Philippines	3.68	2.70	**- 4.4%**	4.52	4.64	**- 1.2%**	1.22	1.71	**3.4 %**
Thailand	1.70	1.30	**- 2.4%**	4.39	4.62	**1.9%**	2.56	3.56	**4.5 %**

Therefore, given a bigger land area available for expansion of corn production and the higher yield levels obtained in Thailand plus the lower incidence of typhoons, it would not be surprising for Thailand to be more competitive than the Philippines in producing corn. This would be the case if we are not able to reverse the decline in land areas used for corn production and accelerate the growth of corn yield levels.

Competitiveness in Corn Production

Thailand's smaller area devoted to corn is probably not due to limited areas suitable for corn production. As earlier discussed in this paper, the soil and environmental conditions for corn production is less demanding than rice, and there is still substantial land for corn expansion in both the Philippines and Thailand. The reason is that Thailand has adopted a national policy of corn importation to meet their national supply requirements. They have opted to import instead of producing it themselves because of the highly competitive market prices of corn from other countries (i.e., USA and Argentina). Furthermore, alternative high value crops are probably more viable than corn.

Table 19 shows that Filipino corn farmers' net benefits/hectare from corn production in 1997 was merely ₱ 4,798. This rate of return could hardly provide incentives for competition.

Table 19. Updated Average Production Costs and Returns of Yellow Corn, Philippines, 1991-1997 (BAS, 2000).

ITEM	1991	1993	1995	1996	1997
	In Pesos				
CASH COST	2,798	2,842	3,939	4,115	4,199
Seeds/planting materials	354	439	581	570	552
Fertilizer	1,154	882	1,299	1,388	1,306
Chemicals	144	98	144	154	145
Hired Labor	762	994	1,425	1,496	1,663
Irrigation Fee	1	1	1	1	1
Land Tax	107	109	111	112	113

Rentals:					
Tools and Equipment	7	8	10	11	12
Machine	10	12	15	17	19
Animal	12	14	18	21	23
Lend Lease	33	48	69	56	69
Fuel and Oil	68	76	83	89	97
Interest Payment on Crop Loan	6	8	10	11	13
Food Expense	90	102	122	134	136
Transport Expense	50	50	51	54	60
++++++					
NON-CASH COST	725	1,033	1,473	1,440	1,531
IMPUTED COST	2,180	2,339	3,263	3,427	3,740
ALL COSTS	5,703	6,214	8,676	8,982	9,470
GROSS RETURNS	7,087	9,560	14,363	13,430	14,268
RETURNS ABOVE ALL COSTS (NET RETURNS)	1,365	3,246	5,687	4,448	4,798
COST PER KILO	3.28	3.00	3.91	4.12	4.34
YIELD PER HECTARE (kg)	1,740	2,070	2,220	2,180	2,390

In comparing the average production costs as well as marketing and distribution costs of corn across countries (with Argentina as a major exporter of corn), the Philippines consistently registered higher values for both the wet and dry season croppings. One explanation could be the consistently lower yield levels registered by the country for the same period. With lower yield levels, economies of scale in terms of volume of corn traded is not attained. Hence, the overwhelmingly higher costs of marketing and distribution.

Table 20. Comparison of Average Production and Marketing and Distribution Costs of Corn (US$/mt) for Argentina, Thailand and the Philippines, Wet Season Cropping, 1997-1998 (BAS, 2000).

COST COMPONENT	ARGENTINA	THAILAND	PHILIPPINES	
			OPV	HYBRID
Labor	24.52	42.15	41.20	38.90
Materials				
Seeds	15.65	9.15	4.89	11.38
Chemicals	6.10	2.92	0.06	0.99
Fertilizers	3.20	8.44	24.87	23.95
Miscellaneous	4.80	1.91	2.02	1.89
Land and Fixed Costs	5.20	12.24	4.29	6.18
Production Cost	59.47	76.81	77.32	83.28
Processing, Marketing and Distribution Cost	24.25	15.00	62.56	62.57
Total Cost	83.72	91.81	139.88	145.85
Yield (mt/ha)	5.00	3.27	2.66	3.15

Table 21. Comparison of Average Production and Marketing and Distribution Costs of Corn (US$/mt) for Argentina, Thailand and the Philippines, Dry Season Cropping, 1997-1998 (BAS, 2000).

COST COMPONENT	ARGENTINA	THAILAND	PHILIPPINES	
			OPV	*HYBRID*
Labor	24.52	42.15	44.70	40.03
Materials				
Seeds	15.65	9.15	4.28	11.59
Chemicals	6.10	2.92	0.67	1.27
Fertilizers	3.20	8.44	21.08	22.68
Miscellaneous	4.80	1.91	5.52	4.88
Land and Fixed Costs	5.20	12.24	5.01	6.46
Production Cost	59.47	76.81	81.26	86.91
Processing, Marketing and Distribution Cost	24.25	15.00	62.12	62.58
Total Cost	83.72	91.81	143.38	149.49
Yield (mt/ha)	5.00	3.27	2.42	3.22

At the same time, production costs for both the wet and dry seasons are consistently higher in the Philippines. This is largely due to the cost of fertilizers as inputs to corn production. Overall, these higher costs as well as the relatively lower yield levels obtained in the Philippines paint a dire forecast for the country's competitiveness in corn production.

III. C. Coconut Area (vis-a-vis Malaysia's Oil Palm)

Coconut/Oil Palm Production and Expansion Areas

The current levels of Philippine production of coconut and Malaysian production of oil palm are almost equal --- 11 million tons/year. These are the outputs from 3 million hectares of coconut area in the Philippines, and 2.4 million hectares of oil palm area (1997 data) in Malaysia (Shamsuddin, 1999).

Table 22. Growth of coconut production (000' tons) across countries 1989 to 1999 (FAO, 2000).

	1989	1996	1997	1998	1999	Growth 89-99
Philippines	7866	11368	12118	10905	11000	2.9 %
Thailand	1436	1410	1419	1372	1372	- 0.3 %
Indonesia	11550	14140	14710	13000	13000	1.4 %
Malaysia	1130	933	835	711	711	- 4.4 %

Table 23. Growth of oil palm production (000' tons) across countries 1989 to 1999 (FAO, 2000).

	1989	1996	1997	1998	1999	Growth 89-99
Philippines	42	52	52	48	48	0.7 %
Thailand	199	400	449	475	475	9.9 %
Indonesia	1965	4898	5385	5902	6200	12.1 %
Malaysia	6056	8385	9068	8319	10553	5.4 %

In both countries, there is a national program for the rehabilitation and expansion of crop areas. In the Philippines the expansion area for coconut is in Mindanao while in Malaysia, old rubber fields are now being converted into oil palm plantations. Recently Malaysia obtained funding support from the Asian Development Bank to expand oil palm production in the Sarawak region.

Coconut/Palm Oil Industries

The oil palm industry in Malaysia is a well-organized enterprise. Their oil processing mills have been recently modernized, and their plantations are organized into estates that are operated as corporations. Thus, they have attained a higher degree of production efficiency.

The coconut industry in the Philippines, on the other hand, is quite the opposite. Coconut areas are broken up into small land holdings owned by farmers. Our oil mills badly need to be modernized but the oil mill owners have problems with funding. Thus, we do not have the economy of scale nor do we produce coconut oil at an efficient rate.

IV. General Discussion

The main question being posed by the paper is --- *can our current physical resources support the ever-increasing demands of Philippine agriculture, specifically in terms of rice and corn production?* The assessment of Philippine physical resources presented in the paper tells us that our potential to produce rice and corn is enough to supply rice and corn demands for the next ten years. By common sense, if our agricultural resources (particularly suitable land) can support rice and corn demands for a projected population increase, then we also currently have the potential to produce at a surplus and compete in the global market for both products. However, there are several moderating variables that would limit the use of available agricultural resources and affect our actual production outputs, namely: climate, irrigation facilities, and incentives to use modern technologies due to the low benefit-cost ratio. Nevertheless, investment in R&D and policy changes could balance out the negative effects of these moderating factors, specifically: a) R&D on typhoon-tolerant varieties; b) expansion of irrigation facilities; c) reducing cost of inputs through policies; etc.

Given our physical resources and the constraining effects of the above moderating variables to high production as well as the huge investment requirements in research and development, expansion of irrigation facilities and the high rate of population increase, in what direction should the country proceed? Should we aim for food self-sufficiency or food security? If we opt for food security, at what level should we produce domestically in order to ensure that current and future supply could cope with increasing demands? If we were to invest on the above, at what population level would it be capable of supporting survival?

Can we afford more agricultural investments considering the state of our economy? Who will benefit from such investments? How do we ensure that the coconut, rice and corn farmers truly benefit from such investments and would it be significant enough to allow them to escape poverty?

Are these the right crops for Philippine agriculture? For instance, 70% of the corn we produce is used as feed ingredient for livestock. Corn is used because the current livestock breeds we are using are best responsive to this feed material. Would it better to breed for livestock that will respond equally well on feed materials we can competitively produce?

In terms of the country's bid for global competitiveness, are these domestically produced products competitive with the imported ones? While other countries have bigger agricultural land areas, better irrigation facilities and are not as subject to natural calamities such as typhoons, their yield levels are not much higher than ours. Does this mean that we can compete not only in terms of quality but in quantity as well? The succeeding table summarizes the paper's major findings on comparisons across countries.

Table 24. Summary of Comparisons Across Countries.

	Philippines	**Thailand**	**Indonesia**	**Malaysia**
Land Area Total Agricultural	 smallest small	 large large	 largest largest	 small smallest
Irrigated area Growth rate of irrigated area	small low (almost none)	large highest	largest high	smallest high

(Table 24. cont'd.)

	Philippines	**Thailand**	**Indonesia**	**Malaysia**
Typhoons	frequent, with strong winds	without strong winds	rare	rare
Ratio of land to agricultural population	low	high	lowest	highest
Agricultural population growth rate	positive (highest)	negative	positive	negative (lowest)
Corn Area harvested Production level Yield level Marketing cost	 large (comparable) low high	 small (comparable) high low		
Rice Area harvested Production level Yield level	 small low low	 large high lowest	 largest highest high	
Coconut Area harvested Production level	 (comparable) high	 low	 highest	 --- lowest
Oil Palm Area harvested Production level	--- lowest	 low	 high	(comparable) highest

For all intents and purposes, the bottomline of all agricultural development endeavors must encompass food security, global competitiveness and increasing farmers' income. But in any policy making process, it is paramount that a clear statement of goals and priorities be made. What are the short-term and long-term goals as well as priorities of our national agriculture program? Is national food self-sufficiency a concern above the welfare of the low-income farmers? Can food security take a back seat for global competition? The effectiveness and efficiency of the agricultural performance of the country given its physical resources thus have to be measured against these goals and priorities.

In approaching the above concerns, several points must be considered:

First, in addressing our agricultural production requirements while competing with our Asian neighbors (i.e. Thailand, Indonesia and Malaysia), major differences in terms of characteristics of the agricultural sector must be considered:

- Among the four countries, the Philippines is the smallest followed by Malaysia. In terms of agricultural land, Malaysia registered the least area devoted to agriculture from 1989 to 1998, followed by the Philippines. However, the fact that Malaysia is bigger may explain its greater rate of agricultural land expansion compared to the Philippines. This implies that our approach to compete production-wise through the expansion agricultural areas can only help to a limited extent since Thailand, Indonesia and Malaysia have greater potentials for expansion.

- In terms of the ratio of land to agricultural population, our closest "competition" is Indonesia, which registered the lowest ratios for 1989 and 1998. Both Thailand and Malaysia registered increasing ratios for the same period which may be attributed to the negative change in agricultural population within the ten-year period. This indicates that the country does not really need to advocate for the increased transfer of labor forces towards agriculture (ex. "Back-to-the-Province" projects for urban areas) but instead must diversify into other entrepreneurial activities.

- Our agricultural land is predominantly planted to rice, corn and coconut. In terms of rice, our growth rates are comparable to those of our Asian neighbors. While the growth of our corn yield level is also comparable to Thailand and Indonesia, ours remain the lowest in terms of absolute yield/ha. On the other hand, the Philippines reported the highest growth rate of coconut production area. The latter however can be explained by the other countries' apparent interest in oil palm production, where the Philippines registered the lowest production area growth rate. All of the above provide the rationale for shifting towards the production of other crops instead of continuously seeking for the expansion of rice, corn or coconut production areas.

Second, it must be noted that the identified suitable land areas for agricultural production are more than enough to produce the country's food requirements. Thus, food security is not really an issue when we talk about available land. However, we do suffer from lower yield levels due to limitations imposed by weather conditions and inadequate irrigation systems. For example, it is generally the case that we are only able to profit from a single cropping per year since the second cropping is usually severely affected by typhoons or drought.

Third, there is little incentive for farmers to grow food crops because of the low return of investments. This can be attributed to small landholdings that result to very low net incomes from rice, corn or coconut. As net incomes from these crops are rarely enough for decent lifestyles, encouraging farmers to plant these crops would be tantamount to asking them to remain poor. Thus, while food security approaches may prescribe increased production of these crops, such may not be compatible with development goals of increasing farmers' incomes.

Related to the last is the fact that farmers in the Philippines were found to derive substantial incomes from non-farm activities. Thus, it becomes doubly hard to encourage them to invest on necessary inputs (i.e. fertilizers) for increased agricultural production when they are able to obtain higher absolute incomes from non-farm opportunities. Any development initiative/policy must therefore be made within the context of these socio-economic concerns.

With these realities --- small landholdings, low return on investment, limitations imposed by weather patterns and inadequate irrigation facilities --- one option that could be employed for the rational use of agricultural resources is the diversification of cropping systems (Lozada et al., 1999). Diversification may include high value crops which could increase farm-level incomes. Other options could include shifting land use away from agriculture. Whatever the case, there is a great need to reconcile national food security policy with the country's policies on poverty eradication.

Lastly, in all approaches to agricultural development, support services play an important role. These support services (i.e., a more efficient marketing system which would bring down costs of distributing products) must be put in place in order to fully realize gains in agricultural resource utilization. This is highlighted by the cost of distribution of corn in the Philippines. In Thailand the cost is only US$ 15/mt, while in the Philippines it is US$62/mt. While the country's relatively smaller landholdings contribute to the disparity in marketing and distribution costs, other factors include inefficiencies of marketing processes. Thus, there is an urgent need to transform our transportation and marketing system into an efficient and globally competitive system.

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