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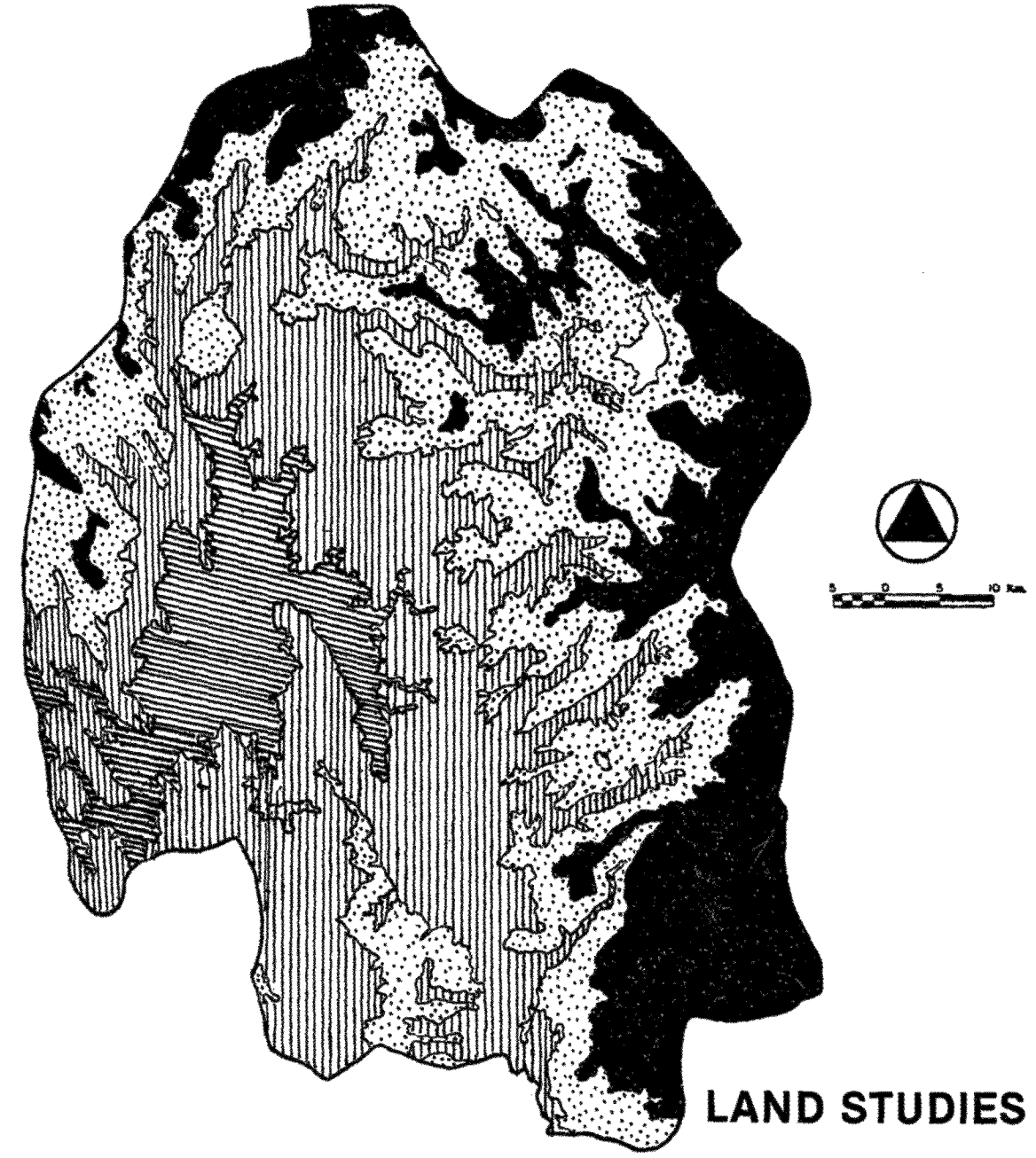

LAND STUDIES

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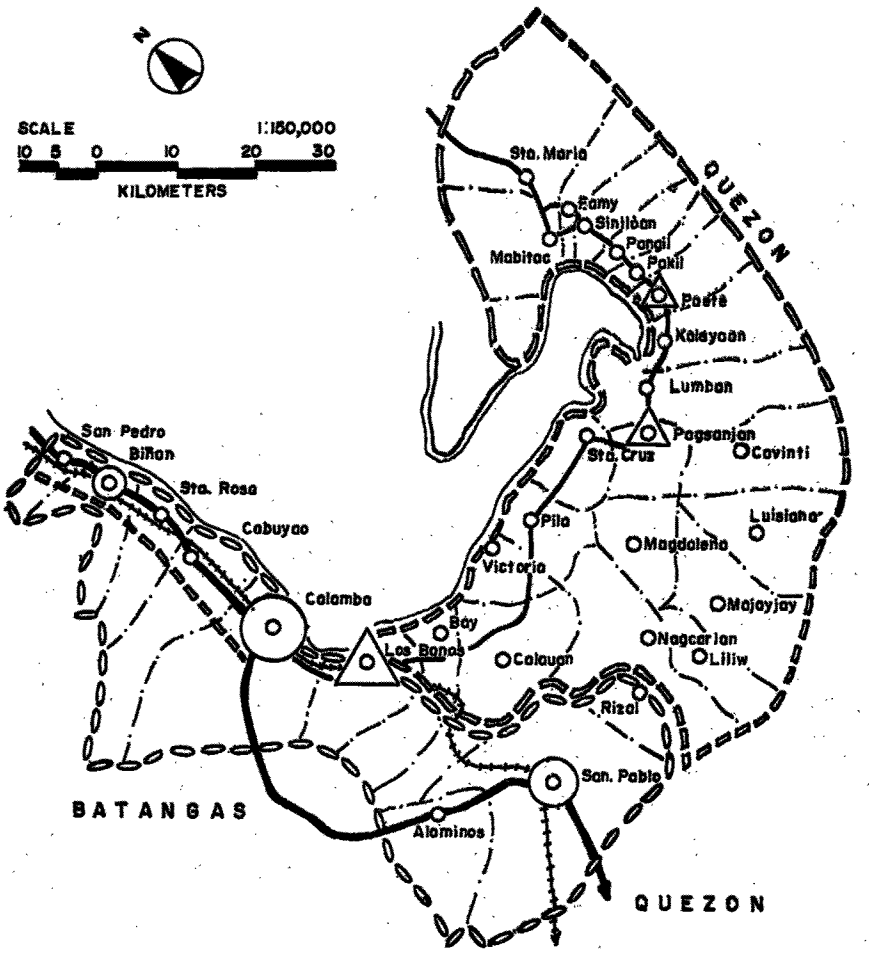

LEGEND:

- AREA FOR INTENSIVE AGRICULTURAL AND TOURISM DEVELOPMENT
- AREA FOR URBAN CORRIDOR DEVELOPMENT
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- EXISTING MANILA SOUTH EXPRESSWAY EXTENSION

A SPATIO-ECONOMIC STUDY OF THE LAGUNA PROVINCIAL GROWTH AND DEVELOPMENT

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INTRODUCTION

Local development studies, focusing on various economic, social and physical planning and development problems and involving cooperating local governments and agencies as well as individuals, have formed part of a growing field of practical and academic interests since the adoption of the 1972 Integrated Reorganization Plan (IRP).[1] The specific reasons for this growing interest and concern appear to be, among others, the need to improve local data base for, and strengthen local development planning, and establish a more effective linkage between local and regional/national development planning.

This article is drawn from a study bearing the same title which the author did as part of his academic research activity during the school year 1979-80, with the financial assistance from the University of the Philippines, Planning and Development Research Foundation (U.P.-PLANADES). The main aim of this study is to generate planning information and demonstrate the application of some simple approaches and techniques for analyzing complex factors for a better knowledge and understanding of the spatial and economic problems of Laguna province. The article highlights the findings of the study and is written in a "non-technical" manner. Nevertheless, it uses the terminologies currently found in already available studies and writings in the Philippine local development planning field.

The succeeding section is concerned with an historical perspective of Laguna's spatial and economic transformations. Applying an historical-narrative approach it looks at the broad sweep of history and describes some spatial and economic factors and other significant socio-political forces that have contributed to the past growth and development of Laguna. This is followed by an analysis in varying depth and detail of the population and settlement system, present economic structures, and the forces likely to shape the future growth of the province. A final section attempts to bring together all of the various findings, and suggests some further direction for future study.

AN HISTORICAL PERSPECTIVE OF THE SPATIAL AND ECONOMIC TRANSFORMATIONS OF LAGUNA PROVINCE

Much of the analyses in this section have been derived from a review of the historical markers placed by the Historical Committee, and of available books and other historical literature drawn from the English translations of the early missionaries and Spanish accounts of colonization in the Philippines.[2] It appeared from the findings of the analysis that the early colonization of the province of Laguna probably took place in the early 1570's or about the same decade when Miguel Lopez de Legaspi was building Manila, which was then an already established Moro settlement located at the mouth of Pasig river. This early colonization con-

[1] Refer to Republic of the Philippines Congress (1972) Integrated Reorganization Plan (Manila). This law has paved the way for an institutionalized approach to local provincial and regional development planning in the Philippines.

[2] See, among others, Bureau of Public Schools (1968) the Historical Markers Placed by the Historical Committee (Manila: Bureau of Printing); and Marcos, F.E. (1976) Tadhana: The History of the Filipino People, Part One, Vols. 1 and 2 (Manila).

sisted of intermittent raids or "entradas" which were exploratory or punitive in nature depending on the resistance offered by the native population to the Spaniards. The province was said to have been pacified and placed under an "Alcalde Mayor" in about 1582, at which time based on Loarca's "Relacion" the area had a population of 1500 "tributos" or tax payers who were allotted to three "encomienderos" or Spanish land grantees.[3]

As it was then the common practice, once an area had been pacified the missionaries followed and established town settlements with their characteristic plaza area. This was initially carried out through the process called "reduccion" initiated by the Franciscan missionaries which consisted in bringing the often scattered native population into more compact settlements by force or by persuasion through alliances with, and giving of special privileges to, the traditional leaders or datus and their families.[4] The boundaries of these compact settlements were defined by the limits of the sound of the church bells.

Early Settlement Patterns

The establishment of formal town settlements appeared to have followed certain patterns or sequences which were largely influenced by geography and the need to establish early missionary footholds both along the Laguna de Bay lakeshore and the interior part of the province. Geographical consideration appeared evident in the founding of early settlement areas which already possessed certain natural advantage or possibilities for production. However, the really important early settlements appeared to be those where permanent churches usually made of adobe stones were eventually constructed.

The early Spanish settlements in the province may be categorized into three spatial patterns: two along the Laguna Lakeshore and plain area—the southeast and northeast portions; and the southwest inland part of the province. However, the earliest beginnings of the Spanish town settlements in the province were probably centered around the present town of Lumban located along the interior navigable part (by small boat) of Lumban river from the lake, and the present inland municipality of Majayjay. The founding of these two towns appeared to have preceded the founding of all the other towns in the province. Lumban was founded in the early 1570's and served as an initial center of all missionary work in the province, as a hospital area for sick missionaries and as some sort of a religious school for the teaching of liturgical hymns and use of musical instruments.[5] Majayjay was founded at about the same time as Lumban, and became an "encomienda" under a certain Gaspar de Moya who served as one of the early mayors of the City of Manila.[6]

From these early Spanish footholds in the province, the evolution of the other settlements followed. Most probably the early influence of Lumban extended east of the area along the lakeshore from the present town of Kalayaan up to Mabitac on the boundary with present Rizal province, and north along the lakeshore and plain area covering the present town of Pagsanjan, the present provincial capital town of Sta. Cruz, and the towns of Pila up to possibly Bay. On the other hand, Majayjay served as staging area for the establishment of the nearby inland towns of Liliw, Nagcarlan, Rizal and possibly the present San Pablo City.[7]

The evolution of settlements northwest towards Manila from the present towns of Los Baños to San Pedro started also after the establishment of Lumban and Majayjay. However, one unique feature of this area was its immediate proximity to, and the influence of, the expanding city of Manila. This factor exerts profound influence on past and present economic conditions of the area. Moreover, the entire area later on became a friar or religious agricultural hacienda established in response to the galleon trade and

[3]Marcos, F.E., Tadhana, Part One, Vol. 2 *op. cit.*, p. 134.

[4]*Ibid.*, pp. 61, 138 and 139.

[5]Bureau of Public Schools, *op. cit.*, p. 138.

[6]*Ibid.*, p. 137. Also Palazon, J. (1964) Majayjay: How a Town Came into Being (Manila).

[7]See, for example, Borlaza, G.C. (1960). "Liliw" *This Week Magazine, Sunday Chronicle*, Vol. 15, No. 26.

geared to sustaining religious institutions in Manila and supplying the city with agricultural products.

There are some indications that these early settlements were linked to each other by inland and lakeshore trails, some of which where originally used by the Spanish "entradas", and later on became permanent road networks. As the lake provided the most convenient means for transportation to Manila, the seat of Spanish colonial and religious administrations, certain towns along or at convenient accessible distance from the lake like Sta. Cruz, Bay, Calamba and Biñan grew as some sort of local transport nodes linking the different areas and the interior settlements with the lake.

As far as the overriding objectives of the colonization, namely spread of Catholic religion and imposition of Spanish authority over the native population, were concerned, these were probably already achieved as far back as 1582 when the province was pacified and placed under an "Alcalde Mayor". It would be of interest to know the fate of some of the earliest established town settlements over the centuries of their existence. In the case of Lumban, its early local ecclesiastical-administrative prominence probably ended during the early 16th century when other settlements along the lake became independent "cabecera" municipalities. For instance Pila became some sort of a local religious information center when it was chosen as the site of the first printing press established by the Franciscan missionaries in 1606 under Tomas Pinpin and Doming Loeg.[8] In the economic sphere, the town of Paete was founded in 1580 as already a thriving community of artisans due mainly to the indigenous skills of the population in wood carving (buen ebanistas).[9] The Spanish missionaries capitalized on these skills and commissioned the population to carve religious figures, some of which were even sent to Spain. As the skills are transmitted from generation to generation, Paete has remained to this day an important wood handicraft town.

Some towns, on the other hand, had acquired prominence by becoming the seat of Spanish provincial colonial administration. This was the case of Pagsanjan (an important tourist destination at present owing mainly to the famous Pagsanjan Falls), which was declared a municipality in 1688 and immediately afterwards became the Spanish colonial administrative capital of Laguna. In 1858, the capital was transferred to Sta. Cruz which has remained the provincial capital to this day.

The town of Majayjay suffered a different fate since it lost its early prominence due to internal disputes. This led to the fragmentation of the original settlement into smaller municipalities (present towns of Magdalena and Luisiana were parts of the original municipality of Majayjay).[10] Apparently, the early prominence of Majayjay shifted to the nearby municipality of Nagcarlan, the latter becoming another ecclesiastical administrative center of the province covering the town of Liliw and extending probably to the present city of San Pablo. San Pablo became a municipality much later in 1647. Judging from the massive churches including a catacomb built in Nagcarlan, the town probably had attained a level of economic prosperity at certain periods in its several centuries of existence. In fact, its nearby towns of Liliw, and Majayjay itself probably also experienced similar levels of economic prosperity, judging from their own equally impressive churches. The possible reason for this was the exploitation of the area's hard lumber resources for the galleon trade and partly due to early successful cultivation of wheat and grapes by the friars in the area.[11] However, the latter temperate zone crops degenerated and their cultivation was abandoned after some time.

In the northwest lakeshore, the shifting fortunes of the towns over the centuries slightly differed from those of the rest of the province due to the area's proximity to Manila and special socio-economic relations with the friars. Here the first semblance of Manila's urban influence were occurring with the early establishment of Los Baños as the

[8]Bureau of Public Schools, *op. cit.*, p. 134.

[9]Dharam, M. (1956). "The Chisel and the Fruit: Biography of Southern Town." *Sunday Times Magazine*, Vol. 12, No. 19.

[10]Palzon, J., *op. cit.*, pp. 9-24.

[11]Bureau of Public Schools, *op. cit.*, p. 99.

Spanish "hospital de Agua Santa" (the equivalent of today's health resort) as far back as 1590.[12] Moreover, as the whole area became one of the first large scale friar agricultural haciendas, the native population theoretically became workers of the haciendas. A system called "casa de reservas" was introduced by the religious orders and sanctioned by the Spanish colonial civil authorities to compel the native population to render compulsory labor services to the haciendas. In return, those who rendered this forced labor were exempted from payment of certain taxes and compliance with the "vandala" or compulsory sale of individual farm produce to the Spanish civil officials. The system of "casas de reservas" had its equivalent in the field of public works called "polo y servicios," which required the native population to render compulsory labor in Spanish civil works like galleon building and road construction. The native population who evaded these two forms of forced labor as well as the payment of the equivalent taxes in case of non-compliance with the forced labor and compulsory sale of their products to the authorities at fixed prices were treated as criminals or "cimarrones" and dealt with accordingly by the Spanish authorities. Added to these oppressive measures, small native landholders were deprived of their farms through encroachments by the big haciendas/hacienderos who either bought the land from the landholders or gradually usurped their rights to the land through fraudulent surveys and attachment of their farms to the haciendas. This condition led to agrarian and provincial discontent which contributed to the Philippine revolution of 1896 and, eventually, to the end of Spanish rule.

An important articulator of these oppressive conditions—Dr. Jose Rizal—was born in the area in the town of Calamba. According to one source, the town had reached the stage of a rural trading center in about 1860 and performed an important role in the long defunct ferry transport in the lake.[13] Moreover, the town's favorable location with respect to the inland agricultural area of Batangas made it an important agricultural marketing outlet (a function the municipality still performs at the present time).

Biñan was the other town of some early status in the northwest lakeshore. Probably Biñan attained the same level of development as Calamba immediately prior to the Philippine revolution, however, it performed higher religious and educational roles than Calamba. The national hero, Dr. Jose Rizal, had some of his early education in the town of Biñan. Biñan also served as the seat of higher local religious and colonial civil authorities.

The Provincial Agricultural Hacienda Economy

The evolution of the Laguna provincial agricultural hacienda economy which persisted during most of the Spanish period up to the coming of the Americans may be traced to the early "encomiendas," which were large land grants given by the Spanish Crown or the Colonial Governor General of the Islands to colonists, soldiers, retired colonial civil officials and religious orders.[14] The encomienda system provided the early unifying and consolidating force for the rapid spread of Christianity and imposition of Spanish authority over the native population. It also served as an economic means to sustain the Spanish colonists. However, the system was later on abandoned due largely to the abuses of the "encomienderos", and replaced by the agricultural hacienda system. The motivation for the latter system was economic and appeared to

[12] *Ibid.*, p. 152.

[13] Hilberto, D.L. (1972). "Calamba Facts and Figures," *Calamba Souvenir Magazine.*

[14] The Encomienda System was introduced in the Philippines on November 16, 1568 by King Philip of Spain as a form of reward and as an incentive to Spaniards to settle in the country. Specifically, an encomienda refers to a large land grant which gives rights to the grantees or "encomienderos" to collect tributes (i.e., the equivalent of 10 reales paid in cash and in kinds) from the individual natives living within the boundaries of the grant. This system was abolished and later on replaced by the hacienda system in late 17th century due to abuses of the "encomienderos." See, for example, Corpuz, O.D. (1965). *The Philippines* (Englewood Cliffs, N.J.: Prentice-Hall Inc.), pp. 30-34; and Agoncillo, T.A. and Guerrero, M.C. (1973) *History of the Filipino People* (Quezon City: R.P. Garcia Publishing Company), pp. 97-100.

be in response to the launching of the galleon trade in 1593. The galleon trade remained as the only foreign trade of the country in the succeeding two centuries. Both the haciendas and the galleon trade were designed to give economic benefits to Spanish colonists, religious orders and Spanish civil and retired officials.

As Manila was the center of the galleon trade, the religious orders which by the time had already consolidated their position in the local community vis-a-vis the Spanish civil authorities began to extend their sphere of activities to the economic area by engaging directly in agricultural haciendas.[15] The Jesuits, who were permitted by their order to accumulate material possessions and had extensive early experience in operating agricultural haciendas in South America, were the first to acquire large agricultural haciendas around Manila including Laguna province. Consequently, by 1833 when they were expelled from the Philippines as a result of the secularization movement, the Jesuits already possessed extensive haciendas covering Biñan extending up to Los Baños as well as haciendas in San Pablo and Sta. Cruz. Upon the expulsion of the Jesuits from the country, the Dominican order took possession of the Jesuits' large agricultural haciendas.[16]

The Recollects during the same period owned the San Pedro Tunasan hacienda in the present town of San Pedro and other haciendas in the nearby province of Cavite.

In analyzing the impacts of the agricultural haciendas on the local/provincial economy, two propositions were explored and then preliminarily confirmed through a review and analysis of available historical materials. These propositions are: ***First,*** the province can be viewed as if it were a nation and its growth depended on external factors like the demands for the products of the province arising from the galeon trade and the expanding Manila economy. Under this proposition, since the agricultural haciendas served as the main economic base of the province the economic growth of the area would rise and fall depending on the volume of its exports through the galleon trade and direct sale to the city. The ***second*** proposition relates to an idea of local economic welfare derived from the haciendas, reflected in terms of employment and income benefits to the population and related social and community development benefits. These latter benefits may include, for example, new introduced and/or acclimatized plants or livestock and development of irrigation infrastructures.

As regards the first proposition, available sources of informatioin do not provide data on volume of trade but, gleaned mainly from the supply side, the province appeared to be a producer of materials for export like sugar which was one of the early main crops introduced in the haciendas, and some native products like religious images carved in Paete, cotton, silk, coconut, coffee, pineapple, kapok, and abaca fibers. The spatial distribution of these crops in the province reflected the influence of geographic forces and some consideration of distance to the markets in, or through, Manila as well as of labor availability. For instance, sugar cane was intensively cultivated in haciendas around Manila while fiber crops and coconuts which were suited to the upland areas and lent to native labor and technology were cultivated further away from the city. With respect to sugar cane, moreover, its cultivation close to the city was probably due also to the need for extra labor during harvesting period. By cultivating this crop close to the city, the peak labor requirement during harvesting was easily remedied by bringing in recruited Chinese labor from the city to the haciendas.

There were restrictions regarding both the types, with preference to products from China, and volume of commodities that could be traded in the galleon, and probably this served as the greatest stumbling block to the growth of the hacienda exports. With respect to volume restriction, the galleon trade limited the volume of merchandize coming from the Philippines every year to half a million pesos in exchange for one million pesos in silver bullion. However, despite this restriction, the galleon trade remained the most profitable business for the religious orders, civil officials and colonists. The explanation for this was the circumvention of

[15]Marcos, F.E., Tadhana, Part One, Vol. 2, *op. cit.*, pp. 132-138 and 146-147.

[16]*Ibid.*, p. 147.

the restrictions through undervaluation of the merchandize as well as through the equivalent of the present "technical smuggling."

While the foregoing restrictions may have adversely affected the Laguna provincial economy, as well as that of the entire country, the geographical limitation of the Philippine foreign trade to between Manila and Acapulco in Mexico probably was a more significant factor that impeded local-provincial and the nation's socio-economic growth and development. The restriction was conceived herein as an "opportunity cost" to the local-provincial development particularly around Manila and the nation's as a whole since it limited these areas and the nation from exploiting fully their comparative advantage in possible direct trade with Asian neighbors and Europe and America. Moreover, the trade restrictions prevented the early exploitation of Philippine natural resources and manpower.

The geographic restrictions imposed by Spain on the galleon trade stemmed from economic reasons as well as the fear of the Spanish colonial administration that broadening contacts of Filipinos with their Asian neighbors and the Europeans and Americans would pose a problem to the socio-political stability of the Islands. The latter fear appears to have strong basis since at some points the British occupied Manila from 1762 to 1764; the Dutch threatened Manila from Indonesia; and Koxinga's threat loamed from Taiwan.

Deducing from the foregoing factors on the demand side, and considering local social upheavals brought about by oppressive conditions, it may be concluded that the hacienda economy and the galleon trade probably did very little to change the provincial economy to a higher level. The provincial economy probably remained at near or below subsistence level during centuries of Spanish colonization of the area. Another aggravating factor to this was the siphoning off of hacienda production and income from the province to support religious institutions in Manila. Moreover, whatever capital accumulation may have been achieved during the period in the fields of agriculture and public works was the direct result of native labor rather than the hacienda system, or the Spanish colonial administration ***per se.***

As regards the second proposition, the haciendas may be viewed in some positive way as an effective medium for the introduction and/or transfer of available agricultural technology and manpower skills to the native population. There are two apparent dimensions to this: First, the hacienda served the equivalent of today's agricultural experiment station and demonstration farm for the introduction, acclimatization and eventual production in the province of new plants and breeds of livestock. Nearly a majority of the present commercial and food crops in the province and the country as a whole may be attributed one way or another to the early encomienda and/or hacienda agriculture. Secondly, while the compulsory labor system was oppressive, on the positive score it provided for the transfer of skills to the native population. For example, the native farmers learned the cultural practices of newly introduced crops and care of new breeds of livestocks from the friars. Moreover, in the hacienda's labor pool there would probably be a possibility for recruited **Chinese skills particularly in vegetable farming to "rub off" to the native population and *vice versa.***

Secondly, the hacienda served as a means of realizing internal economies of scale in hacienda production through utilization of abundant land and cheap labor. However, this advantage appeared out-weighted by the fact that increased hacienda productivity did not really redound to income benefits of native population as the income earned were used to support religious institutions in Manila. The hacienda has some present parallel in the case of mining. Big investors, **usually multinationals, are often attracted to** the region to develop mining resources. However such activity despite its usual large size adds little to the regional/local economic welfare or growth since the incomes generated are mostly repatriated or spent outside the region. Employment benefits to the immediate local area are often not realized either because locally available labor do not possess necessary skills or because the mining company prefers to recruit migrant labor for one reason or another.

In the case of the early haciendas because of the oppressive condition under which native labor were involved therein, probably direct income and employment benefits

accrued only to few selected members of the colonial community. These included the lay brothers comprising usually of mestizos or Chinese who were hired as overseers or hacienda administrators, but the native labor remained in the lowest bracket in the local employment and income ladder. The Spanish colonists and retired officials if they were not direct owners of the haciendas tended to engage in business connected directly or indirectly with the galleon trade.

POPULATION AND SETTLEMENTS

Population Estimates of Laguna, 1852-1980

The earliest account of the province's population was in 1582, and pertained to Loarca's of 1500 "tributos" or tax-paying population (by definition, population age 13 and over). If this tax-paying population were to be used as a benchmark, even with ample allowances for possible underestimate of the figure, considering children age 12 and below and people exempted from payment of the tributes or taxes like the Spanish colonists, missionaries, sacristans and some traditional leaders or "datus" and members of their families, the total provincial population in 1582 would probably not be very far from 2000-3000 people.

In the span of over 400 years (from 1582 up to the period immediately prior to the first national census in 1903), there were eleven major estimates of the national population which could serve as bases for determining the likely size and trends of the province's total population. These estimates have been summarized in Table 1.

As Table 1 reveals, in the span of over 200 years from 1582 to the first Spanish account of the national population in 1799, the province's total population grew at an annual rate of around 3.8 percent. This meant an increment of only around 24.8 thousand people over this long period. From 1799 to the first Philippine census in 1903, the province's population expanded by an additional over 120.7 thousand people but this meant a lower average annual rate of increase of around 3.0 percent than the previous 200 years.

Table 1

LAGUNA POPULATION 1582-1980

Year	*Estimated Population*	*Estimates based on Stated Sources*	*Year*	*Actual Census Population*
1582	2000-3000	Loarca	1903	148,606
1799	27,862	Buzeta		
1800	28,956	Zuñiga	1918	195,546
1812	35,857	Cedulas	1939	279,505
1819	39,066	Cedulas	1948	321,247
1829	46,100	Church	1960	472,064
1840	57,430	Local Officials		
1850	71,547	Buzeta	1970	699,736
1858	79,579	Bowring	1975	803,750
1870	87,407	Guia Oncal	1980	973,104
1877	103,280	Census		
1896	116,140	Professor Plehn's Estimate based on Census records		

N.B. Estimates were made by applying percent share of the province in the national population from 1903-1980 to national figure in stated years.

The rapid expansion of the provincial population both in absolute number and in percentage terms occurred during the recent past 77 years from 1903 to 1980. Between 1903 and 1960, the percent share of the province to the national total population showed a declining trend. However, this downtrend was reversed starting with the 1970 up to the last 1980 census, perhaps reflecting the growing importance of the province vis-a-vis the nation.

An important feature of this more recent growth of the population was the increasing number of towns falling within the higher population size range, which is also an index of the growing urbanization in the province (See Table 2).

As Table 2 shows, the percentage of towns falling within the population size range below 10 thousand sharply declined from around 90 percent (26 towns) in 1903 to little over 13 percent (4 towns) in 1980. The reverse was true for population size range 10-20 thousand which increased from around 7 percent (2 towns) in 1903 to 43 percent (13 towns) in 1980. During the nearly 77 years considered in the analysis, at least two towns moved up from size range 20-30 thousand to the next higher range with every new population census. The last 1980 census showed that 6.7 percent of all towns (2 towns) had already reached the over 120 thousand population size range, while over 13 percent (4 towns) had attained the over 50 but less than 100 thousand population size range.

Hierarchy of Settlements in the Province

As indicated by the population censuses, the most populous town in Laguna from 1903 to 1980 had always been the present city of San Pablo. In 1903 it first registered a population of 22,612; this increased to 31,399 in 1918. The other leading towns in 1903 were the provincial capital of Sta. Cruz with 12,747 and Nagcarlan with 10,212. These were followed by Biñan and Calamba. By 1918 Calamba rose to second position, behind San Pablo City, with a population size of 18,062. Nagcarlan was third with 14,854 and Sta. Cruz wih 14,156 was fourth. Calamba's rise was a result of its high absolute growth of population mainly due to in-migration of workers to work in the remaining sugar haciendas. For the period from 1903 to 1918 it posted a 21.3 percent change, edging out San Pablo City which had 18.7 percent.

Starting in 1939 San Pablo City and Calamba were the leading towns in Laguna which exhibited markedly growing populations. San Pablo City had a population of 46,311 and Calamba had 32,363. By 1948 San Pablo City's population had increased to 50,435, largely due to its expanding role as a transport node and coconut processing center, and Calamba's to 36,586. These were followed by Sta. Cruz and Biñan with population sizes of 22,534 and 20,794, respectively. In 1960, Biñan surpassed Sta. Cruz. It showed a 33,309 population as against the 32,850 of Sta. Cruz. At this time San Pablo City and Calamba had populations of 70,680 and 57,715, respectively. For the time interval between 1939 and 1948 (or coinciding with greater part of World War II), Sta. Cruz showed the greatest increase, posting an 11.7 percent change in population. However, Sta. Cruz was relegated to the fifth position from the early post-war years 1948 to 1960. At this time Calamba led all other towns with about 14 percent change, followed by San Pablo City with 13.4 percent.

In 1970, San Pablo City was again in the top position with a population of 105,517, followed by Calamba with 82,714; Biñan with 58,290; and Sta. Cruz with 47,114. In the fifth and sixth places were Sta. Rosa and San Pedro. This ranking remained consistent in 1975 except Sta. Cruz which fell to eighth place. Sta. Rosa and San Pedro moved up to fourth and fifth places. By 1980, San Pablo City had a population of 131,686, Calamba had 121,066, and Biñan had 83,684. At this time San Pedro, which had a 74,598 population surpassed Sta. Rosa which only had 64,012. In terms of percent change in population for the 1960-1970 period, San Pablo City led all the other towns with 15.3 percent, edging out Calamba with 11 percent.

By 1970-1975 these positions reversed and Calamba led with 14.2 percent compared to San Pablo City's 10.7 percent. On third rank was San Pedro with 10 percent. However, in the short span of five years from 1975 to 1980, San Pedro surpassed both San Pablo City and Calamba. It registered an 18.4 percent change. Calamba ranked second with around 14 percent, followed by Sta. Rosa and Biñan with 9.7 and 9.6 percent change, respectively. This latter trend was a clear indica-

Table 2

Percent Distribution of Population by Town Size Categories Laguna, 1903-1980

Size Categories	1903	1918	1939	1948	1960	1970	1975	1980
Below 10,000	89.7	77.8	72.5	69.0	50.0	23.3	23.3	13.3
10,000-20,000	6.9	18.5	20.7	17.3	26.7	46.7	43.3	43.3
20,000-30,000	3.4	—	—	6.9	10.0	3.3	6.7	13.3
30,000-40,000	—	3.7	3.4	3.4	6.7	10.0	10.0	3.3
40,000-50,000	—	—	3.4	—	—	6.6	3.3	6.7
50,000-60,000	—	—	—	3.4	3.3	3.3	3.3	—
60,000-70,000	—	—	—	—	—	—	3.3	6.7
70,000-80,000	—	—	—	—	3.3	—	—	3.3
80,000-90,000	—	—	—	—	—	3.3	—	3.3
90,000-100,000	—	—	—	—	—	—	3.3	—
Over 100,000	—	—	—	—	—	—	3.3	6.7

Source of Basic Data: NCSO (1980) Laguna Integrated Census of the Population and Its Economic Activities, Laguna.

The percentage computation for the periods 1903 to 1948 was based on 29 towns; for the succeeding years the computation was based on 30 towns with the creation of Victoria out of the present town of Pila.

Table 3

Functional Hierarchy of Towns by Activity Category and Provincial Area

Provincial Area	Manufacturing	Wholesale and Retail	Financing, Real Estate Insurance & Business Services	Community Social & Related Services	Transportation Communication and Storage
Southeast Lakeshore	Paete (2) Pila (6) Victoria (9) Kalayaan (10)	Sta. Cruz (2) Siniloan (3) Paete (7) Mabitac (10) Famy (12) Sta. Maria (13)	Sta. Cruz (4) Siniloan (5) Paete (8)	Siniloan (3) Sta. Cruz (5) Paete (7) Pila (8) Pagsanjan (10) Victoria (13)	Sta. Cruz (2) Siniloan (3) Mabitac (7) Famy (8) Calauan (9) Bay (10) Pagsanjan (11)
Northwest Lakeshore	Biñan (1) Sta. Rosa (4)	Biñan (1) Calamba (5)	San Pablo City (1) Rizal (7)	San Pablo City (1) Nagcarlan (11)	Biñan (1) San Pedro (4) Sta. Rosa (5)
Southeast Interior	Liliw (3) Rizal (5) San Pablo City (7) Nagcarlan (8)	San Pablo City (4) Rizal (6) Luisiana (8) Cavinti (9) Liliw (11)	Sta. Rosa (2) Calamba (3) Los Baños (6)	Biñan (2) Calamba (3) Los Baños (6) San Pedro (4) Sta. Rosa (12)	Nagcarlan (6) Cavinti (12)

NOTE: Figure in parenthesis refers to provincial ranking for each major activity category. Provincial areas refer to the same areas as discussed in the historical perspective.

Source of Basic Data: NCSO (1978) Census of Business Establishments.

tion of the continuance of the earlier historical tendencies towards greater concentration of population and development in the northwest lakeshore towards Manila. A possible reason for this is the impact of Metro Manila's "overspill development" into the area. During the period 1970-1980, there had been a proliferation of commuter housing subdivisions particularly in the adjacent towns of San Pedro and Biñan and a rapid influx of manufacturing plants in the entire northwest lakeshore area.

Functional Town Centers

The analyses in the earlier sections provide only an idea of the evolutionary process of the provincial settlement structure, but they do not show the functional relations of the various towns with each other or with their respective catchment areas. In reality, however, some towns may have a large population, or contribute large percentages to the total absolute growth rate of population, but are relatively undeveloped in terms of regional/sub-regional functions. This necessitates the use of some parameters or formula for determining the functional hierarchy of towns. For this purpose a modified index of centrality,[18] represented below was used:

$$CI = NE - \frac{PT}{p} \text{ where:}$$

CI = centrality index, NE = number of establishments in specific activity category in the town; T = total number of establishments in specific activity category in the province; p = total population in the town; and P = total population in the province. An index of 1 and over means that the particular town is a provincial center for the specific activity category or function. The results of the analyses are summarized in Table 3. They provide the following possible conclusions:

i) The overall findings of the analyses agree with Christaller's original concept of centrality that the major function of a town is not necessarily that in which a major part of its population is engaged, but rather that in which a usually large proportion of its population is engaged. Moreover, the findings show that some small towns perform central place functions while other towns have no central place functions at all. Also some towns have large populations but perform only a few central place functions.

ii) In terms of manufacturing function, the town of Biñan ranks first, followed by Paete, Liliw, Sta. Rosa and Rizal. Biñan and Sta. Rosa are both located in the northwest lakeshore. Their distinctive features are that they have more advanced industry mix owing largely to the dispersal of large and medium manufacturing plants to the area. All other four lead manufacturing towns are engaged in small-scale, cottage-type industries using mainly raw materials from agriculture and forestry. Paete is a wood handicraft town, while Liliw specializes in slipper making. Rizal is primarily engaged in bakery and home processed food products. The other towns having manufacturing function in the order of importance are: Pila, San Pablo City, Nagcarlan, Victoria and Kalayaan. These towns are also mostly engaged in cottage-type industries, except San Pablo City. San Pablo City has a diversified mix of small-scale, cottage-type industries, but is also serves as a specialized coconut (dessicated and processed oil) and coconut by-product manufacturing center.

iii) In wholesale and retail services function, Biñan again ranks first in Laguna, followed by Sta. Cruz, San Pablo City and Calamba in that order.

iv) In financing, real estate, insurance and business services, San Pablo City leads in this activity, followed by Sta. Rosa, Calamba and Sta. Cruz.

v) San Pablo City leads again in terms

[17]Computation was based from National Census and Statistics Office (1980) Laguna Integrated Census of the Population and its Economic Activities.

[18]The only modification is in the uce of number of establishments by town instead of number of telephones as in Christaller's original concept. Refer to Carlisle Baskin (1963) translation of Walter Christaller, *Central Places in Southern Germany* (Englewood Cliffs: Prentice-Hall, Inc.). See also Monkhouse, JF. and Wilkinson, H.R. (1963), Maps and Diagrams. (London: Methuen and Company, Ltd.), pp. 353-355.

of community social and related services, followed by Biñan, Calamba, Siniloan and Sta. Cruz.

vi) In transportation, communication and storage, Biñan, Sta. Cruz, Siniloan, San Pedro and Sta. Rosa are the leading centers.

vii) In terms of the number of lead functions performed by individual towns, Biñan leads in the province's hierarchy of town centers. The other towns in the order of importance are San Pablo City, Sta. Cruz, Sta. Rosa, Paete, Siniloan, Liliw, Calamba and Rizal. As may be gleaned from this distribution, some towns with apparently large population like Calamba have not yet developed their urban servicing functions. Similarly, some smaller towns like Paete, Siniloan, Liliw and Rizal are playing a significant role as some kind of a production and/or servicing center in their immediate influence area. The spatial configuration of this hierarchy of functional town centers is illustrated in **Figure 1 below.**

As revealed from the previous analysis of population distribution, the apparent threat to the provincial hierarchy of town centers appears to be the continuing "overspill development" from Metro Manila. As this "overspill development" will not only aggravate urban problems (e.g. ribbon-type development) in the northwest lakeshore but it will also place the existing hierarchy of town centers somewhat at a disadvantage development-wise, it would probably be advisable for the province to reinforce and maintain the growth and development of selected functional town centers as reception areas for dispersing population and economic activities from Metro Manila. A development scheme involving both local and larger regional efforts is desired along this line.

Fig. 1. FUNCTIONAL TOWN CENTERS
PROVINCE OF LAGUNA

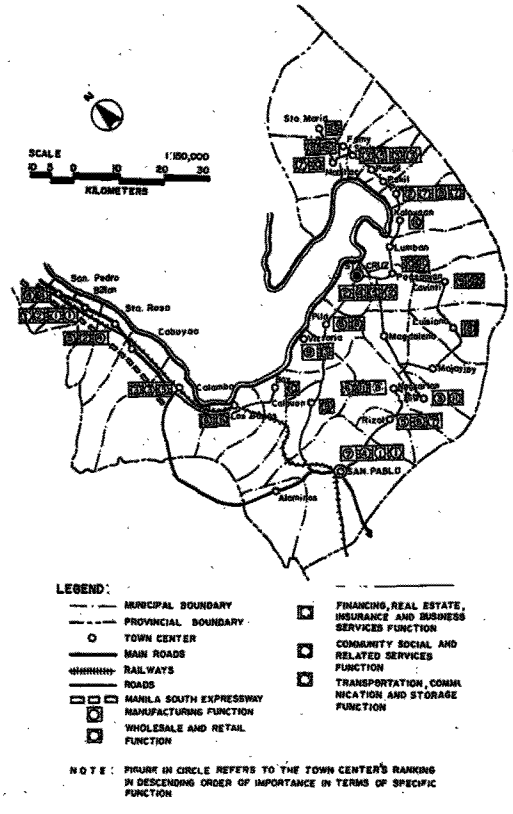

Table 4

Employment by Major Economic Sectors and by Occupation, Laguna Province Rest of Southern Tagalog and National Capital Region, Metro Manila

Sector	Laguna	Rest of Southern Tagalog	National Capital Region	Combined Southern Tagalog & National Capital Region
Industry:				
— Primary	89,019 (36.9)	722,253 (30.3)	37,187 (2.3)	848,456 (30.0)
— Secondary	49,455 (20.5)	441,838 (18.5)	404,751 (24.9)	896,044 (21.1)
— Tertiary	100,800 (41.7)	1,182,470 (49.6)	1,162,463 (71.6)	2,445,733 (57.5)
— Industry Inadequately described	2,216 (0.9)	39,192 (1.6)	19,299 (1.2)	60,707 (1.4)
TOTAL	241,490 (100)	2,385,752 (100)	1,623,700 (100)	4,250,942 (100)
Occupation:				
— Farmers, fishermen, hunters, loggers and related workers	87,812 (36.4)	711,009 (29.8)	32,804 (2.0)	831,625 (19.6)
— Craftsmen, production process workers and related workers	55,313 (22.9)	485,493 (10.4)	411,443 (25.3)	952,249 (22.4)
— Sales workers	27,864 (11.5)	231,302 (9.7)	208,744 (12.9)	467,910 (11.0)
— Services, sports and related workers	20,082 (8.3)	317,442 (13.3)	334,531 (20.6)	672,055 (15.8)
— Transport & Communication workers	15,028 (6.2)	144,456 (6.3)	140,385 (8.6)	304,869 (7.2)
— Professional Technical & Related Workers	14,701 (6.1)	166,663 (7.0)	154,614 (9.5)	335,978 (7.9)
— Clerical workers	10,092 (4.2)	188,246 (7.9)	219,565 (12.5)	417,903 (9.8)
— Administrative, Executive & related workers	4,293 (1.8)	47,950 (2.0)	54,398 (3.9)	106,641 (2.5)
— Stevedores, related freight handlers and laborers	2,238 (0.9)	39,269 (1.7)	36,990 (2.3)	79,597 (1.9)
— Miners, quarrymen and related workers	816 (0.3)	5,372 (0.2)	—	6,188 (0.2)
— Others	3,251 (1.4)	43,367 (1.8)	30,822 (1.9)	77,440 (1.8)
TOTAL	241,490 (100)	2,385,752 (100)	1,623,700 (100)	4,250,942 (100)

Source: NCSO (1975) Integrated Census of the Population and Its Economic Activities (For Laguna, Rest of Southern Tagalog Provinces and Metro Manila). Laguna forms part of the larger economic and administrative region comprising Southern Tagalog and Metro Manila. Rest of Southern Tagalog refers to the provinces of Cavite, Rizal, Batangas, Quezon and Aurora within Mainland Luzon, and the island provinces of Marinduque, Romblon, Palawan and two Mindoros. Metro Manila or National Capital Region consists of the core cities of Manila, Pasay, Caloocan and Quezon and their thirteen immediate surrounding municipalities.

PRESENT PROVINCIAL ECONOMIC STRUCTURE

The analyses in this section have been confined to the most readily available census data at the time of the study. These are employment and business establishments data. Applying descriptive statistical techniques to these data, the analyses attempted to identify in some detail the different economic activities and also determine their spatial distribution in the province and in the larger economic/administrative region.

Table 5 presents a comparison of the distribution of employment by major and minor industry and by occupation in Laguna, Rest of Southern Tagalog and Metro Manila. The specialized character of the province is reflected by the fact that it has a higher share (36.4 percent) of total employment in the primary sector as compared to that of the Rest of Southern Tagalog's 30.3 percent and Metro Manila's only 2.3 percent. This provincial lead role roughly corresponds to the higher percentage of the province's workers within the primary occupational groups-farmers, fishermen, hunters, loggers and related workers-which comprise 36.4 percent as compared to the Rest of Southern Tagalog's 29.8 percent and Metro Manila's 2.0 percent.

In the secondary or manufacturing sector, Laguna's share of employment of 20.9 percent was higher than that for the Rest of Southern Tagalog with 18.5 percent, but lower than Metro Manila's and the Combined Southern Tagalog and Metro Manila's 24.9 percent and 21.1 percent, respectively. This same pattern also shows in terms of the distribution of employment by occupation. Laguna accounts for 22.9 percent of all craftsmen, production processes workers and related occupations. In contrast, the Rest of Southern Tagalog has 20.4 percent, and Metro Manila and the Combined Southern Tagalog with 25.3 percent and 22.4 percent respectively. Laguna's slight edge over its immediate region in manufacturing may be attributed to the recent influx of modern manufacturing in the northwest lakeshore from San Pedro to Calamba. The tendency towards further industrial dispersal in the latter area has been highly favored by the recent (1977) completion of the four-lane Manila South Expressway to Calamba, with possible extension further south through San Pablo City, and the combined influence of other supply-side factors such as already existing large investments in public and private industrial estates, availability of skilled manpower, abundant supply of good quality fresh water, availability of agricultural raw materials and development of hydroelectric and geothermal power resources in the province.

The notion that the existing manufacturing mix will give rise to the tertiarization of employment has not yet been felt in the province, however, largely due to the pervading influence of Metro Manila on local consumption. Moreover, this observed trend is aggravated by the apparent weakness of the provincial pattern of central places, which is in turn affected by "overspill development" from the Metropolitan City. Consequently, the statistics show that tertiary or services employment comprises 41.7 percent which is way down below that of Metro Manila's 71.6 percent and that of combined Metro Manila and Southern Tagalog 57.5 percent. The surprisingly slightly higher percentage of employment in the services sector for the Rest of Southern Tagalog probably indicates a better tertiarization of activities in the island provinces' main servicing centers, which are far from the influence of Metro Manila's overspill development, than in Laguna province *per se.*

Growth of Employment by Major and Minor Industry

The analyses of the past growth in employment in the province have made use of the 1970 and 1975 census data, summarized in Table 5.

The conclusions that may be drawn from this table are:

i) The relative weakness of Laguna's economy during the period 1970-1975 was highlighted by the fact that the province lagged behind in growth of employment with that of Rest of Southern Tagalog and Metro Manila.

ii) Metro Manila remained the undisputed economic "growth achiever" as reflected in its very high rates of growth in employment in all three major economic sectors. However, its surprisingly high average growth rate in the primary sector (notably agricultural production and services) may be largely attributed to the creation of the Metropolitan Manila Commission, which enlarged the metro area's agricultural land resulting from annexation of some thirteen municipalities.[19] This same reason probably also applies to Metro

[19]Refer to Malacañang Palace (1975) Presidential Decree No. 879 (Manila).

Table 5

Growth of Employment by Major and Minor Industry in Laguna, Rest of Southern Tagalog and Metro Manila (1970 = 100 percent)

Industry	*Laguna*	*Rest of Southern Tagalog*	*Metro Manila*	*Combined Southern Tagalog and Metro Manila*
Primary:	*$$ = ./*	*117.3*	*579.0*	*121.1*
— Agricultural production & services	111.8	113.2	434.0	114.9
— Hunting, trapping and game propagation	116.0	328.8	*	388.9
— Forestry and Logging	79.3	75.0	200.1	82.4
— Fishing	130.3	167.7	956.5	179.3
— Coal mining	—	164.0	*	332.8
— Crude petroleum and natural gas	—	185.9	288.8	227.8
— Metal ore mining	113.0	161.6	456.1	189.3
— Other mining	158.8	96.3	1151.8	136.3
Secondary:	*107.5*	*127.1*	*472.0*	*187.0*
— Food manufacturers	129.5	168.8	641.6	232.6
— Beverages	135.0	155.5	359.9	221.8
— Tobacco products	142.5	136.4	526.1	213.8
— Textiles	62.1	114.4	1168.7	184.9
— Footwear, other wearing apparel and made up textile goods	81.1	87.3	302.1	119.6
— Wood and cork products except furniture and fixtures	172.0	191.3	835.0	181.7
— Furniture and fixtures	104.3	120.9	351.6	181.3
— Paper and paper products	92.4	196.8	591.7	260.0
— Printing, publishing and allied industries	50.3	173.0	354.8	237.3
— Leather and leather products except footwear and other wearing apparel	141.6	315.1	2571.6	531.8
— Rubber products	623.3	224.6	225.4	434.5
— Chemical and chemical products	177.1	215.8	768.7	349.9
— Products of petroleum and coal	88.3	143.7	444.9	200.8
— Other non-metallic products	72.2	171.7	658.4	281.3
— Basic metal industries	160.6	182.1	749.7	305.0
— Metal producs except machinery and transport equipment	72.2	171.7	658.4	281.3
— Machinery except electrical machinery	78.0	102.5	248.5	142.7
— Electrical machinery, apparatus, appliances and supplies	52.7	96.7	273.5	343.0
— Transport equipment	219.1	218.7	565.9	320.0
— Miscellaneous	601.5	350.1	864.5	484.5
Services:	*114.4*	*126.7*	*363.7*	*182.4*
— Electricity, gas, water, and sanitary supplies	102.6	119.4	493.6	192.1
— Construction	115.6	114.0	420.5	168.5
— Commerce	115.5	142.1	351.1	194.3
— Transport, communication & storage	102.5	114.8	300.3	160.8
— Public and private services	117.6	126.6	373.9	185.8
Industry inadequately described	68.9	99.6	167.9	112.3
TOTAL	119.9	123.2	383.8	165.1

Source of Basic Data: NCSO (1970 and 1975) Integrated Census of the Population and Its Economic Activities * No 1970 data.

Manila's high growth rates in the manufacturing and services sectors.

iii) The province achieved relatively high rate of growth in certain activities over that of its immediate region. These are mining (mostly quarrying which has high demand in infrastructural and building construction) and certain manufacturing like rubber products, tobacco products and miscellaneous manufacturing. But, on the whole, the analyses show that Laguna's economic structure during the period was simply less "growth-oriented" as compared to its immediate larger region, i.e. Rest of Southern Tagalog and Metro Manila.

Employment Location Quotient Analyses

To estimate more precisely the degree of economic specialization in the province, a statistical device called location quotient (L.Q.)[20] was used. The L.Q. for a particular activity (employment category) is derived by dividing the proportion of the total employed in a particular activity in Laguna by the proportion of the same activity in the larger region (this case combined Southern Tagalog and Metro Manila). The L.Q. measures the relative importance of an area's economic activity with regard to another area's similar activity. For example, if Laguna's activity X constitutes 20 percent of the provincial total employment compared with the combined Southern Tagalog's/ Metro Manila's 15 percent, then the L.Q. in activity X in the province relative to its larger economic region is 1.3—i.e. it is one and one-third as important or specialized in terms of employment. In an area economic base study, the L.Q. index also indicates whether a particular activity is "basic" or "income-producing" (i.e., L.Q. of more than 1 or higher the better) or "non-basic" or "income absorbing" (i.e. L.Q. of less than 1).[21] The idea in such study is to divide the local area's economy into basic and non-basic activity (or employment) components, and then derive a basic to non-basic ratio as basis for analysis.

The results of the analyses of the L.Q. for the province and its immediate larger economic region is summarized in Table 6. The main conclusions and implications to be drawn from these are as follows:

i) The relative importance of the primary sector in Laguna is highlighted by its higher L.Q. of 1.85 as compared to the same activity for the Rest of Southern Tagalog with L.Q. of 1.52 and for Metro Manila with L.Q. of only 0.11. In particular the province is specialized in agricultural production and services, forestry and logging, fishing and other mining (quarrying). The province may capitalize on this specialized advantage by modernizing particularly agriculture (e.g. through truck gardening and intensive cropping and poultry and piggery) and fishery (e.g. through aqua-culture technology), with their products geared to the local and expanding Metro Manila markets. However, as the long-range viability of these activities depends greatly on proper conservation of prime agricultural lands and lake resources, it will be necessary for the province to adopt guided or planned development approach. An alternative two-pronged approach involving intensive agricultural and tourism development in the southeast lakeshore and southwest interior part of the province, and "corridor-type" development of the northwest lakeshore to San Pablo City

[20]See, for example, Isard, W. (1976). *Methods of Regional Analysis; An Introduction to Regional Science* (Cambridge: The MIT Press), pp. 123-126; also Dunning, J.H. and Morgan, V.E. (1971). *An Economic Study of the City of London,* (London: George, Allen J. Unwin Ltd.), pp. 76-80.

[21]Other relevant references are: Thompson, W.R. (1968). "Internal and External Factors in the Development of Urban Economics." *Issues in Urban Economics,* edited by Perloff, HS. and Wingo, L., Jr. (Baltimore: The John Hopskins Press for the Resources for the Future), pp. 43-62; Tiebout, C.M. (1962), The Community Economic Base Study (New York: Community for Economic Development); and Krueckeberg, D.A. and Silvers, A.L. (1974). *Urban Planning Analysis: Methods and Models* (New York: John Wiley and Sons, Inc.), pp. 396-406.

Table 6

Employment Location Quotient by Major and Minor Industry in Laguna Province, Rest of Southern Tagalog and National Capital Region (Metro Manila)

Sector/Industry	Laguna		Rest of Southern Tagalog		National Capital Region	
	L.Q.	Rank	L.Q.	Rank	L.Q.	Rank
Primary:	*1.85*	*(1)*	*1.51*	*(1)*	*0.11*	*(3)*
— Agricultural production and services	1.93	(2)	1.55	(1)	0.06	(28)
— Hunting, trapping and game propagation	1.0	(10)	1.0	(7)	1.0	(19)
— Forestry and Logging	1.85	(3)	1.35	(4)	0.35	(25)
— Fishing	1.45	(6)	1.39	(3)	0.36	(26)
— Coal mining	—	—	1.0	(7)	1.0	(19)
— Crude petroleum and natural gas production	—	—	1.0	(7)	1.5	(2)
— Metal ore mining	0.01	(26)	1.4	(2)	0.6	(24)
— Other mining	1.79	(4)	1.12	(6)	0.41	(25)
Secondary:	*0.97*	*(2)*	*0.88*	*(2)*	*1.18*	*(2)*
— Food manufacturers	1.66	(5)	0.82	(18)	1.03	(17)
— Beverages	0.88	(12)	0.73	(22)	1.42	(5)
— Tobacco products	0.21	(26)	0.88	(14)	1.27	(10)
— Textiles	0.53	(19)	0.92	(10)	1.18	(13)
— Footwear, other wearing apparels and made up textile goods	1.35	(7)	0.95	(8)	1.02	(18)
— Wood and cork products excluding furnitures	3.25	(1)	0.93	(9)	0.75	(23)
— Furnitures and fixtures	0.38	(22)	0.82	(18)	1.34	(8)
— Paper and paper products	1.17	(8)	0.80	(20)	1.23	(11)
— Printing, publishing and allied industries	0.21	(26)	0.73	(22)	1.53	(1)
— Leather and leather products excluding footwear and other wearing apparels	0.67	(17)	0.89	(13)	1.44	(3)
— Rubber products	0.84	(14)	0.82	(18)	1.32	(9)
— Chemical and chemical products	0.47	(2)	0.78	(21)	1.40	(6)
— Products of petroleum and coal	0.30	(23)	0.90	(12)	1.10	(16)
— Non-metallic mineral products	0.60	(19)	0.93	(9)	1.18	(13)
— Basic metal industries	0.23	(24)	0.81	(19)	0.81	(21)
— Metal products except machinery and transport equipment	0.22	(25)	0.78	(21)	1.43	(4)
— Machinery except electrical machinery	0.44	(21)	0.78	(15)	1.29	(9)
— Electrical machinery apparatus, appliances and supplies	0.35	(22)	0.81	(19)	1.38	(7)
— Transport equipment	0.61	(18)	0.78	(20)	0.80	(22)
— Miscellaneous manufactures	1.13	(9)	0.91	(11)	1.11	(15)
Tertiary:	*0.73*	*(3)*	*0.86*	*(3)*	*1.24*	*(1)*
— Electricity, gas, water and sanitary supplies	0.72	(16)	0.81	(19)	1.34	(8)
— Construction	0.85	(13)	0.91	(11)	1.16	(14)
— Commerce	0.92	(11)	0.86	(16)	1.22	(12)
— Transport, communication, and storage	10.75	(15)	0.81	(15)	1.23	(1)
— Public and private services	0.61	(18)	0.85	(17)	1.27	(10)

Basic Course of Data: NCSO (1975) Integrated Census of the Population and Its Economic Activities, Laguna.

to take advantage of the area's immediate proximity to Manila and existing improved interregional highway and railway networks, may be explored. This two-pronged approach, which is illustrated in the map, will boost agricultural and fishery production and, at the same time, also promote intensive tourism, strengthen central place functions of selected "growth corridor" town centers, and provide for more orderly conversion of agricultural lands into urban/industrial land uses particularly in the northwest lakeshore.

ii) The province is also more specialized than either the Rest of Southern Tagalog or Metro Manila in certain lines of manufacturing notably food manufacturing, footwear and other wearing apparel and made-up textile goods, wood and cork products except furniture and fixtures, and miscellaneous manufactures. It is worthwhile to note that wood and cork products are more than three times as important in terms of employment in the province as compared to the Rest of Southern Tagalog and Metro Manila.

iii) Overall, the findings in this analysis appear illuminating, First, it is clear that the province in relation to its larger economic region depends largely on primary activities and certain lines of manufacturing activities that are directly or indirectly related to the primary activities. If the province intends to capitalize on its specialized advantage it will have to adopt measures such as guided or planned development of agricultural land and lake resources. Second, to the extent that the L.Q. index tells whether an activity is "export or income producing" or "income-absorbing", it may be estimated that, about half of the province's employment in 1975 was used to produce goods and services for export outside the area. This means that the provincial economic growth for the period was determined to the extent of about 50 percent by forces outside the area. Applying the same notion for the larger region, the economic growth of the Rest of Southern Tagalog for the same period was determined 32 percent by forces outside the region, for Metro Manila by over 58 percent.

Coefficient of Localization Analysis

To complement the L.Q. measure, a coefficient of localization (C.L.) was derived from data on employment and establishments to determine the extent to which employment in particular activities (or establishments) is concentrated or dispersed over the province.[22] In the analysis, the C.L. was derived in two ways:

i) Using provincial employment data: By getting the difference (positive or negative) between the percentage share of the province in employment in a particular activity and that of its share in employment in the combined Southern Tagalog and Metro Manila, and then dividing this difference by 100.

ii) Using data on establishments by Municipalities: By adding together all the positive (or negative) differences between the percentage share of individual municipality's particular establishments and that of its share of establishments in Laguna as a whole, and then dividing the result by 100.

The results from the foregoing analyses slightly differed from each other, but both generally confirmed the previous findings that primary activities (notably agricultural production and services, forestry and logging, other mining and fishing), and certain lines of manufacturing such as wood and cork products, food manufactures, paper and paper products and miscellaneous manufactures, among others, are the most concentrated activities or employment in the province. However, the coefficients derived for these employment (or activities) appear to be uniformly low (C.L. index of around 0.05 to 0.21). Overall, the possible conclusions that may be drawn from this is that the province's employment or activities in relation to the larger region of which it forms a part are more evenly dispersed rather than concen-

[22]For applications of the Coefficient of Localization Technique refer to Isard, W. *op. cit.*, pp. 249-254, and Dunning, N.H. and Morgan, V.E. *op. cit.*, pp. 76-80.

trated. Perhaps Laguna could benefit from government economic dispersal efforts, but it will require identifying and developing best sites or town centers as future reception areas for dispersing population and economic activities in the province.

With regard to the latter determination of the extent to which particular business establishments are spatially concentrated or dispersed, the findings appear to be more illuminating. Larger establishments forming roughly 2.4 percent of provincial total, and comprising mostly new non-agribased industry-mix (e.g. beverages, paper and paper products, printing, publishing and allied industries, leather and leather products, machinery products, transport equipment and miscellaneous manufacturing), have uniformly high C.L. index of 0.42 to 0.45, indicating a greater tendency of larger firms to be concentrated than smaller firms. There are two aspects behind this pattern: First, is that some advantages are apparently gained by larger firms (e.g. external economies of scale) in a concentrated location. The other is that since these larger establishments are apparently mainly export-oriented, they require a more central location (such as in the northwest lakeshore) than the smaller firms (e.g. small scale, cottage-type industries), which cater to more limited local or export demand. Again, this suggests the possible viability and feasibility of identifying and developing selected town or "growth corridor" centers to allow these centers to achieve economic size to serve as effective reception areas for dispersing population and economic activities from the Metropolitan City.

SOME FACTORS LIKELY TO INFLUENCE FUTURE SPATIO-ECONOMIC GROWTH OF THE PROVINCE

As may be gleaned from the earlier historical perspectives, natural geographic forces and space or distance *per se* appeared to have influenced the spatio-economic transformation of the province. Natural geographic forces *per se* influenced not only the activities or types of goods produced by the early natives, but also the supply and demand of goods and services derived from these activities. During the early period of colonization of the province, the Spaniards discovered that the native population was already engaged in production activities most suited to the lake area like boating, fishing and lowland rice farming. In the case of the latter, moreover, a system was developed for sharing the harvest between the land-owning class of "datus" and their families and the free-born land tillers or "maharlikas."

On the other hand, space or distance affected activities or types of goods produced in more basic ways than that reflected by the natural predisposition of the natives to suit their production to their environment. But, more so, it influences the spatial distribution of population and the hierarchical settlement patterns of "servicing town centers." This pattern of settlements or town centers has bearing on the type of goods and services produced and consumed by the population in the given area or town centers. For example, in rural servicing town centers, activities related to agricultural marketing and provision of needed inputs to boost agricultural production will tend to be emphasized. In the larger center, the same patterning of production and consumption activities occur but the emphasis is towards tertiary services and higher urban amenities.

In looking at some of the factors likely to influence the future shape of the province, the following factors are given emphasis:

1. *Industrial location factors.* The author did a survey of industrial location factors in the province with the assistance of his graduate class on Regional Location Theory at the Institute of Environmental Planning during the First Semester of School Year, 1979-1980, and came up with the following findings:[23]

   i) Of the 37 manufacturing firms interviewed through purposive sampling, 21.6 percent were engaged in food manufacturing: 10.8 percent each engaged in textile, footwear and wearing apparel, pulp and paper products,

[23]This study served as a practicum for the students and covered primarily manufacturing firms that have located in the province from 1970 to 1979, when the rapid influx of non-agribased manufacturing firms in the province was observed. The study sought what factors motivated firms in their decision to locate in the province and what were their experience in their present location. Main respondents were firm managers or senior officials.

chemicals and chemical products, and miscellaneous products; 8.1 percent engaged in metal products; and the rest were engaged in beverages, tobacco, rubber and plastic products, petroleum products, ceramic products and electrical and automotive products. Sixty percent of the firms were totally Filipino owned, 11 percent, completely foreign-owned, and the rest represented joint ventures between Filipinos and foreigners. Capitalization of the firms ranged from ₱61-70 million (8.0 percent) to below ₱1.0 million (28.0 percent). The rest consisting of 64.0 percent of the firms had capitalization within the range of ₱1.0-10.0 million. All firms sold to both domestic and foreign markets. Over 60 percent of firms derived their raw materials from sources within the province, while the rest depended on foreign sources for their raw materials.

ii) A summary of location factors considered of primary importance by the respondent firms reveals that of the 21 location factors mentioned, those with the highest responses are as follows: low cost of labor (45.9 percent); availability of sufficient water supply (43.2 percent); good transportation (37.8 percent); availability of reasonably priced industrial sites (32.4 percent); and firms' response to Presidential ban on further industrial expansion within 50 kms. radius from the City of Manila (32.4 percent).[24] The remaining factors in the descending order of their importance are: relative ease in disposing factory wastes, area's economic growth potential, proximity to a large market, pleasant living conditions, low-cost raw materials, skilled and semi-skilled labor, existing industry-mix, low freight cost, tax incentives, agencies' recommended area, local development plans, readily available capital/credit, local concessions, less competition, access to technical/consultant advice, and existence of adequate community facilities, services and amenities. The 21 choices are ranked from 1 to 12 depending on number of responses given to each choice. It was noted that the government policies were given a relatiely low weight considering that tax incentives and area recommended by government agencies as factors both only ranked 11. However, the policy on the 50 km. ban was considered of high importance, placing fifty among the factors mentioned.

Seventy-five percent of the firms from the industry sector involving footwear/wearing apparel and miscellaneous products considered low cost of labor as a factor of primary importance. All the firms in the paper products and pulp industry found the availability of sufficient water supply of primary importance. For chemicals, petroleum and rubber and plastic products, over 57 percent considered availability of sufficient water supply, good transportation and proximity to large and existing potential markets as important location criteria for industry site selection. It was also in this industry group where response to the ban on industries to locate outside 50 km. radius of Manila was strongly indicated.

iii) Based on the firms' experience in their present location, 71 percent of all firms considered Laguna's water supply an advantage; 51 percent found it a major advantage. On the other hand, 60 percent of the total number of firms considered the telephone services a disadvantage, while 48 percent considered it a major disadvantage.

All the firms manufacturing pulp and paper products considered water supply a major advantage. Also, 80 percent of firms manufacturing chemicals/chemical products and 71 percent of the food manufacturing firms considered this factor a major advantage. Seventy-one percent of food manufacturing

[24]The Presidential ban on further industrial expansion within 50 kms. radius of the city of Manila is contained in a Presidential Memorandum Circular issued in 1973 to promote dispersal of industries throughout the Philippines. It was observed that while the implicit intent was to effect wider regional industrial dispersal, the ban tended to influence location or proliferation of firms just beyond the 50 kms. radius or, in any case, chose enough from Metro Manila. Moreover, due to many exemptions given to special firms considered of strategic economic importance, the ban became difficult to implement and later on lost its effectivity.

firms and 66 percent of the firms manufacturing footwear and wearing apparel considered the state of telephone services a major disadvantage. Twenty-eight percent of all firms considered the land cost and/or rent a minor advantage. From this it can be inferred that the firms found land cost/rent reasonable if not low. On the other hand, 25.7 percent of all firms considered the transport cost for finished products a minor disadvantage. Lastly, it is interesting to note that a high percentage of firms (65.7 percent) took a neutral stand on the matter of access to readily available capital/credit, and 54.3 percent took a similar stand with respect to access to business services and consultancy advice.

As a conclusion to this analysis, it is evident that the factors that influenced firms and industries to locate in the province are certain practical considerations which have a direct bearing on their operations. Needless to say, these factors must allow and sustain the smooth operation of industries at a low cost. Worth emphasizing are the ten location factors which were considered of major advantage to firms such as, in descending order of importance, water supply, power supply and land cost/rent (both second rank), transport costs for raw materials, labor cost and ease of disposing sewage/solid wastes (both fourth rank), transport cost of finished products, availability of skilled manpower, community living condition and housing facilities, house rents and secondary level educational facilities and telephone services (all in eighth rank), diversified supporting industries and education facilities at elementary level (both in ninth rank), and education facilities at the collegiate level.

It is also to be noted that government policies such as tax incentives were seen by respondents as factors of low importance and, therefore, could not really induce wider dispersal of industries in the regions. This implies that industries have a rather natural way of finding location sites and that government policy regarding their dispersal may not be seen as wise or acceptable and, may even be avoided by industries unless the designated area or region for such dispersal already meets locational requirements considered of major importance to the individual industries. Hence, it is wise for government to consider the capabilities of the place or region to provide for the needs of the industries in formulating its policies on industrial dispersal.

2. *Supply-Side Factors.* Mainly based on the supply-side, the factors that will likely influence the future shape of the province are the following, among others:

i) Land and Water Resources. These factors will likely continue to be among the most significant developmental assets of the province for the following reasons: First, whereas the total provincial area of roughly 176 thousand hectares represents a mere 0.6 percent of the national total, its location adjacent to the 90,000-hectare Laguna de Bay (largest fresh water lake in the country) and immediate proximity to Metro Manila makes the province prime area for intensive agricultural and fishery production and tourism as well as major reception area for dispersing population and industries from the Metropolitan City. Secondly, with regard to the first primary sector development option, existing favorable soils and climatic conditions, presence of improved transport and agricultural infrastructures, and proximity to large Metro Manila markets are making full-scale provincial agro-modernization feasible and advisable. Such agro-modernization may eventually take the form of a shift in the existing cropping systems (of lowland rice, sugar cane and annual crops in the lakeshore plain area, and coconut and fruit trees in the upland areas) towards high value crops including horticultural and ornamental plants and intensive livestock and poultry. On the other hand, fishery in the lake is already being gradually modernized through the introduction of fish pens and fish cages and related fresh water aqua-culture technology and the proposed zoning of the lake. Intensive tourism based on properly selected potential sites like the Los Baños and Pagsanjan areas and the existing small-scale, cottage-type industries will serve to complement agro-fishery modernization under this primary sector development option.

Thirdly, the present proliferation of industries and housing subdivisions in

the northwest lakeshore would probably be difficult and may, for economic reasons, be unwise to totally control, but their impacts on the environment especially on the lake water quality may be minimized. This aspect of the provincial spatio-economic growth and development has not been properly dealt with even with the existence of the Laguna Lake Development Authority and related national agencies which have interest and function for the lake preservation. An alternative development option which has been discussed in the earlier section calls for the adoption of planned "corridor-type" development in the northwest lakeshore while, at the same time, retaining the primary sectoral development option in the southeast and southwest interior part of the province. This development option provides a better alternative to the "ribbon-type" development presently occurring in the northwest lakeshore in terms of the following: First, it will strengthen the central place functions of already identified town centers in the area like Biñan and Calamba. The principle underlying this development option is that these towns will be developed as part of the provincial network of interrelated production activity and service centers linked to each other and with the outside area by the existing main arterial system. The specific activities or servicing functions to be pursued by each center need not be the same, but rather they may vary depending on needs and potentials of each area and should complement instead of pose conflict with one another. Second, the alternative development option will provide for more orderly conversion of agricultural and open lands into urban/industrial land uses through adoption of land use plans and land use regulatory measures. The relevant concept here is that, instead of the ribbon-type development as is the present development pattern, the prime agricultural lands between the selected "corridor town centers" will be conserved as far as possible for intensive agricultural production through land development density regulation and site development planning. Lastly, the alternative development option will encourage and promote selected "corridor town centers" to expand their population to sufficient size to allow for internal/external economies to be achieved in the provision of basic community services and amenities as well as employment opportunities.

ii) Labor Supply. In the 1980 census, the province's total population was 973 thousand representing around 21 percent increase over the 1975 population. The 1980 labor force population (by definition, population 15 years old and over) comprised around 555 thousand or 57 percent of the provincial total. This figure is expected to reach over 1.07 million out of a projected total of 1.87 million people by the year 2000, giving a labor force increment of over half a million to be provided additional employment and community facilities, services and amenities. Of the total labor force figures, the economically active was estimated at around 412.9 thousand in 1980 and 778.8 thousand by the end of this century. If the latter total labor force figures could not all be provided with employment opportunities and services within the area (e.g. due to criss-crossing of workers between the area and nearby province and Metro Manila), its implication appears tremendous. It means that a total labor force in the order of magnitude of close to 92.5 thousand (15-19 age group) will need to be provided with juvenile employment opportunities; 246.6 thousand (age group 20-29) will probably be starting their own families and seeking more stable occupations; about 414.2 thousand (age group 30-64) are probably secure in their jobs; and the remaining 25.5 thousand (age group 65 and over) are probably retiring or retired and will demand social welfare services.

Based mainly on past trends, over 524 thousand (67.3 percent) of the projected economically active labor force are expected to concentrate in the northwest lakeshore and San Pablo City areas, and the rest in the southeast

lakeshore and southwest interior upland areas.

In treating labor supply as a factor on the supply side, it is not only the size but, more importantly, the skills and level of education of the labor force that are crucial. As earlier discussed, one of the factors considered of major importance by industrial firms which have located in the province relates to labor skills and labor cost and productivity. This confirms the province's high literacy rate (over 90 percent compared to the national average of only 83 percent) as well as varied skills of its labor force. Among several ways the census characterizes manpower skills, the categorization of the economically active labor force by occupational work experience is highly relevant. By this categorization, it may be deduced that primary occupational skills are still possessed by a sizeable (over 36 percent) proportion of economically active labor force which seems to suit well the agro-fishery modernization scheme suggested earlier. The other major skills possessed by the economically active labor force relate, in the order of importance, to the occupational category of craftsmen and production process workers (23 percent of economically active labor force having these skills); sales workers (11.5 percent); professional, technical and administrative/management workers (nearly 8 percent); clerical workers (over 4 percent); and the rest of transport, communication and freight workers category.

On the other hand, in terms of highest educational attainment of the provincial population (7 years old and over) in general around 5.8 percent are degree holders, about 8.0 percent have one year or more of college schooling, over 30 percent have high school education, and nearly 55.6 percent have elementary education. The major conclusion that may be drawn from this data is that, whereas the provincial literacy rate is relatively high, there is still much scope for improving the educational level of the population to boost future development efforts of the province. The opportunity for this appears bright, however, due to existing investment in educational facilities at the tertiary and technical/vocational levels. The present concentration of these facilities coincides with the earlier identified hierarchy of town centers. The expanding educational role of centers like Biñan, Calamba, San Pablo City, Los Baños, Sta. Cruz and Siniloan was moreover specially noted. These centers provide not only formal collegiate education but also middle-level skills training required for both urban/industrial and agricultural/fishery development. The Los Baños campus of the University of the Philippines System and specialized international agricultural research complexes and a government School of Fisheries located in the area lead in the latter development field. On the other hand, a public agricultural school located in Siniloan plays a minor but nevertheless significant role in agricultural education in the southeast lakeshore. The varied higher educational and technical/vocational facilities offered at Biñan, Calamba and San Pablo City augur well for the realization of the "corridor-type" development option earlier proposed in the northwest lakeshore and San Pablo City area.

iii) Improved Transport. As noted earlier this factor has played and will continue to play a vital role in shaping the future growth and development of the province. Of significance are the expansion in 1977 of the Manila South Expressway from Alabang, Muntinglupa to Calamba, and the completion of the main lakeshore road connecting Calamba with the southeast lakeshore areas and Rizal province. The former transport network emphasizes fast movement of traffic (limited access), while the latter emphasizes direct transport access to town centers and agricultural/fishery production areas. Needless to say, the already existing investment in improved land transport in the area (including initial extension of commuter rail service from Manila to Los Baños) are factors that can not be ignored in the future growth and development of the province. As these

are already permanent features of the land, they will continue to influence land uses as well as intensify the provincial urban settlement patterns.

iv) Power Supply. The province has been favored, moreover, with hydroelectric and geothermal energy resources. To date, the only pumped hydroelectric or "hydrocycling" facilities in the country has been added to already existing hydroelectric plants in the Lumban-Kalayaan area in the southeast lakeshore. These hydroelectic facilities add power in the magnitude of over 300 MW to the Luzon power grid. When eventually completed the phased energy development plan for the area will generate over 1800 MW. Another major energy development is the MAKBAN geothermal power project in the town of Bay which presently generates power output of 110 MW. When eventually completed, this power project will generate 600 MW. Again, in conclusion, the power supply factor will likely influence the future shape of the province's development since investors consider it as an important location factor.

3. *The Influence of Metro Manila and the Larger Region.* On the demand side, the influence of Metro Manila and that of the larger region over the province's economic growth and development can not be ignored. Needless to say, they will influence the pattern of production and consumption in the province. The relevant parameters on which this influence may be assessed are the gross regional domestic product (GRDP) and gross value added (GVA).[25]

The 1980 figure on GRDP shows that Southern Tagalog accounts for ₱13,877 million (at 1972 prices) which roughly corresponds to 13.9 percent of the Gross National Product (GNP). Moreover, the Southern Tagalog GRDP represents a little less than one half of the Metro Manila's, but this nevertheless places the region second to the Metropolitan City in the national ranking. Southern Tagalog's GVA in 1980 amounted to ₱12,947 million at constant 1972 prices, composed of the following: agricultural sector—₱3,662 million or over 28 percent; industrial sector—₱4,924 million or 38 percent; and tertiary/service sector—₱4,360 million or 34 percent. Lack of provincial data relevant to these aggregate magnitudes prevents further in-depth analysis on this aspect. In conclusion, it may be said that both the aggregative GRDP or GVA and the movement of these parameters between periods will be vital to the economic growth as well as to the level of economic welfare in the province. Relatedly, the international economic situation will tend to affect the province since the area's growing industrial bases also cater to the international export markets and are influenced by them.

4. *Socio-Political Structure and Government Policies.* The local socio-political structure and local, regional and natioinal development policies will also affect the likely shape of the future spatio-economic development of the province. In particular, local official perception on development, and the actual translation of this perception in terms of targeted and implemented plans and programs will influence the likely future shape of the province. There are some indications that both provincial and municipal/city government are doing their best to enhance and advance development in their respective areas. These are manifested in their ongoing development plans and programs. However much they want to develop their areas, they are constrained by their limited local revenues. This prompted these local units to always seek, and eventually become overly dependent on, national grants and assistance. The latter are mostly not assured unless the local officials are politically strong with the national administration. Development planning, therefore, under this circumstance becomes a continuing challenge. Development plans without adequate backing of funds from the national government are bound to fail. Mobilization of private sector capital has often been thought of as a way out of local funding problems, but the exact mechanism for this has not yet been developed.

On the other hand, the province is quite fortunate, as earlier noted, that major power and transport projects have been planned and actually implemented in the area. These are positive points for the province. Moreover, these infrastructural improvements are

[25]See. NEDA (1980) Gross Regional Development Product Estimates.

seen by private investors as advantages to be tapped. In essence, these public investments have the effect of providing an atmosphere conducive to the flow of private capital to the province.

CONCLUSION: SOME FURTHER DIRECTIONS

Previous sections of this paper have focused on the main descriptors of Laguna's historical and spatio-economic transformation including the factors or forces underlying them. Of significance are some theoretical and empirical issues which the findings of the study (although still preliminary and rough) have brought into the open. These issues may be formulated in terms of the following questions: First, to what extent can we attribute the evolution of towns or the identified provincial sub-areas to the influence of natural geographic factors and the influence of space or distance per se or to both of these two forces? In particular, for example, what could have attributed to the final choice of Sta. Cruz as permanent provincial administrative capital, and how come the shift from the original capital (Pagsanjan) involved only a very short distance of less than 10 kilometers? (By observation, Sta. Cruz is highly centrally located in terms of its distance to Manila via the northwest and the southeast and northeast [Rizal Province portion] lakeshore road networks). There are other related questions that can be asked. In the southwest interior upland area, why did San Pablo City surpass Nagcarlan? Can the growth of San Pablo City be due primarily to its strategic location on the main interregional highway and railway networks linking Manila and the Southern Luzon Provinces? (By observation, Nagcarlan and Sta. Cruz figured rather prominently in the early evolution of the province's settlement system but both bowed down to San Pablo City even prior to the 1896 Philippine revolution). Also, can the growth of the northwest lakeshore be primarily the result of this area's immediate proximity to Manila? Can these two towns' spatio-economic prominence be the result of the hacienda agricultural economy and the oppressive sociopolitical system attendant to it?

Secondly, the northwest lakeshore and, for that matter, the province as a whole has been continuously influenced by recent suburbanization owing to its proximity to the Metropolitan City. There are certain dimensions to the spatio-economic problems which the area or province now faces. These are, among others: First, the ribbon-type development occurring in the area has attendant problems like congestion, high cost of extending public services and preemption of suitable land for future location of planned production and services. Secondly, if present suburbanization is allowed to go on unhampered possibilities are high that the whole northwest lakeshore and even the province as a whole will coalesce with, and be indistinguishable from, the Metropolitan City, and further aggravate the problems cited above.

Finally, in response to the present spatio-economic problems the province faces, the study suggested a scheme of planned or guided development which decision-makers may consider. The dimension of the issues pertaining to this development strategy transcend physical or economic considerations. The assumptions of the planned or guided development are all attractive enough. These are: First, a large percentage of the province's population will have the advantage of urban life without having to suffer the congestion and related disadvantages of the big city. Second, more efficient use of limited land resources will be encouraged by controlling the proliferation of substandard subdivisions ill-equipped with services or improperly located in relation to transport, employment and business commercial centers. Third, a more orderly conversion of agricultural and undeveloped lands will follow standard guidelines. Fourth, better protection and use of natural resources particularly prime farmlands, large fresh water lake, hot springs, tourist areas, geothermal energy resources, and dwindling forest stands and forest reserves will be attained. Lastly, more efficient and economic provision of employment opportunities and public transport, utilities and services will be achieved by encouraging more compact yet balanced urban centers rather than dispersed small centers. Evaluating how all these assumptions stand with respect to socially desired values and objectives will require further studies. □

AGRICULTURAL LAND USE PLANNING IN ABRA: AN APPLICATION OF THE ECO-ENGINEERING ANALYSIS OF LAND*

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Introduction

Planning the use of the land is crucial to a developing country like the Philippines which needs the space and resources of its land for accommodating its burgeoning population and for realizing its development goals. Prudent allocation and distribution even assumes more meaning and urgency if one considers lands as more or less fixed resources, hardly capable of expansion, growth in size or multiplication and, in some cases, are even irreplaceable—whether such lands are classified as forest, grazing area, mineral, swampland, water resources, open space or lands in populated places classified as agricultural, industrial, commercial, residential and resettlement.

Of the above uses of the land, planning for agricultural land use acquires one of the highest priorities, based on certain considerations. Firstly, the Philippines has an agricultural economy, with more than half of its population depending on agriculture and related activities for their livelihood. Maximizing the use of suitable land for agriculture will enhance the growth of the agricultural sector and consequently provide crops and livestock not only for consumption but for the market as well. The second rationale has to do with undesirable ecological effects like soil exhaustion, erosion, floods and the like that result from the pressure of increasing population on finite land. Amidst the growing scarcity of land, farm areas decrease in size, the sloping foothill and mountain areas are filled and, as a whole, farmers forcibly utilize different types of land, many of which are marginal in productivity.[1]

The above considerations have prompted the author to conduct a study on agricultural land use planning in relation to the limitations imposed by such aspects of the environment as *slope, soil, elevation* and *climate.* The author also noted the dearth of land use planning studies in the Philippines dealing particularly with the limitations imposed by these four factors on agriculture. There are also very few studies on the provincial, regional or national levels using the *overlay process* or *convergence approach* in constructing land suitability maps as part of general agricultural land use planning. The purpose of the present exercise, therefore, is to prepare a land use plan for general agriculture in the mountainous province of Abra in Region I based on the factors of slope, soil, elevation, climate and existing land use and using the *eco-engineering analysis of land* or the *overlay process* of constructing land suitability maps.

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*This paper is based on the author's masteral thesis in geography entitled "Agricultural Land Use Planning with Reference to Slope, Soil, Elevation and Climate," which was submitted to the then College of Arts and Sciences, University of the Philippines, in December, 1982.

[1]Telestoro W. Luna, Jr., "Land Resources Development in the Philippines," *Likas-Yaman* (Journal of the Natural Resources Management Forum), Vol. 1, No. 8 (1979), p. 19.

The Problem

Based on the introductory discussion above, the following questions may be asked in connection with the problem and design of the exercise. The questions are grouped into three phases which constitute what is called in the land use planning procedure as the *standard approach.*

Descriptive Phase

1. What are the physical geographic characteristics of the province of Abra in terms of slope, soil, elevation, climate and existing land use?

Appraisal Phase

2. How do the different physical geographic characteristics in combination affect the suitability of the land for agricultural utilization in the province?

Development Phase

3. How can lands in the province be planned properly for agricultural use based on their land use potential as revealed by comparing the land suitability and existing land use situation?

Significance of the Study

In addition to the reasons of provincial farm productivity enhancement and prevention of natural hazards cited earlier, a third significance of the study lies in the fact that the methodology based on the convergence area approach presented here can be easily adopted as there is no need for the researcher to gather ground truth information and considering that he can already work on the prepared topographic maps of the Bureau of Coast and Geodetic Survey as well as on inventory maps prepared by numerous government agencies. This graphic method, therefore, saves on money and time.

The fourth significance is that the study hopes to stress the importance of the physical geographic components of the environment by showing that although the physical environment does not fully control or determine human action, or economic development for that matter, it still circumscribes that action; that despite the freedom of the human will and the wide range of possibilities for courses of action, man still operates with varying success within the framework set up by the physical environment. This is readily apparent in places where the level of technology and scientific knowledge is law. There are also courses of action that man will most probably choose and others that he will discard, depending on their desirability or societal value and on his level of competence or stage of technology. If the physical environment offers several possibilities, it is likely that one will have advantages over the others which would make it a probable choice of action to be taken.[2]

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[2]The short discussion in this paragraph has reference to the dominant philosophical concepts in geography today, namely, *possibilism* and *probabilism.* Possibilism refers to the doctrine that "the physical environment is passive and man is the active agent free to choose between a wide range of possibilities in the environment." This doctrine was a reaction against the rigid doctrine of environmental or geographic determinism which views the physical, natural or geographic environment as rigidly controlling human action—an idea which pervaded the writings of Ellsworth Huntington and other determinists early in this century. This rigid doctrine encountered a strong intellectual backlash not only from other geographers but from other disciplines as well, thus forcing the geographers to formulate new ways of viewing the role of the geographic discipline in a world averse to all forms of determinism. Possibilism is one of the answers. After this came the doctrine of possibilism, another effort at formulating an enlightened approach to the intellectual position of geography. This concept states that "although the environment does not determine human action, it does make certain developments or patterns probable and others less likely." See Gordon B. Lewthwaite, "Environmentalism and Determinism: A Search for Clarification," *Annals of the Association of American Geographers,* Vol. 56, No. 1 (March, 1966), pp. 1-23.

Although some authors may still consider possibilism and probabilism as forms of neo-determinism, these still possess a considerable "ring of truth" and in the opinion of the writer are still valid and practical ideas especially as they are used as theoretical underpinnings in the present study. (See Emrys Jones, "Cause and Effect in Human Geography," *Annals of the Association of American Geographers,* Vol. XLVI, No. 4. (December, 1956), pp. 369-377.) The author subscribes to the rationalistic view that human will and intelligence can and must transcend the bind imposed by the physical environment, but if the present work has any purpose at all, it is to remind libertarian proponents that physical geographic factors do impose certain limiting effects, beyond which human designs on the land can only proceed at great economic and ecological risks under existing technological capabilities.

Conceptual Considerations

The aspect of land use planning cited above which involves the conduct of *land suitability* or *land capability*[3] studies aims to establish potential land use classes in a certain area. This involves what is called *land evaluation* or *land appraisal.*

Land appraisal is concerned with the assessment of land performance when utilized for certain specific purposes. As one geographer says,

> Land evaluation is the process of estimating the *potential* (italics mine) of the land for one use or several alternative uses. The potential may be given in qualitative terms, as degree of suitability for various forms of land use; in quantitative physical terms, for example, as predicted crop yields; or economic terms, expressed as gross or net cash output.[4]

Thus, in a more specific vein, the process or rational land use planning involves actually the procedure of land evaluation in terms of land potentiality, which the present exercise aims to do.

Land evaluation, as a part of land use planning, is premised on the recognition of the need for some changes in the way the land is being used, and in the case of the present study, in the way the land may be used for *agricultural* purposes. Land evaluation and/or land use planning may actually be classified either as special land use planning, or as multi-purpose evaluation, in which case land is assessed for, say, mineral, forestry, grazing, fishery, industrial/commercial, residential, and resettlement, aside from agricultural development.[5] The standard procedural approach to land use planning for agriculture or for other land use purposes consists of three phases and is the approach being used in the present study. The approach involves three phases: 1) description, 2) appraisal, and 3) development.[6]

The descriptive phase involves natural resource surveys or inventory of environmental aspects, particularly climate, soil, slope, elevation as well as current land use. The descriptive information gathered is passed on in the form of maps. In the second stage, i.e., the appraisal or the actual *evaluation phase,* the environmental data are combined with technological information such as agricultural methods and crop requirements, and the combined data are expressed as resource potential. Under this stage, where the bulk of the analysis is done, land suitability maps are produced. The third stage, or *development phase,* tries to formulate plans on how to convert the land potential into production, incorporating in the process social and economic factors.

Young describes further the standard approach in the phasing of agricultural land use planning:

> Most land-evaluation systems are based on the assumption that evaluation occupies a middle position in a sequence of operation, receiving an input of information about the physical environment and providing an output in the form of *advice* (italics mine) to those concerned with the economics and implementation of development. The three phases are more or less successive in time, and at the end of each part the information gathered *is passed on in the form of maps* (italics mine); for example, soil,

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[3] Many experts make a distinction between "land suitability" and "land capability." The former means "a statement of the adaptability of a given area for a specific kind of land use." The latter, which is used, for instance, by the Soil Conservation Service of the U.S. Dept. of Agriculture (Klingebiel and Montgomery, 1961) is viewed by some experts as "the inherent capacity of land to perform at a given level for a general use." See Food and Agricultural Organization, *A Framework for Land Evaluation,* Soils Bulletin, No. 32 (Rome: FAO, 1976), p. 16. Others consider the two terms synonymous, as is the more common practice; however, through-out the article the term land suitability will be used and more in the sense cited above. See Sir Dudley Stamp (ed.), *A Glossary of Geographical Terms* (2nd ed., rev.; London: Longman Group Limited, 1966), p. 290.

[4] Anthony Young, "Rural Land Evaluation," *Evaluating the Human Environment: Essays in Applied Geography,* ed. John A. Dawson and John C. Doornkamp [London: Edward Arnold (Publishers), Ltd., 1973], p. 5. Evaluation, it may be added, also involves assessment and classification of the land with respect to specified kinds of use such as mining, forestry, pasture, inland fishery, settlement or industrial/commercial site.

[5] *Ibid.*, pp. 21-23.

[6] *Ibid.*, p. 10.

landform, vegetation or land-systems maps at the conclusion of the resource survey phase; land-capability classification maps following evaluation; and development plans at the conclusion of the final phase.[7]

More concretely, the above sequence is carried out by the technique called eco-engineering analysis of land, which has been developed and articulated by Dr. Romeo C. Bruce in the Philippines.[8]

Non-physical determining factors, although beyond the scope of the study, must be mentioned as important considerations in the evaluation for land use planning and management. These non-physical determinants have been identified by one authority as the: 1) economic, 2) socially rooted, and 3) public interest determinants. In the first case, land use is seen as a consequence of the economic behavior of the individual land unit in the land market. In the second, land use is explicitly viewed as being influenced by the individual owner's behavior in response to such culture-bound phenomena as customs, traditions, norms, beliefs and values. In the third, land use is seen as being influenced by the demand of the public interest to safeguard and promote public health, safety, convenience, comfort, economy and amenity. All these factors affecting land use are also seen to be interactive or interlinked and the planning process should not fail to consider them.[9]

METHODOLOGY

Descriptive Phase

In carrying out the descriptive phase of the standard land use planning procedural approach using the eco-engineering analysis technique,[10] *inventory maps* were developed for slope, soil, elevation, climate and existing land use for the province (Fig. 1). The inventory maps for slope and elevation were prepared by copying the ranges or categories delineated or traced by the author on the topographic maps. The slope categories were particularly delineated on the topographic maps using the standard slope template prepared by the Ministry of Human Settlements.

The inventory maps for soil were first prepared from the soil survey maps published by the Bureau of Soils. The different soil classes on the map based on soil series, type and phase were then given their equivalent solum depths and clay-silt fractions based on an equivalent chart.[11] The inventory maps for precipitation were traced from the rainfall map prepared by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and was purposely not made elaborate as the land use intended was only for general agriculture. Since there are no extremely cold highland climates in the province, it is assumed that the climatic types occurring can grow all the important or desired crops in the country. The existing general land use map was derived from the latest map (1978) of the Bureau of Soils. In the reduction of the Bureau of Soils map and in the enlargement of the PAGASA map, a manual pantograph was used.

It must be mentioned that before the descriptive phase was carried out in terms of producing the inventory maps, a literature survey was made on how land uses are categorized as well as what scales are used in completed inventory maps that are available. The first to be surveyed were some land use delineations done outside the Philippines, followed next by the scales used in large-scale land use planning, and lastly by land use delineations in the Philippines.

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[7] *Ibid.*

[8] Romeo C. Bruce, "Eco-Engineering Analysis of Land," a handout prepared for the Training Center for Applied Geodesy and Photogrammetry, College of Engineering, University of the Philippines System, Quezon City, 1979. See also Romeo Bruce, "Eco-Engineering Analysis for Land-Use Planning," *Philippine Planning Journal*, Vol. XIII, No. 2 (April, 1982), pp. 53-64.

[9] F. Stuart Chapin, Jr., *Urban Land Use Planning* (2nd ed.; Ill.: University of Illinois Press, 1972), pp. 62-68.

[10] Romeo C. Bruce, "Soil Map of the Philippines Based on Depth of Solum and Clay-Silt Fraction of Surface Soil," Paper presented to the 4th ASEAN Soil Conference, February 12-24, 1979, Manila, pp. 1, 7-8.

[11] *Ibid.*

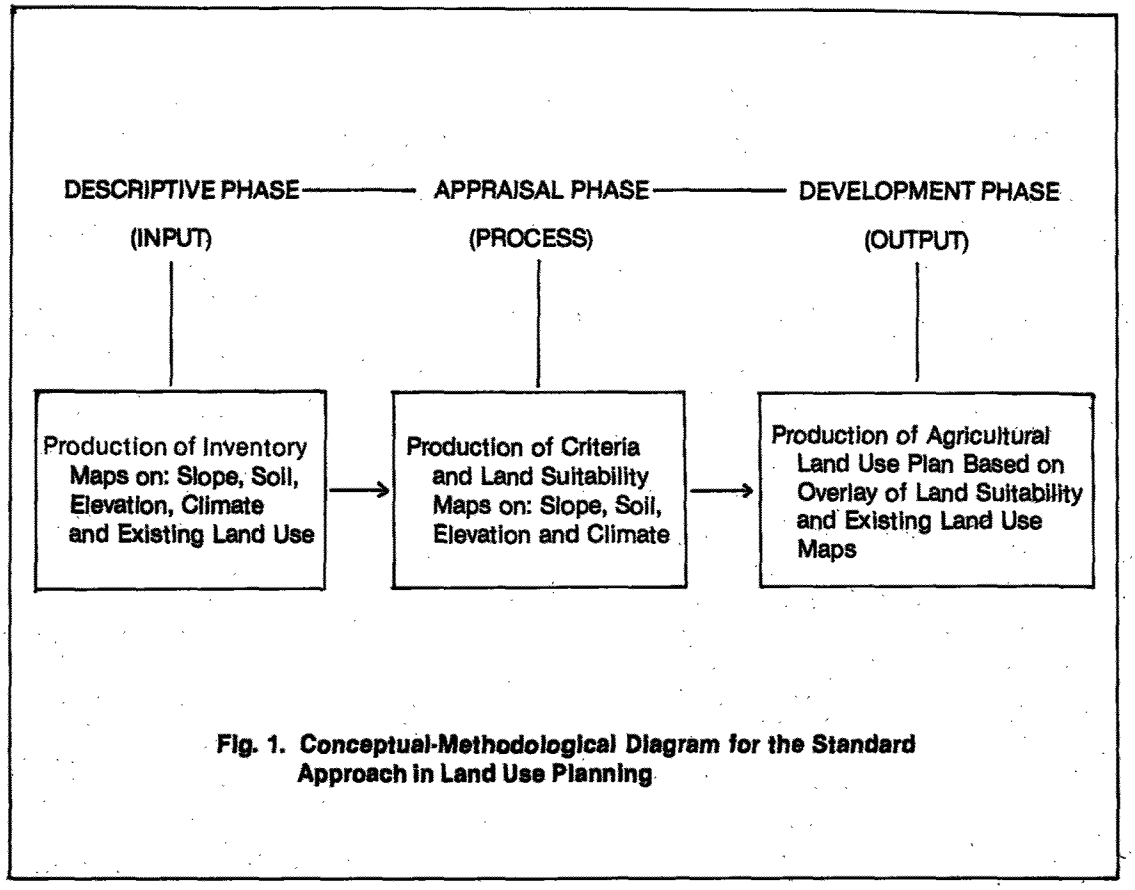

Fig. 1. Conceptual-Methodological Diagram for the Standard Approach in Land Use Planning

Appraisal Phase

A series of criteria maps were prepared from the inventory maps, in which the characteristics of the natural phenomena and the processes interacting with human use are now shown. These criteria maps which were prepared for all the four infuencing factors constitute the working maps which were executed on transparent Mylar tracing paper.

The criteria map for slope delineated in vertical lines the portion suitable for general agriculture, i.e., from 0 to 15 percent. The criteria map for soil indicated in northwest-southeast diagonal lines the areas suitable for agriculture, i.e., the B2, B3, B4, C2, C3, C4 soil mapping units. The criteria maps for elevation showed in horizontal lines the agriculturally suitable areas ranging from 0 to 500 meters.

The final phase of Bruce's eco-engineering analysis of land use is the synthesis of the data from inventory maps onto what is called the land suitability map, a composite map containing data to be used for the second phase appraisal in land use planning. The making of the *composite suitability map* for each of the four categories involves what is termed the convergence area approach, wherein the criteria maps are superimposed over one another on the light table to determine the areas of convergence of the agriculturally suitable categories. The convergence areas based on the four physical criteria constitute areas of prime suitability for general agriculture. Less suitable areas selected by a convergence of less than four categories are also indicated.

Development Phase

This phase involves the overlay process again using the land suitability map and the existing land use map, the latter having been prepared from recent detailed land use maps furnished by the Bureau of Soils and the Ministry of Human Settlements. The resulting

map is an agricultural land use plan that recommends areas available for agriculture as well as for other uses like forestry, settlement, fishery, and the like. The northeast-southwest diagonal lines of the existing land use map denote the agricultural lands and when superimposed with the land suitability map will reveal the areas which are agriculturally suitable and cultivated.

To get the approximate total area of the portions either recommended or identified for different land uses, a dot grid transparency with three-millimeter intervals was used.

For the appraisal and development phase, prior to the production of the land suitability maps and the agricultural land use plans, other systems of categorizing particular land suitability were examined such as those of the US Department of Agriculture, the British and the local Bureau of Soils. The USDA and the Bureau of Soils systems which share much similarity are closer to the land suitability categories used in the present study but they somewhat differ in that the two use such criteria as slope, soil type and degree of erosion while the study uses slope, soil depth and clay-silt fraction, elevation and climate. The British system was the least useful in the study. It was also discovered that of the land use studies surveyed, the multi-purpose evaluation system of the Canada Land Inventory project was closest to the study in its use of the map overlay process at the 1:250,000 scale.

Alternative Techniques

It is worth mentioning that the results of the eco-engineering analysis may also be corroborated by two related, but by no means simple and cheap land capability analysis techniques, and these are the *sieve analysis* and the *threshold analysis.*[12] The sieve analysis bears close similarity to the eco-engineering analysis in the sense that map overlays are still used, but instead of focusing on the suitable portions of the land, the development constraints are emphasized. Tones or shades representing grades of values are indicated on transparent paper and the criteria maps, when viewed over a light table, show value gradients which are indicative of areas that range from most to least intrinsically suitable for a particular land use.[13]

Threshold analysis involves determining development limitations or thresholds in the area's environmental development. Threshold refers to the exceptional public capital (or "first costs") necessary for improvements. Thus, by means of cost indices in combination with analytical procedures for thresholds, various site alternatives suitable for development are compared and choices for the most desirable directions for growth are subsequently delineated. Thresholds occur in three categories: physical, technological and structural.[14]

THE ECO-ENGINEERING ANALYSIS AS APPLIED TO ABRA

Descriptive Phase

Slope. Fig. 2 shows the five categories used in the delineation of the slope characteristics. The slope categories with their descriptions are: 0-3%—level to nearly level; 3-8%—gently sloping to undulating; 8-15%—moderately sloping to rolling; 15-30%—steeply rolling; and 30% and over—steeply hilly.

Depending on the physical condition of the soil, 3 percent is, according to Bruce, about the maximum slope allowing lowland rice production without the costly procedure of terracing. For the second category and depending on soil and climatic conditions, 8 percent is considered the maximum slope for upland crop production that will not need more complex and expensive soil conservation and erosion control practices. In category three, 15 percent is about the maximum

[12] Personal interview with Prof. Ernesto M. Serote, School of Urban and Regional Planning, University of the Philippines, Diliman, Quezon City.

[13] Ian McHarg, *Design With Nature* (Garden City, New York: Natural History Press, 1969).

[14] Geronimo V. Manahan, "The Threshold Theory in Physical Planning," A handout prepared for students at the College of Architecture, University of the Philippines, Diliman, Quezon City, n.d.

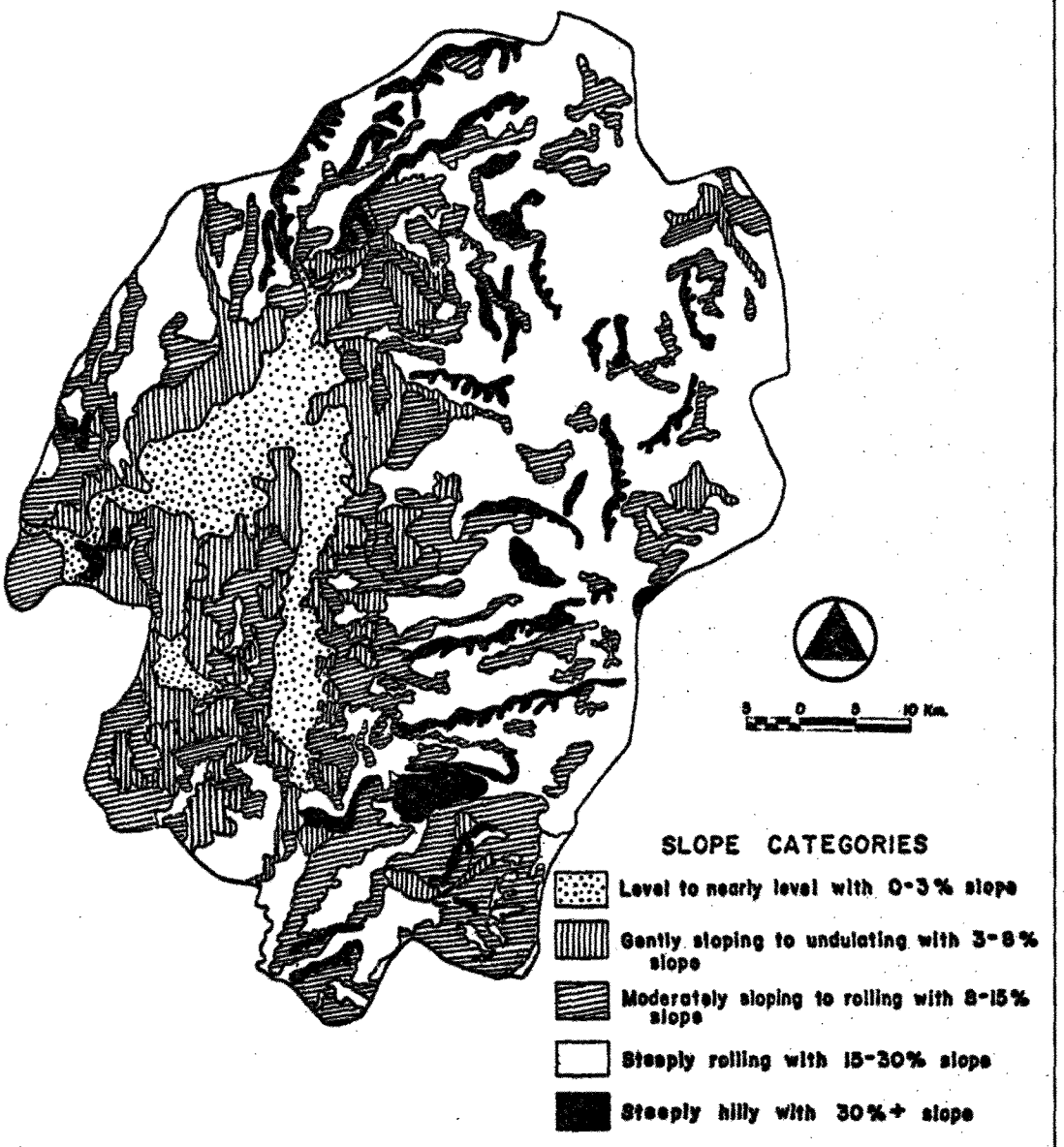
INVENTORY MAP
ABRA PROVINCE
0 5 10 Km.
SLOPE CATEGORIES
Level to nearly level with 0-3% slope
Gently sloping to undulating with 3-8% slope
Moderately sloping to rolling with 8-15% slope
Steeply rolling with 15-30% slope
Steeply hilly with 30%+ slope

FIG. 2. SLOPE

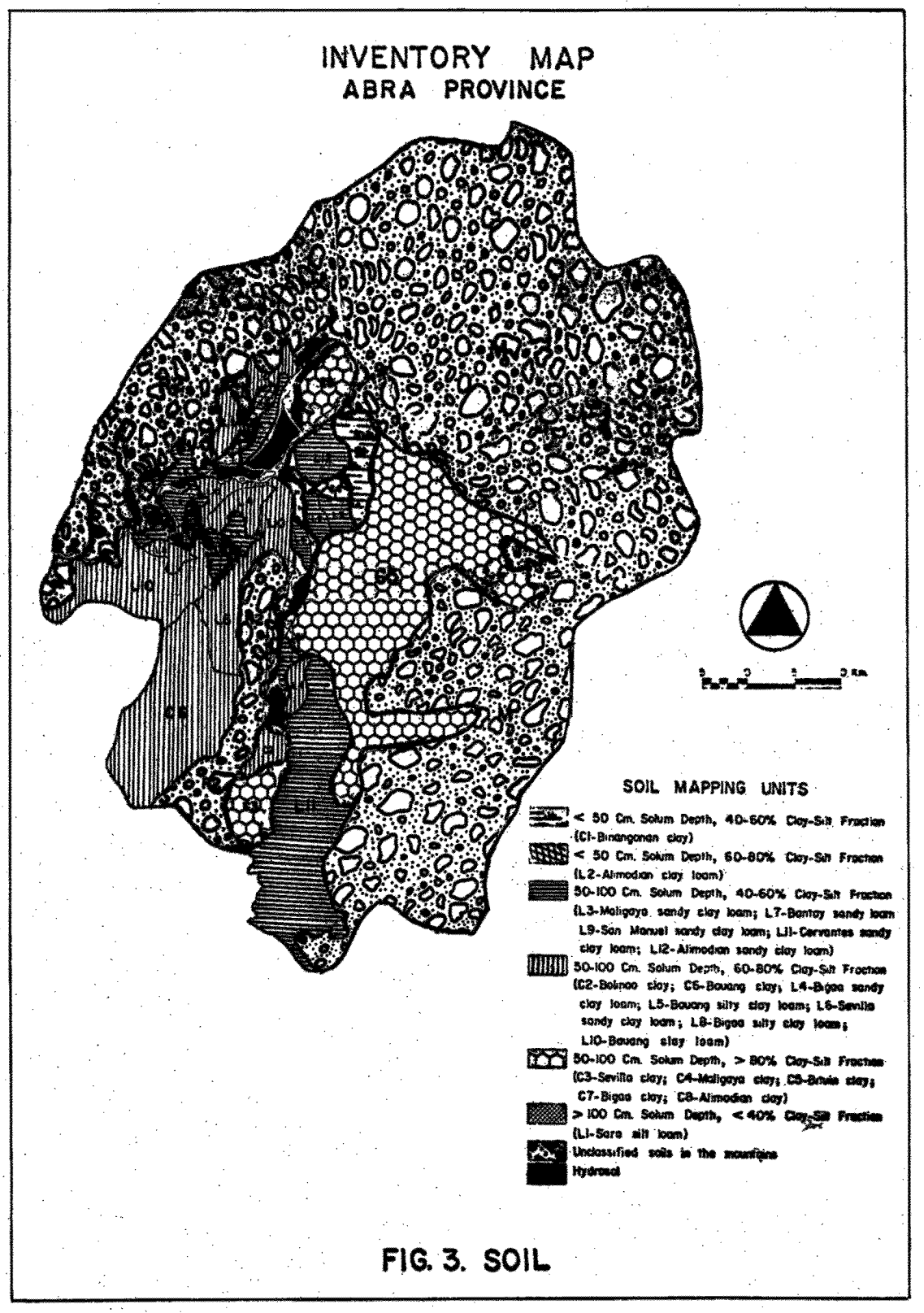
INVENTORY MAP
ABRA PROVINCE
SOIL MAPPING UNITS
< 50 Cm. Solum Depth, 40-60% Clay-Silt Fraction (C1-Binangonan clay)
< 50 Cm. Solum Depth, 60-80% Clay-Silt Fraction (L2-Almodian clay loam)
50-100 Cm. Solum Depth, 40-60% Clay-Silt Fraction (L3-Maligaya sandy clay loam; L7-Bantay sandy loam L9-San Manuel sandy clay loam; L11-Cervantes sandy clay loam; L12-Almodian sandy clay loam)
50-100 Cm. Solum Depth, 60-80% Clay-Silt Fraction (C2-Bolinao clay; C6-Bauang clay; L4-Bigaa sandy clay loam; L5-Bauang silty clay loam; L6-Sevilla sandy clay loam; L8-Bigaa silty clay loam; L10-Bauang clay loam)
50-100 Cm. Solum Depth, > 80% Clay-Silt Fraction (C3-Sevilla clay; C4-Maligaya clay; C5-Bruka clay; C7-Bigaa clay; C8-Almodian clay)
> 100 Cm. Solum Depth, < 40% Clay-Silt Fraction (L1-Sara silt loam)
Unclassified soils in the mountains
Hydrosol

FIG. 3. SOIL

slope economical for mechanized farming, depending on soil characteristics. On this type of terrain, intensive soil conservation measures are necessary to retain the soil during farming operations. For category four, 30 percent is considered the maximum slope safe and economical for livestock raising, depending on soil and climate. All crops can be raised successfully on this land but cultivated crops cannot be produced continuously over an extended period of time without losing the soil. Under the fifth category, land with slopes of 30-65 percent can be used only for tree-crop planting provided there is ground cover. Those with slopes of over 65 percent should be left under forest for timber production.[15]

The distribution of the slope categories in Abra (Fig. 2) shows that the province is predominantly sloping, with the greatest portion being steeply rolling, i.e., from 15 to 30 percent. This is found mostly in the east. Second in extent are the moderately sloping to rolling or the 8-15 percent slopes which are irregularly scattered all over the province with slight concentrations in the central and southern portions. The third most extensive are the gently sloping to undulating, i.e., the 3-8 percent slopes which are concentrated towards the west. The fourth largest portion is made up of level to nearly level or the 0-3 percent slopes located in the western portion where the river valley of the Abra River is found. The steeply hilly or 30+-percent slopes are the least extensive, occurring only in patches from north to south in the eastern portion.

Soil. Fig. 3 shows the 14 soil mapping units, based on solum depth and clay-silt fraction, which are used in describing the soils of the province. According to Bruce, solum depth, which is made up of the topsoil and subsoil, is a very important factor in plant growth and is therefore significant to soil use and management. The clay-silt fraction of the topsoil is the total of clay and silt particles analyzed for different soil types and represents that fraction averaging 5 microns in size. This fraction was selected as it is correlated with the important properties of the soil such as percent moisture, water-holding capacity, cation exchange capacity and settling volume.

The 14 soil mapping units or categories were arrived at through the study of data on mechanical analysis of 1,074 soil types which have been mapped in the Philippines and presented in the provincial soil survey reports of the Bureau of Soils. Each soil classification in the soil map based on soil series and soil type has its corresponding solum-clay-silt fraction category. For ease of identification, the 14 soil mapping units are coded as follows:[16]

Table 1. *Soil Mapping Units for Area Isolates in the Philippines*

Code	*Solum*	*Clay-Silt Fraction*
A1	<50 cm	<40%
A2	<50 cm	40-60%
A3	<50 cm	60-80%
A4	<50 cm	>80%
B1	50-100 cm	<40%
B2	50-100 cm	40-60%
B3	50-100 cm	60-80%
B4	50-100 cm	>80%
C1	>100 cm	<40%
C2	>100 cm	40-60%
C3	>100 cm	60-80%
C4	>100 cm	>80%
MS	Unclassified soils in the mountains	
HY	Hydrosol	

In the soil map of Abra (Fig. 3), eight soil mapping units are represented, i.e., A2, A3, B2, B3, B4, C1, MS and HY. Although most of the soils identified in Abra belong to either the B2, B3, or B4 units, in terms of area, most or about two-thirds of the province has un-

[15] Romeo C. Bruce, "Terrain Slope—An Estimate of Potential Agricultural Land," *Philippine Surveying and Mapping Journal*, Vol. VII, Nos. 1 and 2 (January-March, April-June, 1967), pp. 41-44.

[16] Bruce, "Soils Map of the Philippines...", *Loc. cit.*

classified soil in the mountains. These are located mostly in the east, from north to south, and to a considerable extent in the northwestern and southwestern portions. Second in extent is the B4 mapping unit, which is represented by soil types coded C3 (Sevilla clay), C4 (Maligaya clay), C5 (Bituin clay), C7 (Bigaa clay) and C8 (Alimodian clay). These are found in the middle. Third in extent is soil mapping unit B3, which is made up of the following soil classes as shown in the original Bureau of Soils map: C6 (Bauang clay), L4 (Bigaa sandy clay loam), L5 (Bauang silty clay loam) L6 (Sevilla sandy clay loam), L8 (Bigaa silty clay loam), L10 (Bauang clay loam), and C2 (Bolinao clay).[17] These lie in the western portion. The fourth largest in area is mapping unit B2 which comprises L3 (Maligaya sandy clay loam), L7 (Bantay sandy loam), L9 (San Manuel sandy clay loam), L11 (Cervantes sandy clay loam), and L12 (Alimodian sandy clay loam). These are found mostly near the center along the Abra River. The fifth largest mapping unit is hydrosol, which are sandy and gravelly soils that occur as outwash along the banks and flood plains of Abra River. Mapping unit A2 is sixth in extent and is made up of soil type C1 (Binangonan clay). Seventh in extent is A3 and this is represented by soil type L2 (Alimodian clay loam). Eighth in extent is C1 which is represented by soil type L1 (Sara silt loam).

Elevation. Four categories of elevation in meters are used (Fig. 4). Although there is arbitrariness in the selection of the ranges, these rather big ranges in the four categories are sufficient for identifying later in the criteria map the limit for general agriculture which is placed at 500 meters. The small number of categories has been considered adequate and representative after getting the highest and lowest elevations in the four provinces and averaging them for a composite picture.

Most of Abra, it appears, have an elevation range of 100 to 500 meters and these altitudes are found in the middle-west portion. Next in extent are parts with 500 to 1000-meter elevations and these are seen encircling the province, with most being distributed in the east. Third in extent are places with elevations above 1000 meters, most of which are also in the east. The 0 to 100-meter altitudes, which also correspond to the level areas, are the smallest in extent and lie towards the middlewest. The predominance of the 100 to above 1000-meter elevations shows that Abra is truly a mountainous province, aside from having steep slopes.

Climate. Since the objective of the study is to arrive at formulating land use for general agriculture and not for specific crops, it is assumed that all parts of the province even up to the 1000-meter elevations can grow most kinds of valuable Philippine crops. Table 2 shows, for example, some important crops that can tolerate high elevations.[18] Rice and corn, of course, prefer the lower elevations from 0 to 500 meters which are also found in the province. Thus the climatic factor is not given in detailed categories.

Table 2. *Selected Crops Classified by Elevation Suitability Requirement*

Crop	Elevation Requirement (Meters)	
	Highly Suitable	Moderately Suitable
Abaca	0-500	500-1000
Cassava	1000	1000-1500
Coconut	500	500-1000
Coconut/abaca	500	500-1000
Rubber	500	500-1000
Albizzia falcata	*1000*	*1000*

[17] See soil map attached to Narciso Natividad, *et al., Soil Survey of Abra Province* (Manila: Bureau of Soils, 1974).

[18] *Reconaissance Land Resources Survey of the Agusan River Basin*, Vol. II, A Soil and Land Resources Appraisal and Training Project Conducted by the Bureau of Soils, UNDP, and FAO, 1977, p. 51

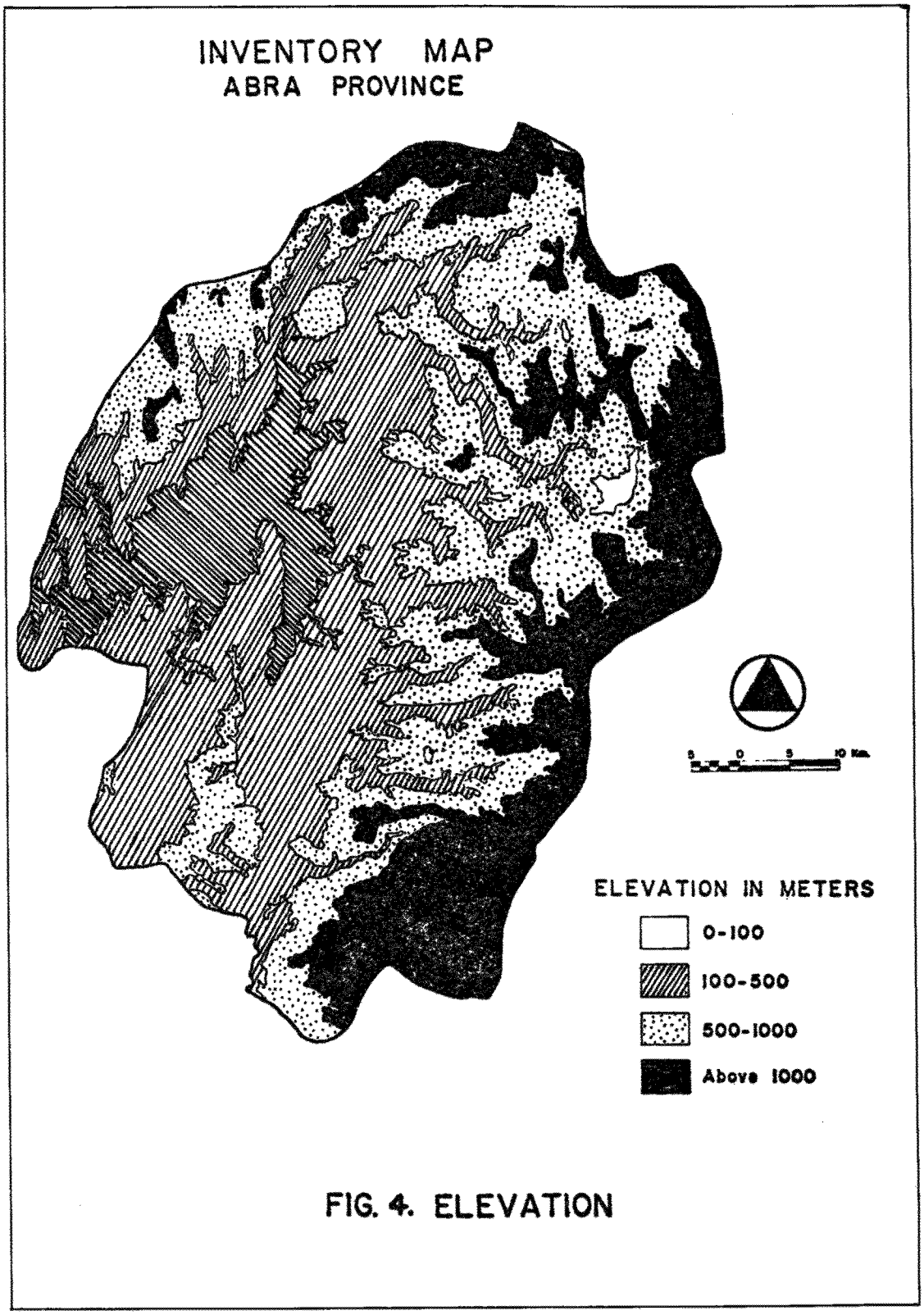

FIG. 4. ELEVATION

The climate classification system used is that of PAGASA which is actually based on rainfall distribution.[19] As shown in Fig. 5, the whole of Abra belongs to the Type 1 climate, which is generally described as having two pronounced seasons—dry from November to April and wet during the rest of the year. As shown by Table 3 and as average for Abra's five climatic stations of Bangued, Lagangilang, La Paz, Kagotungan and Villaviciosa, the wet months last from May to October while the dry months start from November and end in April. Rainfall is most abundant in July and August and lowest in December and FebruarY.[20]

The total rainfall is 2558.94 mm., with August being the wettest at 565.6 mm and February the driest at only 6.3 mm. The total number of rainy days for the whole year is 132 days. As taken from the two climatic stations of Bangued and Lagangilang, the mean annual temperature is 26.5°C, with 25.0°C as the coldest mean monthly (January) temperature and 28.3°C as the warmest mean monthly (April) temperature.[21]

The areal distribution of rainfall (Fig. 5) shows the northwestern portion of the province such as Lagangilang and La Paz as the most rainy, registering totals of 3331.5 mm and 2838.0 mm, respectively. They are close to the 3000-mm isohyet. The eastern and southern portions are the drier side, starting from the 2500-mm down to the 2000-mm-and-below isohyet. These are interior areas far from the influence of the southwest and northeast monsoons that bring rain to the coastal areas.[22]

Table 3. *Mean Monthly Rainfall, No. of Rainy Days and Mean Monthly Temperature in Abra.*

	KAGOTUNGAN, PILAR			VILLAVICIOSA			PROVINCE		
	Rainfall (mm)	No. rainy days	Temp. (°C)	Rainfall (mm)	No. rainy days	Temp. (°C)	Rainfall (mm)	No. rainy days	Temp. (°C)
Years of record		9 years			4 years			10 years	
January	4.0	1		8.2	1		17.4	1	25.0
February	0.8	1		0.9	1		6.3	1	26.2
March	0.5	1		2.0	2		16.8	2	27.4
April	35.3	2		32.0	6		67.6	5	28.3
May	281.9	12		228.2	15		285.4	15	27.7
June	425.7	21		360.0	18		433.0	21	26.7
July	723.4	25		323.0	25		524.7	24	26.6
August	468.4	24		404.5	23		565.6	23	26.2
September	354.3	20		408.7	22		384.4	20	26.3
October	161.0	10		138.5	12		174.2	11	26.4
November	52.0	14		84.4	7		68.9	7	25.8
December	6.1	4		14.6	1		14.6	2	25.4
Annual	2513.4	124		2005.0	133		2558.9	132	26.5

[19]The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) has classified the climates of the Philippines into four types, i.e., Types 1, 2, 3 and 4. The chief criterion used in the classification is the climatic element of rainfall.

[20]Climatology Division, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Metro Manila; Narciso Natividad, *et al., Soil Survey of Abra Province* (Manila: Bureau of Soils, 1974, p. 16.

[21]*Ibid.*

[22]*Ibid.*

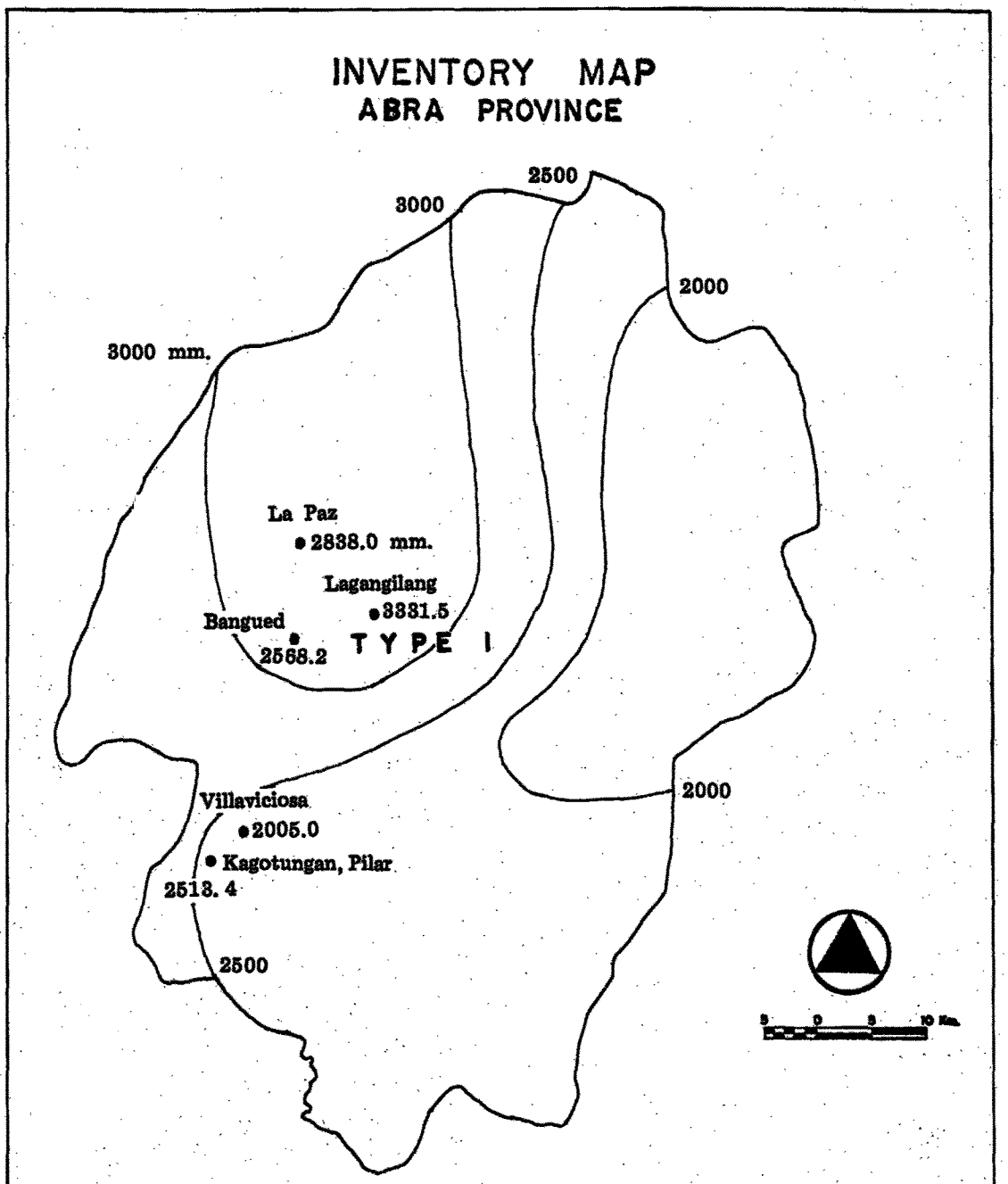

FIG. 5. CLIMATE

Table 3. *Mean Monthly Rainfall, No. of Rainy Days and Mean Monthly Temperature in Abra. (Cont.).*

	BANGUED			LAGANGILANG			LA PAZ		
	Rainfall (mm)	No. rainy days	Temp. (°C)	Rainfall (mm)	No. rainy days	Temp. (°C)	Rainfall (mm)	No. rainy days	Temp. (°C)
Years of record	10 years			20 years			7 years		
January	3.0	1	26.8	29.4	1	23.3	40.6	1	
February	0.0	0	27.6	14.1	1	24.7	15.7	2	
March	1.8	1	29.1	48.8	3	25.7	30.7	2	
April	46.0	4	30.3	152.8	10	26.3	71.9	5	
May	278.1	15	29.4	371.0	17	26.0	268.0	16	
June	410.7	22	28.3	515.2	21	25.1	453.4	21	
July	705.4	25	28.1	602.2	23	25.0	269.6	20	
August	583.4	24	27.7	702.4	23	24.7	669.3	22	
September	274.8	20	28.2	532.8	20	24.4	351.5	18	
October	199.2	12	28.1	210.8	11	24.8	161.5	10	
November	58.0	5	27.6	123.6	6	24.1	26.7	3	
December	7.1	2	26.9	28.0	3	23.9	15.0	1	
Annual	2568.2	131	28.2	3331.5	139	24.8	2838.0	121	

Existing Land Use. Examining the general existing land use as part of the appraisal phase shows that most of Abra is grassland and/or shrubland which are mostly found in the central and western portions (Fig. 10). Next in extent are the wooded areas, with the primary forests predominating and are located mostly near the eastern boundaries of the province in the Central Cordillera. Following next in extent among wooded areas are secondary forests that occur in patches especially in the northern portion of the province. Portions of mossy forest follow next in extent and are found stretching thinly along the southeastern boundary of the province. Third in extent are barelands such as river beds or lands covered with gravel and sand and occur near the center of the province on the banks and flood plains of the Abra River. Fourth in extent are the agricultural areas which are located in patches next to the barelands along the course of the Abra River.

Appraisal Phase

Slope. In evaluating the areas suitable for agriculture using the criteria map, the 0-15-percent slope range is used, which is described as level to moderately sloping/rolling. Depending on soil characteristics, 15 percent is considered the maximum slope of the land economical for mechanized crop production.[23] With this criterion, the slopes

[23] Bruce, *op. cit.*, p. 42. The recommended cut-off point in land classification with the aim of segregating forest areas from those suitable for agricultural and other uses is actually 18 percent. The selection of the 18-percent slope limitation for alienable and disposable lands aims to prevent soil erosion and other adverse effects on the balance of the ecosystem as a whole by insuring that lands beyond this slope remain under forest cover. (See M. Segura, A. V. Revilla and M. L. Bonita, "A Historical Perspective of the Philippine Forest Resources," PREPF Technical Paper No. 35, Vol. II-3a, September, 1977, Appendix B). The 18-percent slope limitation for agricultural land use is provided for in Presidential Decree No. 750 (Section 15, Chapter II), which was issued in 1975, and on this basis the country's land area is divided into 58 percent alienable and disposable and 42 percent forest lands. Letter of Instruction No. 409 later recommended in 1976 a forest-nonforest ratio of 40:60 which must be observed in land use planning for the whole country. (See Meliton B. Juanico, "Research on Land Policies for Philippine Development Planning: A Survey," Philippine Institute for Development Studies (NEDA) Project No. 80-3 Technical Paper No. 3, March, 1981, pp. 24-26).

suitable for economical agriculture in Abra are concentrated more in the west, particularly in the area surrounding the Abra River, while only patches of suitable land are found in the east (Fig. 6) where the Cordillera Central lies punctuated by such mountains as the Bacao and Sapisap. The agriculturally suitable areas have a north-south distribution.

It must be remembered, of course, that not all lands within this category mapped as potential farm areas are available for agricultural production. Considerable areas of low, level, rolling or undulating terrain are currently used for non-agricultural purposes like townsites, subdivisions, roads, railroads, airport sites and recreation areas.

Soil. Of the 14 soil categories cited earlier in Table 1, six are considered agriculturally suitable, namely, B2 (50-100 cm solum, 40-60% clay-silt fraction), B3 (50-100 cm, 60-80%), B4 (50-100 cm., 80%), C2 (100 cm, 40-60%), C3 (100 cm, 60-80%), and C4 (100 cm, 80%).[24] Examining the characteristics of these categories, it can be generalized that the areas suitable for general agriculture are soils with solum depths of not less than 50 cm and clay-silt fractions of not less than 40 percent. These represent soils that have deep A and B horizons and high percentages of clay-silt fraction, i.e., high proportions of clay to silt particles.

Fig. 6 shows that the agriculturally suitable soils are found in the Abra River Valley, or around the Abra River near the center of the province. These soils can possibly make up about one-half of the whole provincial area, despite the rapid erosion rate in the province brought about by denudation of its forests. The locations of those soils somewhat correspond to that of the agriculturally favorable slopes shown in Fig. 6.

Elevation. Site elevation is one of the criteria used in selecting an area for agro-forest production. Although most cultivated crops are able to grow and produce in a wide range of elevations (0-2000 meters), many kinds of tree crops and several forest types cannot thrive well in areas with high elevations. Coconut, for example, is highly or economically productive only up to an elevation of 500 meters.[25] Thus of the four elevation categories used in Fig. 4, the elevation criterion selected is 0 to 500 meters.

In Fig. 8, the 0 to 500-meter elevations are in the western half of the province, running from north to south around the Abra River and extending up to the valley's watershed areas fringing the Central Cordillera to the east. The location of these contiguous elevations that make up about one-half of the province roughly corresponds to those of the agriculturally suitable slopes and soils shown in Fig. 6 and Fig. 7.

Land suitability. The land suitability map (Fig. 9) was derived by performing the central methodology of the study called the overlay or convergence area approach. This composite map was arrived at by superimposing the *transparent* four criteria maps (Figs. 5, 6, 7 and 8) and marking the different levels of convergence.

Thus Class 1 (very good land for general agricultural) among the land suitability classes which is the most ideal for agriculture in terms of slope, soil and elevation is a convergence of the vertical, diagonal and horizontal lines. These make up about a third of the province and are found towards its western portion east and west of Abra River, with a greater portion in the west around Bangued. Class 2 (good land) is based on the slope and soil categories, being next in importance to the combination of the three factors in Class 1. This class which is a combination of vertical and diagonal lines is not extensive, found only in small patches around the southern end of Abra River. Class 3 (moderately good land) is based on soil and elevation which is considered third

[24] Personal interview with Dr. Romeo C. Bruce, Professor of Photo Interpretation and Remote Sensing, Training Center for Applied Geodesy and Photogrammetry, College of Engineering, University of the Philippines, Diliman, Quezon City.

[25] Personal interview with Dr. Romeo C. Bruce. Bruce is supported by geographer, Ooi Jin-Bee who opines that coconut can be grown up to an elevation of about 600 meters inland, although its fruit-bearing capacity is drastically reduced when cultivated on very steep slopes. See Ooi Jin-Bee, *Land, People and Economy of Malaya* (London: Longmans, Green and Co. Ltd., 1963), p. 251.

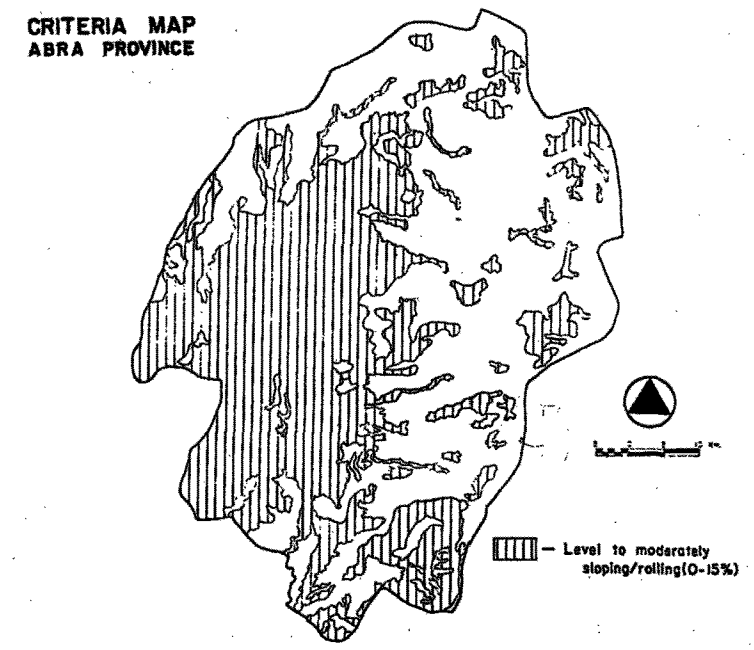

FIG. 6. SLOPE

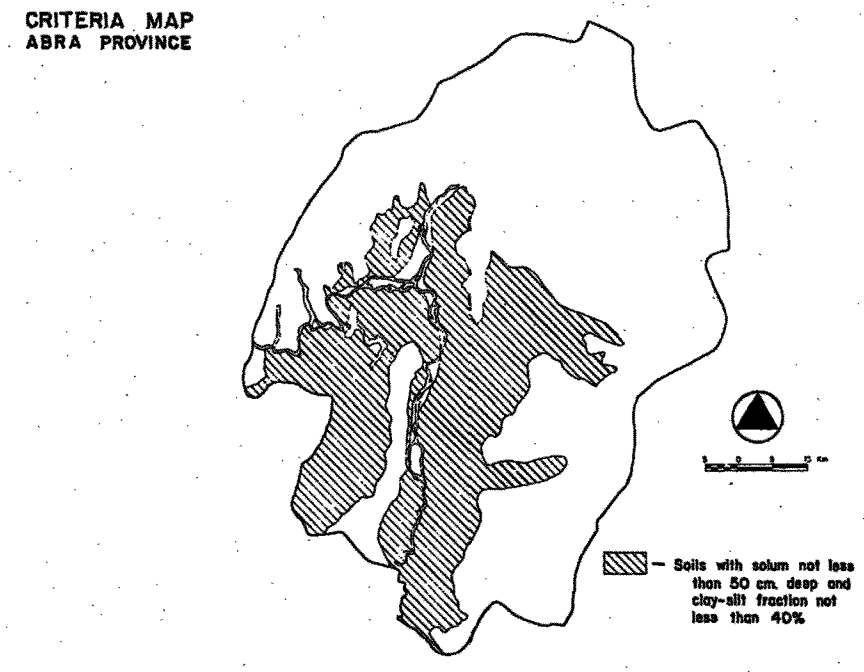

FIG. 7. SOIL

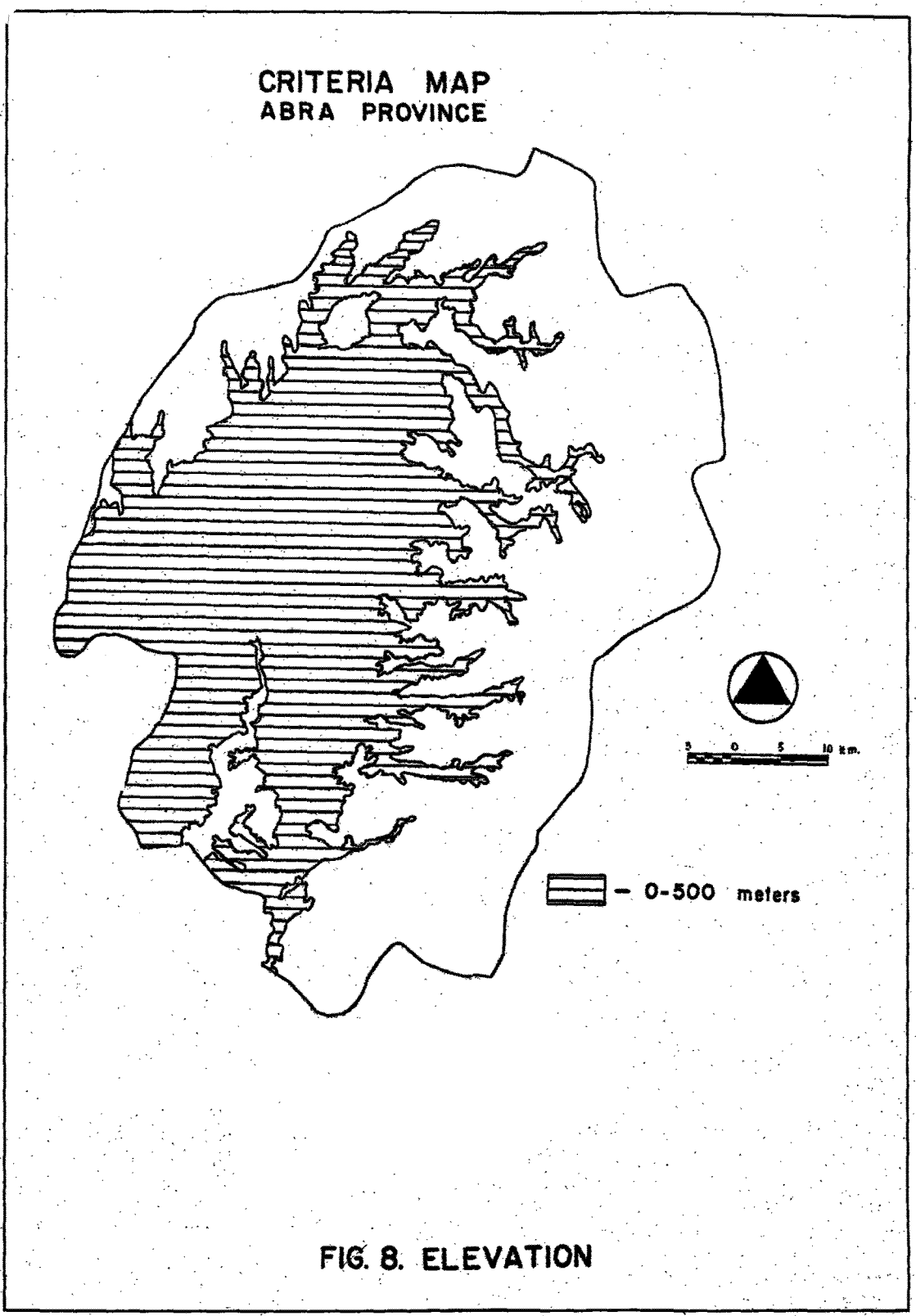

FIG. 8. ELEVATION

in suitability. A combination of diagonal and horizontal lines, this class is also not extensive, being found in small patches in the eastern fringes of Class 1 areas. Class 4 (poor land) is based on slope and elevation and is considered lowest in agricultural importance among the three criteria. This combination of vertical and horizontal lines is more extensive than Class 2 and Class 3 lands and is found mostly around Abra River in the plain area and also in the northern fringes of Class 1 lands. Class 5 (land not suitable for agriculture) lands are those showing no convergence between any two of the three categories of slope, soil and elevation. These are the most extensive in the province and constitute the mountain lands of the Central Cordillera to the east as well as the portions of the Ilocos Range in the northwest.

Development Phase

Agricultural land use plan. Under this phase which tries to propose or recommend ways of developing the agricultural potentials of the province, the convergence or overlay process is again employed through superimposition of the land suitability (Fig. 9) and existing land use (Fig. 10) maps.

Fig. 10 shows the possibilities of utilizing Abra Province after comparing its present land use with its land suitability. Abra has an agriculturally suitable area of 97,551 ha (24.5%) but only about a tenth of this or 10,181 ha is cultivated. This cultivated portion is found in the towns of Pidigan, Bangued (the capital), Tayum, Lapaz, Lagangilang and Manabo—all close to or along the Abra River. On the other hand, almost nine-tenths or 84,895 ha is uncultivated. From the existing land use map, this is actually mostly grasslands and/or shrublands which presumably are used for grazing. *This uncultivated portion, which makes up 21.4 percent of the provincial area, offers great possibilities for agricultural development in the province* as allowed by the factors of slope, soil, elevation and climate and even though limited by the presence of eroded lands. This portion which has a great agricultural potential, is found in the relatively low and less sloping areas along the eastern side of the Abra River and in the southwestern portion of the province. This portion is found in the towns of Pilar, Villaviciosa, San Isidro, San Quintin, Danglas, Lagayan, Pidigan, San Juan, Dolores, Lagangilang, Bucay, Sal-Lapadan, Boliney and Tubo—together constituting the majority of Abra's 27 towns.

The suitable but forested portion of 2,475 ha should no longer be touched or converted to agricultural uses on ecological grounds in a land that has already a rate of erosion categorized as serious[26] due to denudation of the forest by logging concessionaires, kaingineros, miners, timber smugglers and forest product gatherers. Actually, 65.1 percent of Abra is subject to erosion,[27] which is indeed a sizeable proportion.

The agriculturally unsuitable area (including the bareland of the province) is 300,004 ha (75.5%) and of this only a small portion—1,280 ha (0.4%)—is cultivated. This means that the limitations especially of the three physical geographic factors are really difficult to surmount and are wisely considered by the farmers against the risk of low crop returns.

The unsuitable land which is covered with grass and is estimated at 155,821 ha makes up more than half of the total unsuitable area. This is the land that was previously forested but has already suffered denudation and now only supports pioneer grass like cogon *(Imperata cylindrica)* and *talahib (Saccharum spontaneum).* Massive and immediate reforestation is needed here. This land surrounds the suitable and uncultivated area, with the greatest extent found northeast of the province in such towns as Tineg, Lacub and Licuan.

The unsuitable and forested portion has also a considerable extent at 134,634 ha., making up a little less than half of the total agriculturally unsuitable land. This portion which lies in the eastern highlands constitutes land use and should be left as such.

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[26] This means three-fourth of original soil to one-fourth subsoil is eroded. The categories of erosion rate are: no apparent erosion, slight erosion, moderate erosion, serious erosion, severe erosion and excessive erosion. See Francisco Calimbas, *et al., Soil Survey of Antique* (Manila: Bureau of Soils, 1963), p. 75.

[27] J.P. Mamisao, "Soil Conservation Problems in the Philippines," *Journal of the Soil Science Society of the Philippines,* Vol. I (1949), pp. 1-18.

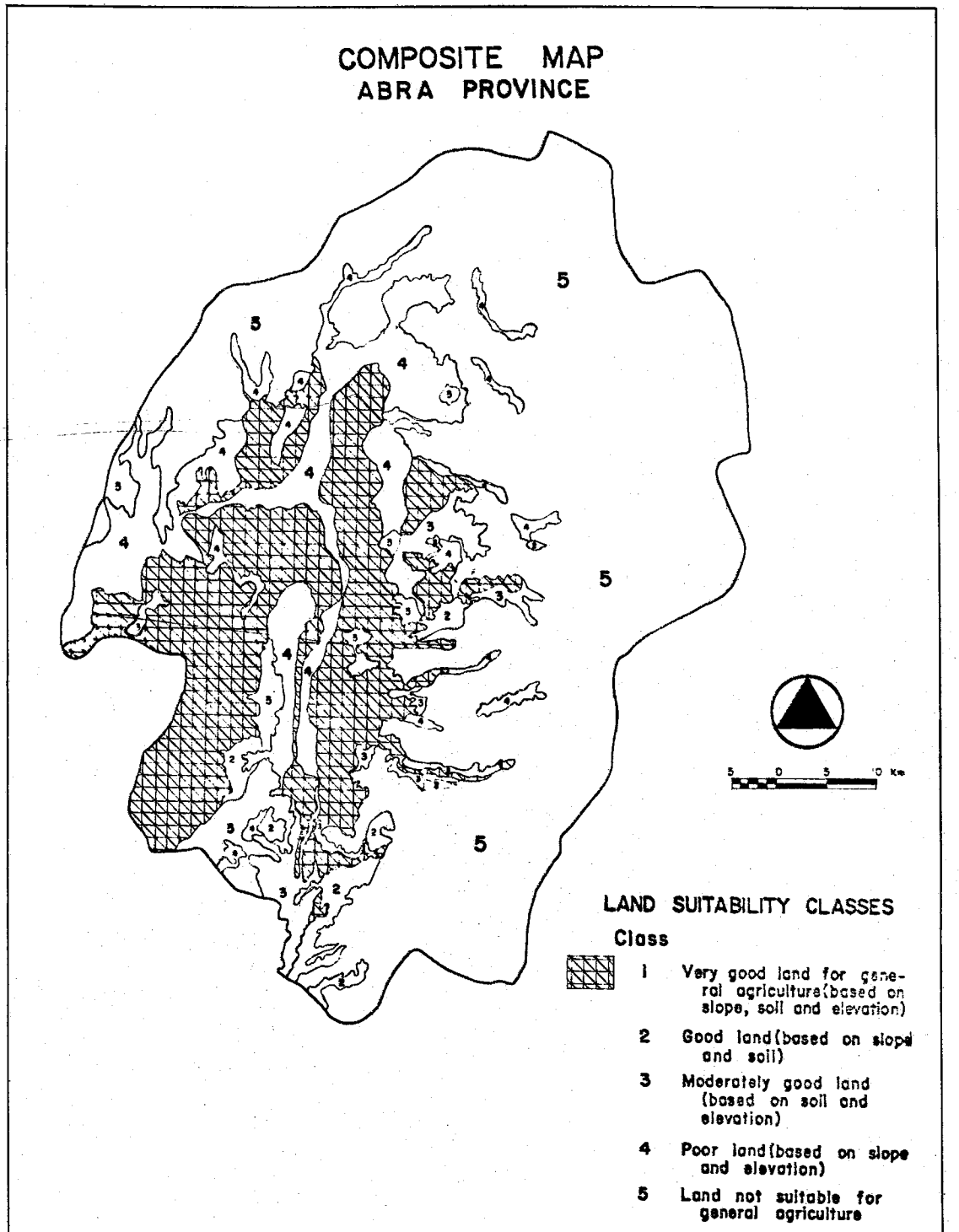


FIG. 9. LAND SUITABILITY

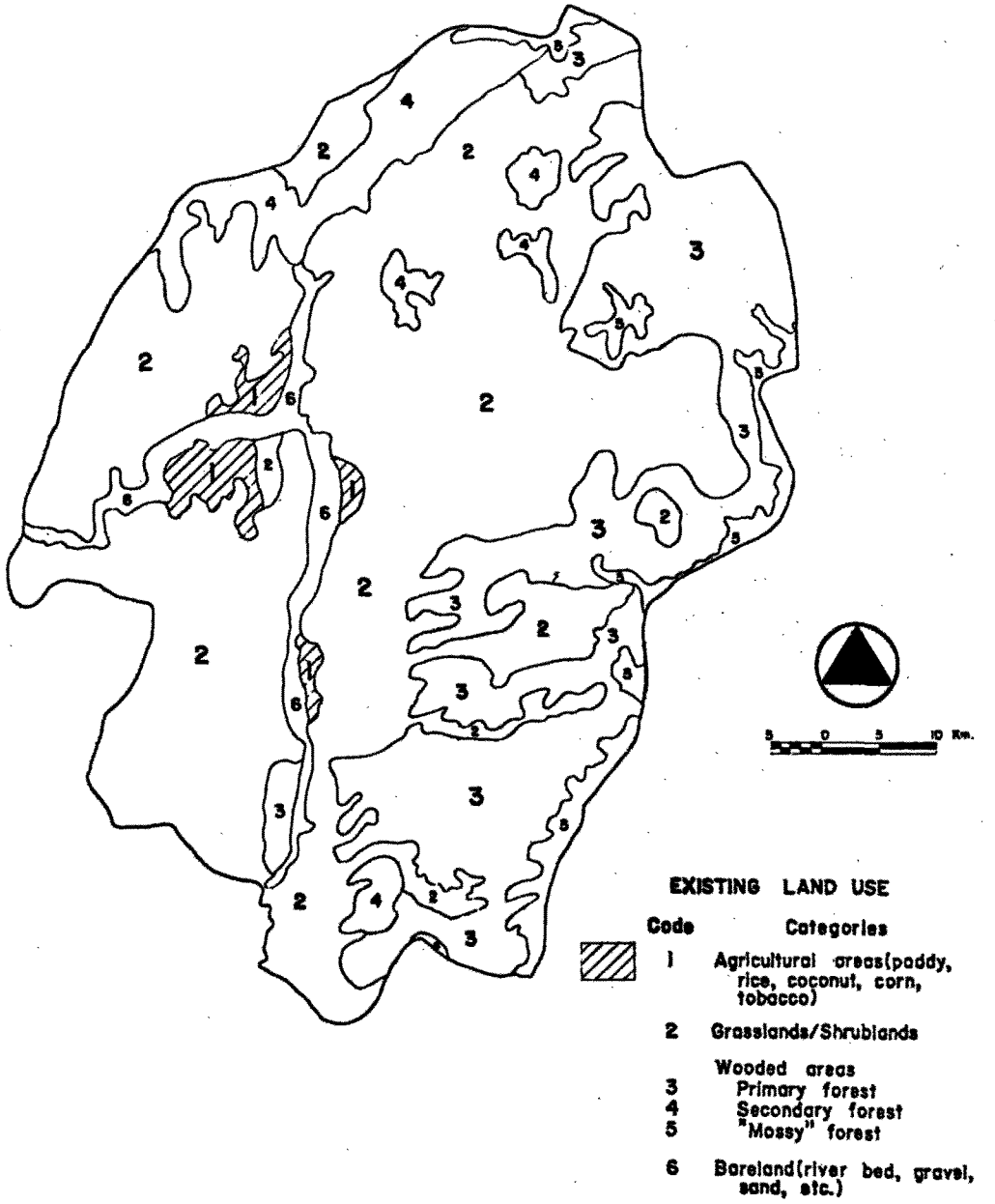


FIG. 10. EXISTING LAND USE MAP
ABRA PROVINCE

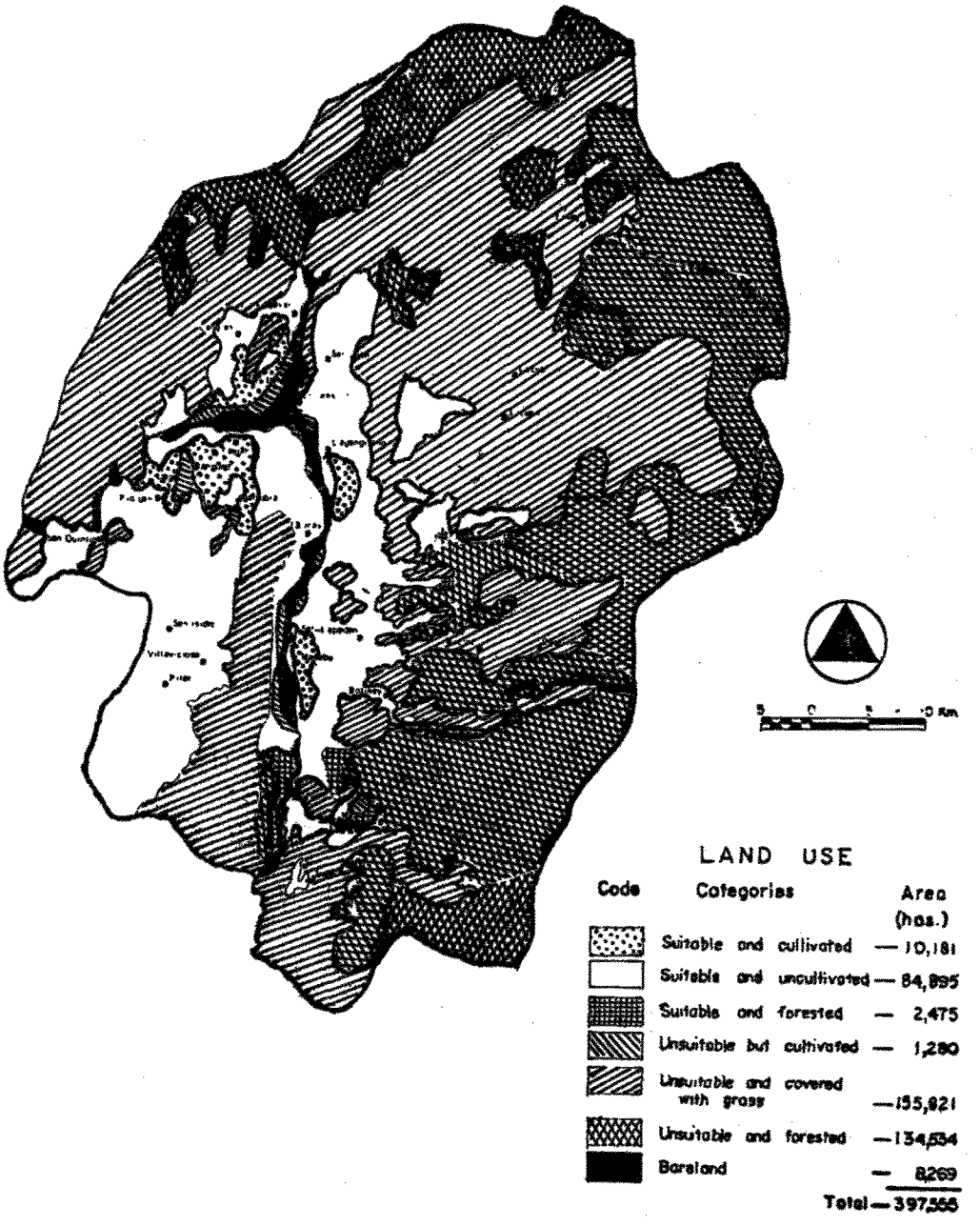


FIG. 11. AGRICULTURAL LAND USE PLAN
ABRA PROVINCE

The bareland constitutes a negligible 8,269 ha. and being made up of hydrosol along the banks dry beds of Abra River, cannot grow agricultural crops.

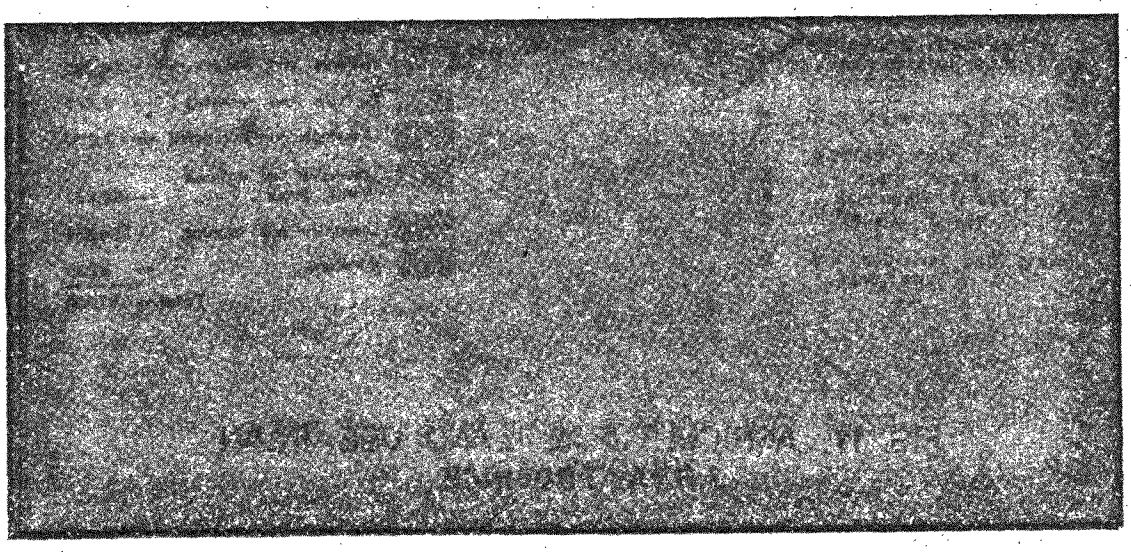
Conclusion

The result of the eco-engineering analysis reveals that Abra, which is a mountainous area has very limited agriculturally suitable areas. However, it was also found out that a high proportion of agriculturally suitable lands remain uncultivated. Some 21.4 percent, or 84,895 ha, of Abra's total area is suited to agriculture, a condition that is primarily a function of slope. Thus cultivated land can be increased eight times in the province. The reason, however, why this sizeable portion remains uncultivated probably points to the operation of socio-cultural factors, these important factors need to be investigated further.

There is, however, a great proportion of the area which is unsuitable for agriculture but is left only under grass cover. These are the steeply rolling and steeply hilly portions ranging from 15 percent to over 30 percent in slope and which comprise 39.2 percent (155,821 ha) of the total area of the province. These are ecologically crucial areas that need immediate reforestation.

Although there is some annual outmigration in Abra, its overall population is increasing. In 1980, the arithmetic density of the province was 40 persons per square kilometer, but when narrowed down to its nutritional density,[28] the population pressure on the land is readily apparent, i.e., there were 1497 persons impinging on one square kilometer of land. Utilization of the suitable and uncultivated land, which has been revealed by the eco-engineering analysis, would lower the nutritional density of the province to only 166 persons per square kilometer! With local will and government support as well as the application of improved agricultural practices, the development of this suitable portion would go a long way in relieving the province of unnecessary population pressure on the land and ultimately enhancing its agricultural production capability. □

[28] The nutritional density is expressed as the ratio of the population to cultivated land—a more accurate measure of population pressure on the land than arithmetic density which is only the gross ratio of the population to the total land area.



IDENTIFICATION AND EVALUATION OF PRIME AGRICULTURAL LANDS FOR LAND USE POLICY FORMULATION: A PHILIPPINE PERSPECTIVE*

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SITUATION ANALYSIS

The complex relationship between and among the (i) availability of modern technology, (ii) changing concepts of development and land utilization, (iii) the felt need for a balanced environment, and (iv) the recent emphasis on the regional and international cooperation on food production brought about a new dimension on the formulation of recent government policies on land utilization and allocation. The high degree of economic efficiency of the non-agricultural sectors (industries, urban/rural settlement) caused a further danger on the rapid displacement of lands for food production and other agricultural products providing raw materials for many agro-based industries. It is a common scene among more progressive regions such as those found along Laguna de Bay (Plate I) where very productive agricultural areas are rapidly displaced by settlement sites.

Thus, if we really desire to satisfy the two most important basic needs of man (food and shelter) with due consideration to the progressive, harmonious relationship between land productivity and environmental quality, we should in earnest develop an acceptable scheme that would provide a professional basis for the rationalization of land use decision and space allocation. This methodology should emphasize the compatibility of the desired use with the associated existing land use, the soils and the total environment. The whole concept of classification and evaluation should require close consultation and integration of inputs between and among land use researchers, land use planners and the country's policy makers.

It is along the aforementioned perspective and the country's economic situation where the author and the Bureau of Soils, Ministry of Agriculture considered this forum as an appropriate occasion to disseminate the recent concepts about the identification and evaluation of prime agricultural lands for area development planning in the Philippines.

CONCEPTS OF PRIME AGRICULTURAL LANDS

Prime agricultural lands are those lands capable of sustaining the economic productivity levels of crops/land use over time in a given climatic region without adversely affecting the immediate and adjoining environment.

The magnitude and diversity of the productivity levels of prime lands are context sensitive and are dependent on (i) compatibility of the chosen crop with the soils and other physical environment (e.g. topography and climate); and, (ii) economic capability of the farmer to sustain the productivity of his farm.

Qualities inherent to a given land provide the limits as to which set of crops/land use under a given climate could be engaged in successfully over sustained period of time. For instance, marshlands are connotative

*Reprinted from First National Conservation Conference on Natural Resources.

of unproductive lands to many users whose land use interests do not fit with the marshland's inherent environmental constraints. However, these same lands are prime lands for fisheries and excellent lands for water-loving plants such as nipa which are excellent sources of raw materials for some cottage industries. Furthermore, poorly drained clayey soils are hardly suitable for many upland crops requiring good drainage but with proper planning and appropriate infrastructures, these lands are prime lands for irrigated rice. Rolling lands are highly erodible and are not good for many raw seasonal crops, but with adequate investments, they are the primelands for many economic tree crops and assuming other factors are at optimum level.

The major reason for the existence of marginally productive lands is the persistence of farmers to plant unsuitable traditional crops as well as their economic inability to provide investments to correct the attendant land limitation. In most cases marginality in this sense refers to the economic marginality of the farmer rather than the farm.

STATE OF LAND UTILIZATION IN THE PHILIPPINES

Of immediate concern in this paper is the distribution of major land utilization types in the country—agriculture, woodland and grassland. In terms of the magnitude of occurrence, woodland represent 48.7 percent of the total land area, agriculture, 29.7 percent; grassland, 19.5 percent (Figure I and Table I).

It will be noted in Figure 1 that, if we assume other factors at satisfactory levels, some 20.1 percent or 6.0 million hectares located on slopes under 18 percent and are technically feasible for various agricultural uses: of the 5.9 million hectares, 8.9 percent are presently under grasslands and 11.2 percent are under woodlands.

Considering the topography and general climate in the Philippines, some 5.5 million hectares or 18.3 percent are considered as

Figure I: General Land use and Slope Relationship

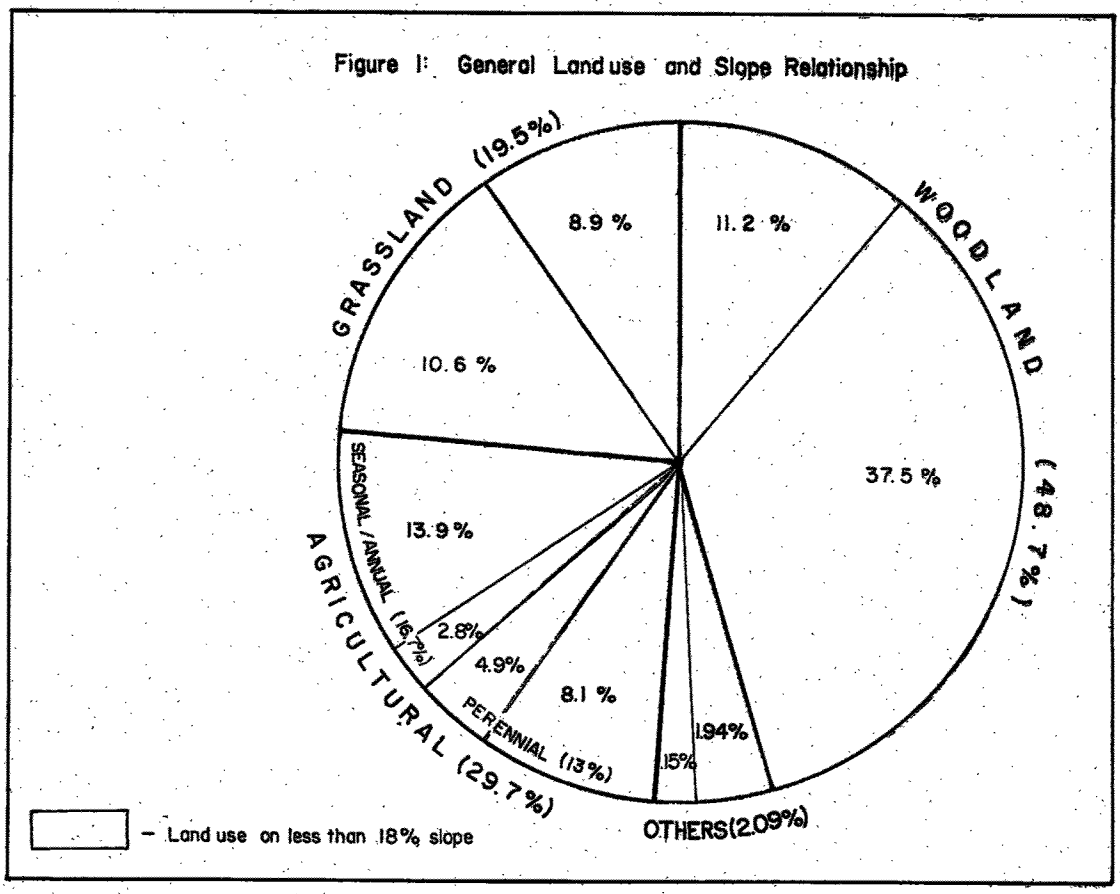

TABLE 1

LAND UTILIZATION TYPES AND SLOPE [a/] RELATIONSHIP

	Total Area (ha)	Percent %		A	Percent %	B	Percent %	C	Percent %	D	Percent %	E	Percent %
I. Seasonal & Annual													
1. Paddy Rice	2 560 014	8.63)	16.8	2 198 576.5)	11.4	233 518.5)	2.5	46 265)	2.2	46 265)	0.5	19 053)	0.1
2. Others b/	2 414 690.96	8.14)		1 183 355)		517 769.08)		584 412)		105 256.49)		23 898.39)	
II. Perennial													
1. Coconut	3 767 736.33	12.7)	13.0	1 232 800)	4.3	1 084 831.96)	3.8	882 943)	3.0	502 709.18)	1.7	64 452.19)	0.2
2. Others c/	97 845.3	0.33)		49 570.5)		31 422.4)		8 060 .5)		8 791.9)		–)	
III. Woodland													
1. Dry	14 084 158.78	47.5)	48.7	884 383)	4.0	2 097 115.81)	7.2	4 598 324.5)	15.6	4 420 701.72)	14.9	2 083 633.75)	7.0
2. Wet	363 925.5	1.23)		300 459)		30 606.5)		22 623)		7 932)		2 305)	
IV. Grassland													
1. Dry	5 642 684.32	19.0)	19.4	1 201 967.5)	4.4	1 323 813.36)	4.5	1 592 615.5)	5.4	1 117 845.9)	3.8	406 442.05)	1.4
2. Wet	125 478	0.42)		114 433)		6 430)		3 073)		1 542)		–)	
V. Fishpond	138 304.5	0.5	0.5	124 262	0.4	4 554	0.02	8 443.5	0.03	1 045	0.004	–	
VI. Non-Agricultural	218 122.85	0.7	0.7	176 469	0.6	6 764.65	0.00–	16 505.5	0.06	16 090.2	0.05	2 293.5	0.01
VII. Lake	256 645.5	0.9	0.9	256 645.5	0.9	–		–		–		–	
					26.0%		18.0%		26.3%		21.0%		8.7%
TOTAL	29 669 606.04	100%		7 722 921		5 336 826.26		7 779 601.5		6 228 179.39		2 602 077.89	

a/ Based on the 1981 land use and slope studies of ALMED Bureau of Soils

b/ Others – upland rice, corn, sugarcane, tobacco and garlic, vegetables, cassava, pineapple, sorghum, diversified crops, kaingin.

c/ Others – coffee, citrus, mango, marang, fruit trees, oil palm, banana and abaca.

critical watershed areas. These lands are generally situated on slopes greater than 18 percent. Of the 5.5 million hectares, 2.8 percent are attributed to lands planted to seasonal and annual crops and 10.6 percent are grasslands. As we all know farmers in this area are mostly on subsistence levels and therefore are not economically capable nor trained to undertake well planned soil conservation measures. Grasslands on the other hand, are a clear manifestation of a derelict landscape which would require immediate rehabilitation measures (i.e. reforestation).

RECENT POLICIES AND PROGRAMS THAT HIGHLIGHT THE NEED FOR THE PROPOSED IDENTIFICATION AND EVALUATION OF PRIME AGRICULTURAL LANDS

I. Total Reclassification—in search of more productive lands

Among other policies, laws, decrees, and other local statements about land utilization, the recent declaration made by the President during the anniversary of land reform decree was the most direct, purposive, and futuristic statement of development with regards to maximization of the use of land as a way to boost rural economy. In that fateful day, the President directed to (Bulletin Today, Nov. 10, 1981):

> "open more lands for production by reclassifying all lands for their most economic use, including public lands classified as "forest" by existing law".

More significant is the specific statement of the President directed to the legislators at the Batasan Pambansa which will:

> "extend priority in the grant of leases and similar disposition to those lands whose gradient exceeds 18 percent as indicators in the forestry and related laws—which they have occupied and developed for a reasonable number of years...."

In the same publication, the President clearly expressed the critical need to look for more productive lands when he further declared that priority be given to "upland farmers in the use of idle or abandoned farms, timber or marshlands."

The explicit statement of the President which emphasizes the exploitation of additional lands in the upland regions actually revolutionalize the concept of land classification. The directive removed the technical restrictions of the Forestry Code which strictly imposed 18 percent slopes in the determination of areas for alienable/disposable and forest areas. With this restriction, classification of lands for food and forest production purposes, therefore consider a thorough study of the complex relationship among the soils, crop and the total environment. This will therefore avoid terrible misuse of the land. Areas to be retained to forest need not be on rough terrain, or areas with slopes greater than 18 percent. In the same perspective, agricultural areas need not be concentrated on flatter regions or areas less than 18 percent slopes. Forest trees could be planted on unproductive lowlands or could be a part of landscape planning within a city or growth center. Agriculture, on the other hand, could be situated on a rougher terrain provided a range of suitable, high income crops—economic tree crops (mango and other fruit trees)—could be economically grown and should ensure a sustained soil productivity in the same manner as forest trees.

II. Environmental Conservation and Protection

Most notable action taken by the Government is the enactment of the PD 1152 on June 6, 1977, better known as the Environmental Code. This code recognizes the need for the assesment of total environment which focused on the complex interplay of the biophysical and socioeconomic elements that directly and indirectly affect the use and ultimate productivity of a given land resources of the country.

Under Title III—Land Use Management, Section 23, National Land Use Scheme, the Code calls for:

a) a science-based and technology-oriented land inventory and classification system;
b) a determination of present land uses, the extent to which they are utilized, underutilized, rendered idle, or abandoned;
c) a comprehensive and accurate determination of the adaptability of the land for community development, agricultural, industry, commerce and other fields of endeavor;

d) a recommended method for periodic revisions and updating of national land use scheme to meet changing conditions.

The environmental code by itself is historic in the sense that land and area designation are determined both on the principal basis of sustained productivity and enhancement of environment quality. It accepts the argument that putting more lands into productive use does not guarantee better quality of life especially if the land utilization scheme did not assess carefully its impact on the environment.

The added concern on environmental protection accentuates the need for a thorough inventory and evaluation of not just slope, but, on equal degree of importance, other parameters such as soils, present land use and climate. The gathering of relevant environmental data and information is not concentrated in the project site, but also on the adjoining areas believed to be affected or influencing the effect of the economic inputs/treatments in the proposed project. Thus, the currently accepted approach is an integrated area development project which always considers a river basin. Study of environmental gradations from the lowland to the upland portion of the landscape is a necessity to get a good view of causal relationships of various elements of productivity and conservation.

PROBLEMS AND CONFLICTS IN LAND UTILIZATION AND ALLOCATION

I. Policy and Implementation Gaps on Land Use Regulatory Measures

The primary emphasis on the livelihood programs expressed in the vigorous implementation of Kilusang Kabuhayan at Kaunlaran (KKK) directly focused the attention of our planning authorities upon the efficient utilization of every land available for economic use. The recent instruction of the President about the reclassification of all lands is a clear statement about the redirection of perspectives in land classification. This is truly responsive to the present thrust on livelihood programs.

Sad to note however, is the present scheme of land allocation where alienable and disposable lands are released for human occupancy only after forest and mineral resources are already defined and declared as public lands. This situation is properly noted by the Steering Committee on Policy Study and was officially transcribed in their main report, Volume I on Proposal for Public Land Management Policy.

> "PD 705[a] the Revised Forestry Code of the Philippines is the primary document dealing with land classification .....
> The approach taken in this decree is that only those lands which are not needed for forestry should be put into agriculture and other uses. This puts all other land needs of the country second to forest. Forest is central and agriculture is residual".

The aforementioned situation has created a negative impact on the citizenry's participation in the wise use of the land and environmental protection. The same committee further reported:

> "People searching for land and livelihood, and prepared to break the law, seek out lands where they cannot be easily detected or evicted. Rather than colonizing lands suitable for agriculture, they often invade unsuitable lands which are then depleted in a very short time .....
> Understanding this problem and recognizing that it is impossible to put a complete stop to the expansion of agriculture is the basis for the development of a positive land policy for development".

A very clear disparity on regulatory measures exist between agriculture, forest and mineral land resources. Agricultural land use is very fluid and could easily be subject to change both in substance and spatial distribution over time, without any significant legal obstacles. Apparently, lands in agricultural use are treated as an economic commodity subject to price speculation and indiscriminate use as indicated in the rapid conversion of prime ricelands to housing subdivisions.

Forest and mineral lands however, are strongly static and it needs a presidential proclamation before any portion of forest lands could be utilized for other economic uses.

While it can be said that land use regulatory procedures do exist for privately owned agricultural lands, restrictions imposed on land conversion is not as stringent as it is for public lands like forest and mineral lands, except possibly in metropolitan cities like Metro Manila area.

II. Data Gaps

a. Environmental Approach (Land Resources Evaluation) vs. Land Classification based on 18 percent slope:

Since land is a basic unit in deciding the spatial dimension of any endeavor in agricul-

tural development, it is therefore a distinct requirement that the single and/or combined ecological relationship of individual element of the land with other biological and economic parameters of productivity should be taken into account during the entire period of their utilization. In this perspective, the recent instruction of the President, placed the land classification scheme in the proper direction by *removing the hazards of environmental abuse* that result from the classification and disposition of lands based on a single criterion—18 percent slope. The ultimate effect is the observation made in the report by the Steering Committee on Policy Study (1981) about the proposal for public land management as follows:

> What deepens the confusion further is the rather liberal use of the term "forest". This refers in national law to all lands whose slope is greater than 18 percent or which fall into a few other minor categories. As now used, "forest" need have no trees and may be grasslands or orchards even croplands which are located in the highly sloping lands. The term "forest" as it is now used is to be equated with public lands which cannot be sold and must by law remain in the public domain. The term is an unfortunate choice as it the real issues dealing with land use and land tenure.

The slope-based land classification takes into a dangerous assumption that other elements of the land such as soils and land use/vegetation are at optimum levels and therefore land released under this scheme could be productive. Records at the Bureau of Soils show that productivity of the land could easily be controlled by soil depth, soil pH and soil texture along with climate. Soils on the flat regions that are rocky, shallow and sandy are no better than lands on steeper slopes with optimum soil and climatic characteristics in terms of the ranges of land use to choose from. Technological advancements allow the use of areas with steep slopes by applying some engineering works such as terracing. It is well understood that slope limitation of agricultural lands can be economically corrected either through vegetative or mechanical control measures of soil erosion. Likewise, as a vegetative soil erosion technique, suitable economic tree crops could simulate the effect of forest trees on lands susceptible to erosion due to slope and climatic conditions.

Viewed from the aforementioned perspectives, it can be said that the choice of land use requires an analysis and integration of a diverse range of physical (soils, topography, climate) and socio-economic (income capacity of the crops, land use preference of the farmers, market and credit facilities) parameters. The choice of land use (forest, economic tree crops, seasonal, urban settlements, etc.) therefore actually depends on the compatibility of the designated use with the physical and economic environment and as they relate to the development goals and directions envisaged by the Government and its people.

b. Conflicting Land Use Statistics Resulting from Sectoral Approach in Land Classification

Maybe because of the nature of bureaucracy in the Philippines, the magnitude of diversity of the concept of land classification is directly related to the range of sectoral interests of the existing agencies concerned with agricultural, forestry, and related land use. In most instances, the concept of land classification of many agencies (BFD, BL, BAEcon, etc.) relates to the grouping of existing land use which are entirely different from the real technical implications of land classification. The statement of the President to reclassify *"all lands for their most economic use"* summarizes the need to re-evaluate as well as unify our land classification concepts that should encompass the traditional present land use grouping/classification by many governmental instrumentalities. This message *in fact calls for a more comprehensive knowledge and basis about the use of the land and the selection of the most suitable crops.*

The "workgoal" concept of various agencies for "land classification" are generally confined to the recording of generalized information about various land use categories such as (Bureau of Lands' Land Classification System, cited in the main report, Volume I, by the Steering Committee on Policy Study, 1981):

(i) Judicially registered lands;
(ii) Covered by Public Land Application;
(iii) Renewing alienable and disposable areas;
(iv) Timberland;
(v) Unclassified lands.

In a similar report of the Steering Committee on Policy Study, another set of land use classification was quoted from the works of the National Census and Statistics Office

which provide the following classes of land use:

(i) temporary crops;
(ii) idle;
(iii) permanent crops;
(iv) permanent meadows and pastures;
(v) covered with forests;
(vi) all other lands.

The above sets of classification are formulated in such a manner that it is "office-oriented" and therefore limits the range of clientele it may serve. Besides, the resulting statistics for similar information, may, in most instances, not in full agreement between and among sources of information.

In as much as the desired output by the President is of great importance to long range planning for the exploitation of available lands for production, a unified information on statistics about land use and land capability is in order.

Land use researchers are in common agreement that information about present land use is not adequate to determine in full the land use suitability of a given economic and environmental region. *At best, present land use provides us a good preliminary indicator about land use preferences of the farming community, available indigenous technology of the existing crop, and possibly some limitations of the land. It does not however, give us the best use of the land and the best crop compatible with the desires of the people and the biophysical environment.*

RELEVANT ISSUES ON THE FORMULATION OF PROGRAMS AND PROJECTS

In the area of land use allocation, the basic questions that must be put forward are:

(i) What are our goals and the basic context of our development?
(ii) What is the present scope of development in terms of farming systems and its relationship to agro-based industries?
(iii) What are our resources available for future and immediate needs?

Goals Setting

Any professional/technical methodology for comprehensive data base generation must be consistent with the basic development issues defined by planning authorities. The design, quality, and quantity of data are directly dictated by the statement of goals and objectives as these will shape the pattern of development and define the nature and amount of logistical support to the actual implementation of development plans. It is therefore necessary that in the formulation of technical methodology for assessment of land suitability, a close consultation of land use planners and land use researchers must be strictly considered.

Present Scope of Development

Aside from knowing various technical biophysical and socio-economic parameters of the site development there is a need to assess the present state of management both on the producers as well as the government side. This will give us an idea about the actual needs of the community where a project is being set for study and implementation.

Assessment of available resources

As of the moment, on a nationwide basis, there is a conflicting version from various statistical sources, about the actual technically utilizable land resources against the actual demand of the country. A flexible and comprehensive information about utilizable land resources is basic to any sound and implementable planning exercise.

RECLASSIFICATION OF LAND THRU INTEGRATED LAND RESOURCES EVALUATION TECHNIQUES

State of the Art

The current dynamism in development technologies, planning concepts and formulation and implementation strategies requires an equally flexible, comprehensive range of land resources inventory and evaluation scheme.

Since the pronouncement of the President categorically placed food production as an immediate concern, land classification should focus principally on agriculture: In this case, agriculture is central, and other uses (e.g. forest) are residual.

It is given knowledge that agricultural activities are one of the vehicles of men in accelerating erosion: Classification and evaluation of land potentials should focus on land use equation where total production activities are made to adjust with the thres-

hold limits of the soil and its environment and not vice versa.

Years of experience by the Bureau of Soils in providing a package of land Resources Evaluation study to national/provincial/municipal planners clearly indicates that inventory and evaluation of lands for agricultural development are highly context sensitive. This means that design and framework of inventory and analysis of data and information are closely designed with the objectives and development issues in the study area.

The magnitude and dimension of data generation is dependent on the nature and type of planning activity (i.e. program levels or project levels).

OBJECTIVES

General

1. To identify and evaluate the prime agricultural lands and recommend a professional scheme for their utilization, conservation, and development;
2. To identify and evaluate the critical watershed or ecological zones and make recommendations for their rehabilitation and conservation;
3. To provide a nationwide comprehensive land resources data base that will facilitate the packaging of regional/provincial/municipal programs and projects.

Specific

1. To characterize and evaluate the biophysical and economic dimensions of various existing and potential farming systems in all potential agricultural lands;
2. To identify and rank according to social acceptability the various existing and potential land utilization types in the development regions;
3. To identify and evaluate land management constraints of individual agricultural management/physiographic units and recommend appropriate economic corrective measures;
4. To determine and evaluate the extent of land degradation (e.g. erosion, sedimentation, salinity, etc.) directly caused by the existing land utilization and management schemes and determine its impact on the environment;
5. To formulate, recommend and rank according to potential productivity, a comprehensive range of socially acceptable and economically viable land use options/alternatives for each existing and recommended farming system.

Scope of Data Documentation

Basically, the study involves an integrated, multi-disciplinary land resources survey which is aimed at identifying the range of land uses that are compatible with the indigenous technology, viable farm system concepts and with the total immediate and adjoining environs.

In this approach, the basic parameters considered, either singly or collectively, in the assessment of the present and future farming system are:

(i) bio-physical elements,
(ii) socio-economic elements, and
(iii) institutional elements.

These elements are studied simultaneously in the representative farms of potential agricultural physiographic units which are considered, within the context of the study, as the smallest units in the utilizable areas in the highland's agricultural landscape.

(i) Bio-physical resources: These aspects include the relevant information about the soils, vegetation/land use, agronomy, topography, and climate. These information are considered important in defining the type, appropriate mix, and management requirement of a given land use. Within the context of mapping or segregating mutually exclusive land management units for the highland regions, the bio-physical resources constitute the basic characteristics of individual land mapping units which are the initial basis for interpreting potential land use.

(ii) Socio-economic resources: These include management parameters such as crop yield, off-farm and non-farm income sources, farm area, type and amount of management inputs, farm ownership/tenural status, degree of family labor participation and other relevant economic parameters unique to the region. A close tie up between the bio-physical and socio-economic resources is done when characterizing selected landscapes in order to arrive at the definition and location of the spatial distribution of prime agricultural lands in the study area.

(iii) Socio-institutional resources: Generally, these involve collecting secondary information about population, market facilities and credit institutions. The primary information generally refers to:

a) flow of goods and farm products from the farm gate to the ultimate consumer, and
b) general attitude of the farmers to possible changes in land use.

Collectively, the socio-institutional resources provide a rationale about the present state of farm productivity from the viewpoint of interplay of institutional forces and performance of the farm and the farmer in a given farming enterprise within a specific agricultural physiographic land management unit.

The design and degree of detail of documentation are dependent on the nature, stage, and level of planning (Table 2).

Program-oriented land resources evaluation:

This kind of study involves extensive areas generally province-wide. Development goals are well defined, but, specific objectives are yet to be clearly spelled out. At this stage, the best index of development is the land use pattern and slope characteristics of the region. Conceptually, the more complex the land use patterns are, the more chances of crop diversification could be expected. In the same situation, variations in land characteristics can be expected. Conversely, if, historically, the area persisted to have limited number of land uses, crop diversification could be a very important issue for the planning authorities. Under this situation, combined sociological (farmer's attitude for other crops) and technological (effective extension services) factors could be the primary concern in the formulation of development plans and strategies for the study area.

Table 2

COMPARATIVE TECHNICAL MAPPING REQUIREMENTS OF PROGRAMS AND PROJECT DEVELOPMENT STUDIES

		PLANNING STAGES	
		Program Development	Project Development
1.	Type of Evaluation Survey	Semi-detailed to Reconnaissance	Detailed to semi-Datailed
2.	Map Scale	1:50 000-1:250 000	1:10 000-1:50 000
3.	Minimum area reflected on maps		
4.	Map units	Land systems, land facets, physiographic units	Soil series, phases association of soil series/phases, land facets, physiographic units.
5.	Type of data used	Generally secondary with some field verification	Generally primary data supported by very recent secondary or even tertiary data.

Methodology

Systematic collection, synthesis, classification and transformation of land resources data into a problem-oriented information is an important tool for an effective formulation of plans and programs on integrated area development.

Within the context of this paper, inventory and evaluation of land resources are envisaged to provide a comprehensive information about the distribution and efficient utilization of prime and marginal lands.

The general framework and processes developed by the Bureau of Soils in appraising land development potentials are indicated in Figure 2.

For this kind of evaluation, the following stages are undertaken:

1. Prepare land use map:
   a. Assess, rank according to area, the most extensive dominant and associated land use;
   b. As agreed with the planners, either first 5 or 10 each for dominant and associated land use are assessed and matched with the physical conditions of the soils and land as well as climate.
2. Prepare slope map:
   a. Determine which set of crops dominate a given slope group. At this stage, we assume that strong relationships between land use and slope pattern do exist. At a regional scale, this assumed correlation adequately provides the initial approximation of sets of land use that are in close agreement with the environment of the area.
3. Prepare land limitation map. This is done by using maps on land use, slope, and soils. Possible limitations are:
   a. Permanent land use such as coconut, economic tree crops, built-up areas, irrigated rice areas and fishponds. These kinds of land use are considered constraints because of their economic importance, high cost of investment and longer productive life span (e.g. tree crop) or the high cost of infrastructure (e.g. irrigated rice, built-up areas);
   b. Steep slopes—generally greater than 35 percent slopes are considered;
   c. Shallow and/or eroded soils;
   d. Surface impediments (rockiness/stoniness);
   e. Flood hazards;
   f. Drainage (wetness of soil);
   g. Accessibility.

Lands with these constraints adversely affect the crops and the environment and are therefore initially excluded from the suitability and evaluation studies.

4. Prepare potential land use zones map. This is the evaluation and matching of land characteristics and qualities with the agronomic and environmental requirements of the selected land utilization types. This output is envisaged to provide insights about potential projects and sites for further evaluation.

Figures 3, 4 and 5 illustrate the activities/outputs for program-oriented land evaluation.

PROJECT-ORIENTED LAND RESOURCES EVALUATION

At this stage of planning, basic issues of development are already defined. The general direction of development, basic objectives and development strategies are well conceptualized. Designs and objectives of the resources evaluation as well as the magnitude of information must conform with the data requirements of the stated objectives of the development project. This, therefore, requires an in-depth, closely coordinated generation of multi-disciplinary information which focuses on the influence and complex interplay of bio-physical resources with the socio-economic and climatic elements on land productivity.

In general, the framework of approach (Figure 2) includes:

I. Definition of basic development issues, objectives, and land use preferences: This is done by conducting a dialogue between Land Evaluation Technical Staff and various government instrumentalities and farmer leaders concerned with the formulation and execution of plans.

II. Geographic identification and characterization of prime and marginal lands, the farming systems, and present land use: This delineation of land units into categories of productivity is the key to the site identification

Figure 2.

FLOW CHART
COMPREHENSIVE LAND RESOURCES EVALUATION
FOR LAND USE POLICY FORMULATION

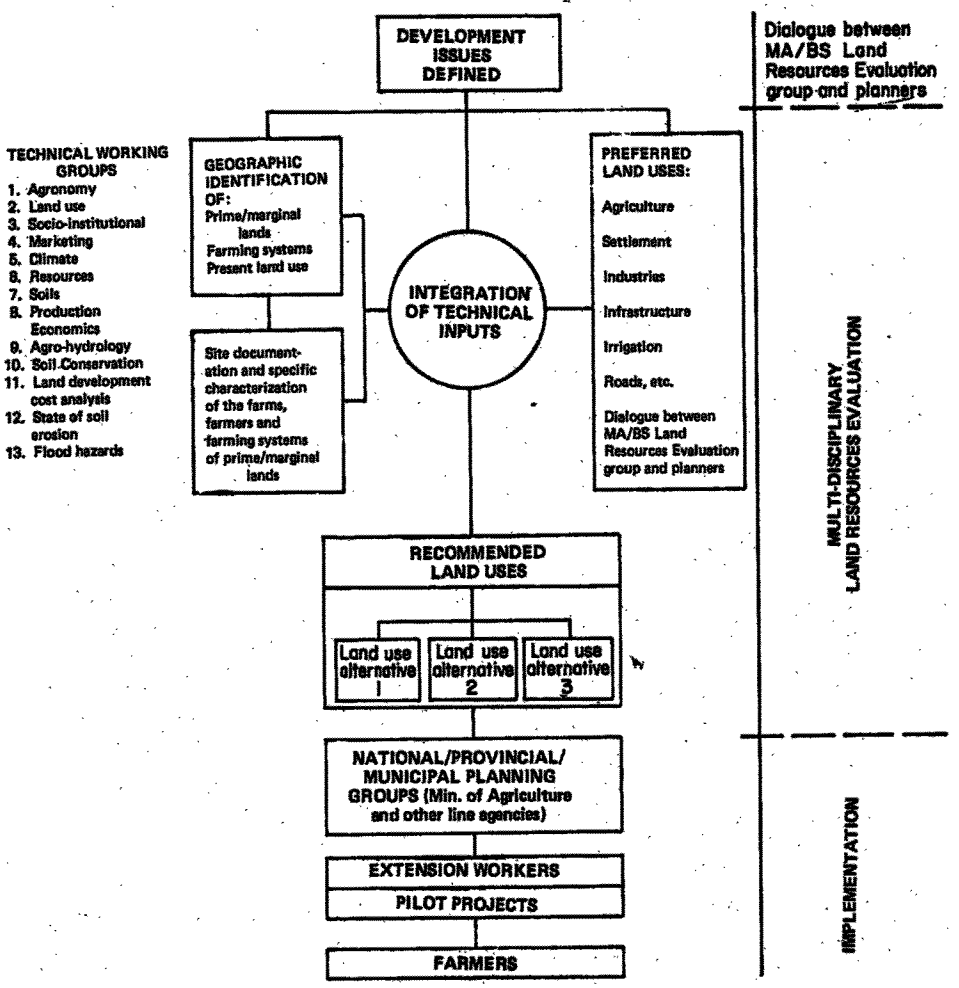

Figure 3

LAND USE MAP

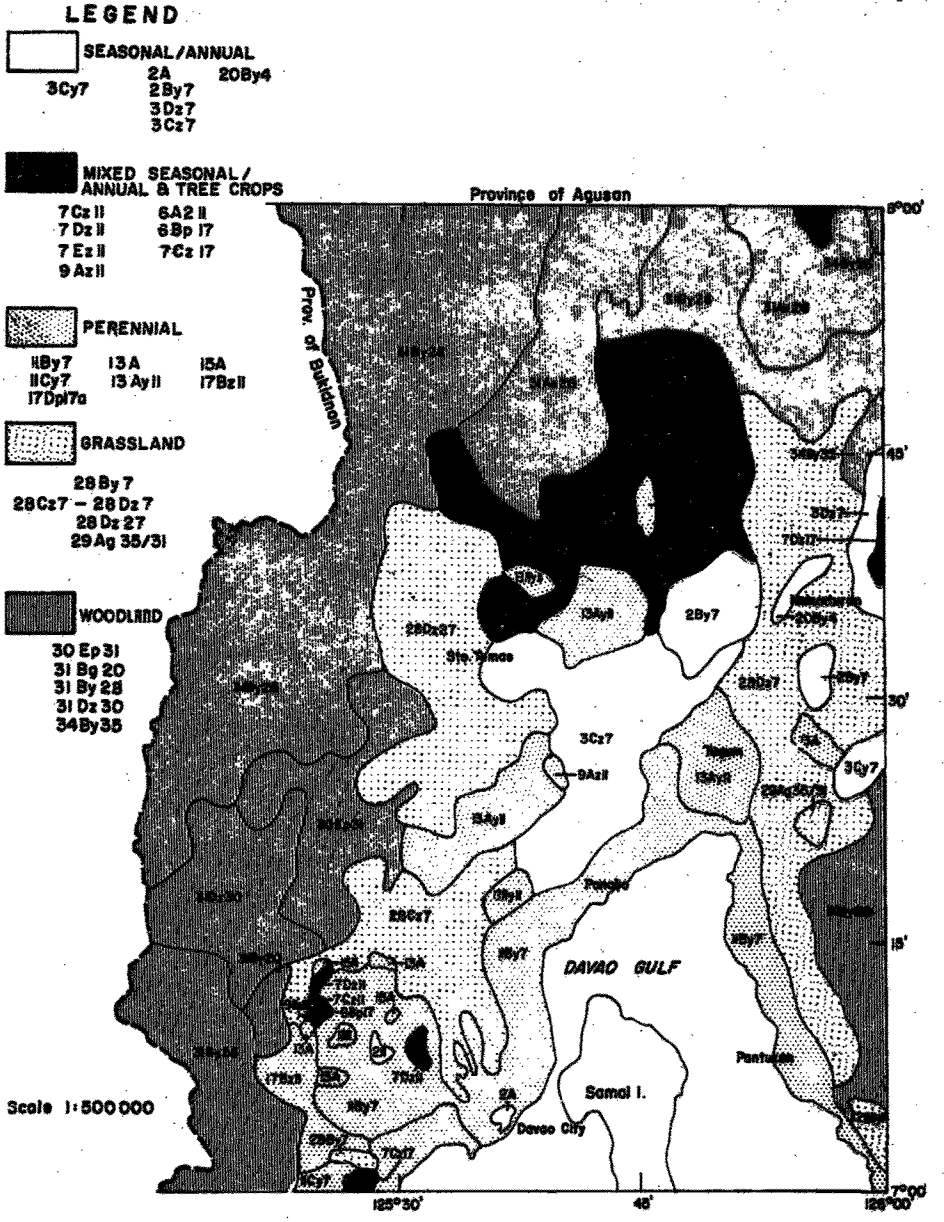

FIGURE 4

POTENTIAL LAND USE ZONE MAP

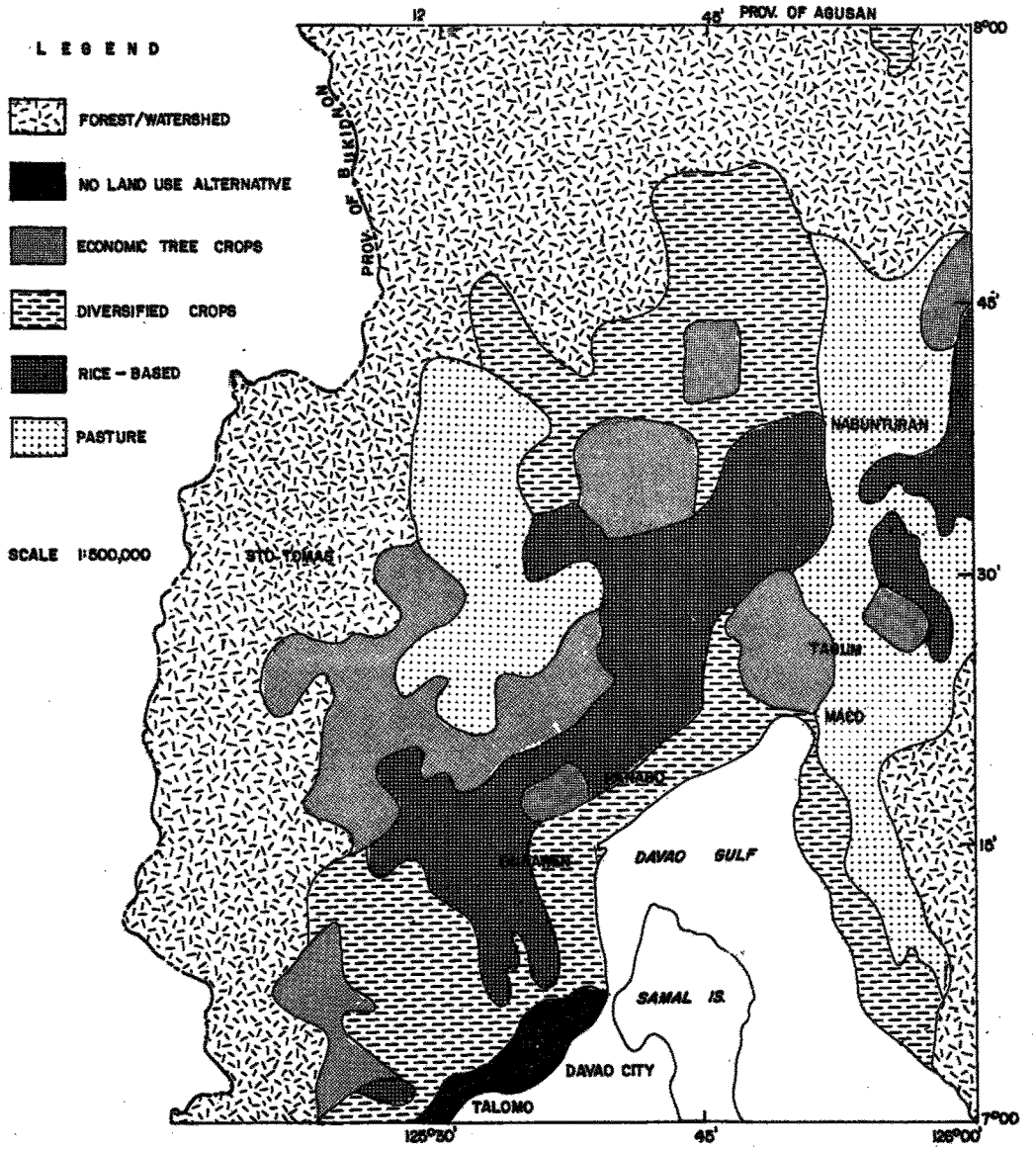

Figure 5

SCHEMATIC DIAGRAM INDICATING RELATIONSHIP AMONG BIO-PHYSICAL ECONOMIC AND SOCIO-INSTITUTIONAL RESOURCES OF EASTERN PANGASINAN

	2		9b		7	
GROSS YIELD (Kg./Has.)	3770 CITRUS	1254 ONION	1158 TOBACCO	2784 EGGPLANT	1000 TOBACCO	4008 EGGPLANT
NET CROP INCOME (P/Has.)	21545	765	3278	1358	2232	3074
GROSS HOUSEHOLD INCOME (P/ Farm)	9159	6212	5078	6771	5992	13125
PREDOMINANT CROPPED AREA (HECTARES)	0 46	0.76	0.66	0.62	0.81	0.58
LAND TENURE	OWNED	LEASED	OWNED		OWNED	
LOCAL MARKET OUTLETS	EASY		EASY		EASY	
FERTILIZER REQUIREMENTS N	HIGH		HIGH		HIGH	
FERTILIZER REQUIREMENTS P	MEDIUM		HIGH		HIGH	
FERTILIZER REQUIREMENTS K	MEDIUM		HIGH		MEDIUM	
GENERAL LEVEL OF FARM MANAGEMENT TECHNOLOGY	IMPROVED		IMPROVED		IMPROVED	
SOIL CONSERVATION COST/ACTIVITIES	CONTOUR PADDIES -P 4300.65/Ha.		DRAINAGE INFRASTRUCTURE		MINOR IMPROVEMENTS	
	ALLUVIAL FAN		SEASONALLY FLOODED ALLUVIAL PLAIN		RIVER LEVEE	
GEOLOGY	ALLUVIUM		ALLUVIUM		ALLUVIUM	
SOIL DEPTH	DEEP > 100 cm.		DEEP > 100 cm.		DEEP > 100 cm.	
SLOPE	3—5 %		1 —2 %		1 — 3 %	
TEXTURE	FINE LOAMY OVER CLAYEY SKELETAL		FINE LOAMY TO FINE CLAYEY		FINE LOAMY OVER CLAYEY	
DRAINAGE	MODERATE TO WELL		MODERATE TO POOR		MODERATE	
SURFACE IMPEDIMENTS	5% STONES & BOULDERS		NONE		NONE	
EROSIONAL FEATURES	NONE TO SLIGHT INSIPIENT EROSION		NONE		NONE	
LAND USE	Paddy rice, tree crops, onion, etc. (dry season), citrus, cogonal		Paddy rice, Fruit trees, tobacco, veg. etc. (dry season), shrubs, grasses, residential		Paddy rice, sugar cane, veg, etc. (dry season), banana, residential	

of the most viable projects. At this stage, agricultural productivity of the project area is identified and assessed in terms of management systems, land use pattern and other broad elements of productivity.

III. Site documentation and specific characterization of selected farms, farmers and farming systems in the representative land units for marginal and prime agricultural lands: This stage involves getting of primary technical data on soils, economics of production and environment that are relevant to the preferred land utilization envisaged in the basic objectives of the project.

IV. Evaluation or integration of various sectoral disciplines for land use decisions. This considers strongly the participation of the authorities concerned with use of land resources data and information. This is done thru a colloquium where processed data are presented to the planning groups for comments and/or approval. During the dialogue, adequacy and deficiency of data and information are clearly threshed out. To facilitate communication between the planning groups and the technical staff, data and information of all participating disciplines are transformed into maps and visual aids.

V. Formulation of land use and conservation management measures: For each land unit—both marginal and prime lands—sets of land use are recommended with a range of land use options/alternatives to choose from. Each set of land utilization is defined in terms of income, capacity and land conservation.

VI. Formation of ad hoc technical advisory team: This is formed to assist the users in further re-evaluation of technical information that may be needed in any future readjustment or changes in the development scheme and strategies.□

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