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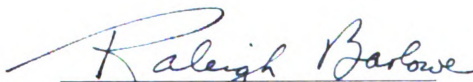
Land Development and Use Problems in Puerto Rico
with Particular Reference to Two Selected Areas

presented by

SALVADOR ALEMANY-PLANELL

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of the requirements for

M.S. degree in Agricultural Economics


Major professor

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ABSTRACT OF 1970

LAND TENURE AND LAND USE PROBLEMS IN PUERTO RICO WITH PARTICULAR REFERENCE TO TWO SELECTED AREAS

By

Salvador E. Alegany

Problems of land development and utilization are of paramount importance in overpopulated areas such as Puerto Rico. Thus, the Island is faced with the task of increasing its per capita economic supply of land. This study was set up with the objective of discussing, presenting and analyzing four problems hindering sound land utilization in Puerto Rico.

The first problem concerns the uneven contribution to the Island economy, of the coffee growing region as compared to the sugar cane growing region. The value of sugar cane production in some years has been twelve times as high as the value of the coffee crop. As examples of the land use areas of the Island, one might take two municipalities, Aguadilla and Jayuya, the first representing the sugar cane growing region, the latter the coffee growing region. Aguadilla is characterized by a more intensive use of the land and a higher population density than Jayuya where intensity of use is not as high and the percentage increase in population has been low.

The second problem involves the urgent need for more input-output studies designed to promote a more efficient and adequate allocation of resources in an agrarian economy that needs to make more intensive use of the land to cope with population requirements.

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important to any well-planned crop production program will be the establishment of a soil testing division.

A third problem concerns the need for preventing land misuses and for adopting better cultural practices. In many cases sugar cane culture has been expanded into the hilly areas. Over the short run this has been profitable, but in many cases, because of the soil exploitation involved, it will not contribute to the long-run welfare of the island. A program for the optimum development of the island resources must involve both the identification of present misuses and the direction of farming practices toward the correction of land misuses and the promotion of sound land utilization.

Finally, attention is given to the importance of an adequate marketing structure. Land capabilities are not fully exploited if the marketing structure does not provide for an ample range of land uses, which permit optimum land use.

The island land utilization pattern has developed within a very complex system where physical, climatic, and institutional factors have combined to make something of a riddle out of the problem of land utilization. Of primary importance has been the political changes which have favored the establishment of a monoculture economy based on sugar cane.

Action programs now in operation in Puerto Rico are discussed to show the steps taken by the Government in improving the use of land and its orientation toward sound development. Particularly outstanding is the program of Rural Land Utilization which is expected to be the cornerstone in future agricultural programs designed to

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Major Professor

LAND DEVELOPMENT AND USE PROBLEMS IN TOLUO RIVER
WITH PARTICULAR REFERENCE TO TWO SELECTED AREAS

by

Salvador E. Alemany

A THESIS

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CHAPTER I

Introduction

Puerto Rico is one of the most densely populated areas in the world, and has only a few natural resources. Thus the problem of better land utilization and development will play a prominent role, if the present standards of living are to be improved, or at least maintained.

Trends of continuous increase in population can be foreseen. The more people there are, the greater will be the social problems. And the greater will be the responsibility of every one concerned to play his own part, and play it with finesse and devotion, if any degree of desirable social welfare is to be attained.

To have a better idea of the present stage of the problem, let us use the words of Chancellor Benitez of the University of Puerto Rico.¹

The population density of Puerto Rico is over six hundred persons per square mile, fifteen times greater than that of the United States. Population pressure in the United States would begin to compare with that of Puerto Rico if all the people of the world--over two billion men, women and children--landed there overnight and if, by the same nocturnal magic, all available mineral resources were eliminated, heavy industry disappeared, and agriculture became the main source of employment. I do not say that mainland ingenuity would be incapable of solving such a riddle. The solution might be so adequate and audacious as to keep under control unemployment, illiteracy, and disease and at the same time foster production, efficiency, and democracy.

¹Perloff, Harvey S., Puerto Rico's Economic Future: A Study in Planned Development, The University of Chicago Press, Chicago, Illinois, 1950, page v.

...in which we can discover the Puerto Rican people and their land and in the trying to correct the existing conditions. ...a test which is both within and without existing.

As this statement implies, every effort in the solution of the island problems should center around two inevitable facts - high population density and a predominant dependence upon agriculture in the Puerto Rican economy.

The Island and Its Problem

Population density per se does not mean poor standards of living. The important thing to consider in any land economic study is man in relation to land,² not in relation to the space, or a given area expressed in terms of a surveying unit. So, in looking to the Puerto Rican situation a relationship of man to resources and the environment within which man is unfolding will be more meaningful.

Due to lack of data which bear on the existing relationships between man and resources, the so called man-land ratio,³ we will be forced to use the conventional data as obtained from Census material and other sources.

In view of this fact we have to think of the problem in terms of 1,900,000 acres of land in farms out of 2,100,000 acres for the

²The term land in this dissertation is used in a broad sense. It includes the natural properties that are associated with it and that affect the productivity of land as much.

³Ely, Richard T., and Wenrwein, George S., Land Economics, The Macmillan Company, New York, 1940, pp 18-22.

whole island. But, of the total acres in farms, only 1,350,000 acres are tillable. This is explained by the fact that about 70 percent of the island is hilly and mountainous.⁴ Furthermore, we have to consider the low-productive capacity of the highly weathered, leached, and eroded soils of the tropics and subtropics, as compared to the rich soils of the different agricultural areas found in temperate zones.

A broad interpretation of marginality is employed by these estimates and they are somewhat optimistic as compared to the figures given by the Soil Conservation Service which extends the margin only to 1,000,000 tillable acres. The latter figure approximates the amount of land actually in cropland. Thus, Puerto Rico has (as of mid-1949) 0.45 acres of tillable land for every person. This compares with about three acres in cultivation per person in the United States--a highly industrialized country, with much less dependency on agriculture.⁵

The situation is therefore self explanatory and considered more critical when we remember that the niggardliness of the material environment is accentuated by a lack of understanding, knowledge and attitudes.

Climate in tropical and subtropical areas is in many ways an asset as it provides a full growing year that enables full exploitation throughout the year when the conditions are favorable for that ex-

⁴ Rivera, Santos Luis, Paper given at the Conference on World Land Tenure Problems on Tenure Innovations and Agricultural Production in Puerto Rico, University of Wisconsin, Madison, Wisconsin, October 8 to November 9, 1951, p 2.

⁵ Perloff, Op. cit., p 47.

ploitation. It permits the growing of many complementary products, grown only in these regions, which will mean greater purchasing power as compared to other products grown on more fertile soils but under different climatic conditions. On the other hand it may also be a liability, as there are many diseases and pests common under tropical conditions affecting both plants and animals as well. This does not mention the effect of climate on the activities of man. According to Huntington, "climatic conditions have a direct influence on man himself as a factor of production."⁶

In view of all these facts presented, Puerto Rico is faced with the problem of increasing its productive potential to provide for the need of a fast growing population. According to Renne a per capita increase in the economic supply of land may be accomplished in the following ways:

1. By bringing new areas into production;
2. By utilizing land more intensively;
3. By the removal of drawbacks or hindrances to make the best possible use of the area and obtain the greatest output;
4. By controlling consumption of products so that people will desire what the earth can produce most readily;
5. By reducing rate of population increase through birth control and other devices;
6. By controlling foreign trade to reduce exports of agricultural or industrial products to other nations or increase

⁶ Huntington, Ellsworth, Civilization and Climate, Third ed., Yale University Press, New Haven, 1924, Chapter VII.

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imports of such products from abroad, thus increasing the economic supply of land.⁷

At her present stage of economic development this is not an easy task, as many of the possibilities which may be true for other countries are out of consideration for Puerto Rico.

There are not many areas into which production can be extended and be profitably accomplished, after providing for the many developmental costs involved.

The second alternative, that of intensifying land use, has already been tried. Even under the present conditions, however, there is a great deal to be done. Some phases of agriculture, particularly sugar cane growing, are conducted on an intensive basis. But, even here the lack of input-output data that will help or guide our steps in the proportioning of the parts for a more efficient production of the whole for the benefit of the greatest number is apparent. Under the Island conditions it is of utmost importance to consider that this intensification should consider the conservation⁸ problem and that "application of 'know-how' is necessary to solve permanently the problem associated with the impact of population pressure against the food supply."⁹

⁷ Renne, Rolland R., Land Economics, Harper and Brothers, New York, 1947, p 23.

⁸ The term conservation has been used loosely but in this dissertation we specifically refer to it as presented by Heady, who refers to conservation as a "maintenance of a production function over time."

⁹ Barlowe, Raleigh, "Population Pressure and Food Production Potentialities," Land Economics, XXV, pp 227-239, 1949.

the present and the future. In the case of the underdeveloped countries, however, the emphasis is on the present. This is due to the fact that, with a lack of credit or little knowledge of its use, institutions tend to place considerable preference on the present, disregarding the future. Emphasis is centered on present income and under this condition adequate land use is of secondary, not of primary, importance to the unaware entrepreneur. In the same manner capital accumulation as far as possible and further development and creation of utility, if progressing, advances at a slow and sluggish rate. Further development can never be attained with a complete or even partial disregard of this concept. Since our economic environment is dynamic and everchanging, in order to keep pace with institutional and technological advancement there must be an equal or greater degree of development with due consideration of this criterion.

The remaining three ways in which the economic supply of land can be rationalized, as outlined in page four and five, are more intimately connected with institutional aspects, mostly of social and political origin. If any improvement is to be effected in this field it will come with the passage of time and the evolution of present ideas, thoughts, beliefs, and sets of values. This will require a great deal of cooperation between the economist and sociologist. It will undoubtedly be a field where much has to be done if many of the basic problems of underdeveloped countries are to be solved. This will be a proper matter for some other study and herein there will only be emphasis on the details relevant to this study.

The matter of controlling consumption so that people consume what the soil can most readily produce does not have full application to forests, rice, or other areas that are mainly producers of consumer

mentary products. The orientation in this problem should revolve around an exchange favorable to the Island. Or, in other words, the important consideration for the Island is to produce the products that will buy the most, even though in terms of physical production these products may not be the best adapted or most productive. With that premise in mind the trend should be toward specialization, as specialized products have a greater command of economic goods and services in the market.

Many of the agricultural economies of Western Europe and the Channel Islands have developed and raised their standards above those of many countries which have larger assets and vast amounts of natural resources. Thus, the problem may be approached by adequate planning and mutual understanding between planners and private entrepreneurs.

A reduction in the rate of population increase will undoubtedly relieve some of the population pressure, particularly when we consider the high natural rate of population increase.¹⁰ This will be something to be decided by the people themselves. The masses are the ultimate judges of their own destiny. But, for a decision of this kind, where soul and mind debate over this struggle, a high degree of education is unavoidable to provide the people with the proper tools to critically evaluate and make the proper decision that will carry them across life with the hope of a better future. This task, indeed, will be very dif-

¹⁰ Puerto Rico had a birth rate of 41 per 1,000 population. Since 1900, it has never been below 38 per 1,000 population, making it one of the highest in the world.

ficuit for a country mostly of Catholic origin and under these circumstances, "the best way to secure this end can come through voluntary reductions in fertility rates."¹¹

In commenting about the sixth way of rationalizing the economic supply of land, it should be mentioned that Puerto Rico does not have direct control, as this policy is administered through the Federal Government. Nevertheless, we should not overlook the fact that one of the regulations of the United States Tariff System¹² and the Sugar Act¹³ has placed Puerto Rico in a favorable position for sugar cane production. This factor has resulted in an extreme emphasis upon this industry at the expense of some other enterprises that merit attention if the goal is to secure a more flexible and stabilized economy. It is not implied by any means that the sugar cane industry should not be the revolving core of the Island economy. It is the main industry as a result of excellent environment as far as climate, soils, and economic conditions are concerned. But, disregard of sound land utilization for the sake of following the trend in sugar cane expansion will hinder the future development and stabilization of a more balanced economy.

The Sugar Act of 1948, passed by the United States Congress, re-established quotas for a five-year period. Puerto Rico has been

¹¹ Barlowe, Op. cit., p 238.

¹² Puerto Rico, being one of the domestic sugar producing areas, enjoys a protective tariff on sugar sold on the mainland.

¹³ Under the Sugar Act, Puerto Rican sugar cane growers receive due compensation if there is compliance with this law.

assigned a basic quota of 911,000 short tons but usually gets an increase in the reallocation due to failures of other domestic areas to fulfill their requirements.¹⁴

By 1953 there will be an increase in this quota, but the fact that deserves recognition is that the sugar industry is revolving in an artificial price medium created by the protective tariff and the compensatory payments to sugar cane growers. The absence of these artificial supports would create a competitive advantage for the low cost producing areas. The task then is to orient the agricultural production with due consideration of this limitation. This job would be easier if alternatives for shifting resources were favorable. But, ironically enough, production of other agricultural products is hindered by the lack of an adequate marketing structure, lack of credit facilities, and related problems.

The local market is easily flooded due to a very low purchasing power. Products that could make a better transformation of natural resources possible have to be disregarded for the lack of demand and absence of a better marketing system. Under these circumstances there will be a conflict of interests between the private entrepreneurs and the economist as to which direction to channel the expansion of agricultural production. Once the purchasing power is increased the task of expansion into other crops or enterprises will go on smoothly and the

task of compromising will be made easier as profits will be good enough to compensate for a conversion or higher degree of diversification.

"Raising the living standards of the nation and increasing the per capita consumption of farm products do not depend upon the smooth functioning of agriculture alone. The problem is one which brings up for consideration the satisfactory functioning of the entire economic system. If agriculture is to be restored to lasting prosperity, there must be an increase in the purchasing power of the general public."¹⁵ The problem will be to organize a developmental program in the manufacturing industries to go along in a parallel way with agriculture. Therefore, one will benefit from the other and will be conducive to a more efficient utilization and significant increase in productivity in one as well as in the other.

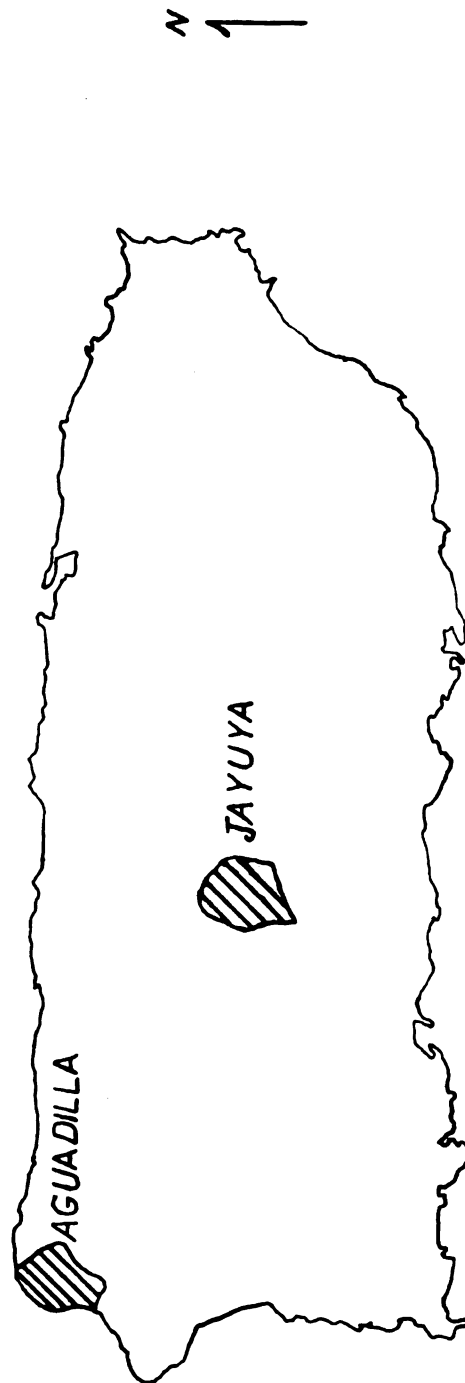
Areas Studied

In this study special reference is made to two selected areas. The relative location of the two areas on the Island is indicated in Figure I. They are the municipality of Jayuya which is located in the coffee growing region and the municipality of Aguadilla which is found in the sugar cane growing belt.

They are not typically representative, but this could hardly be said of any other two municipalities corresponding to both regions. They will be helpful, however, in the presentation of land use patterns

¹⁵ Gruchy, Allan G., Modern Economic Thought: The American Contribution, Prentice Hall, New York, 1947, p 345.

PUERTO RICO



② - AREAS UNDER STUDY

Figure 1 - Study area location of Areas Under Study

and in the comparison of undergoing economic and social phenomena representative of the mentioned regions.

Climatically and edaphologically they are different. Their main sources of agricultural incomes are different. Coffee is the main product of Jayuya, and sugar cane for Aguadilla. This is a typical case for Puerto Rico where despite short distances,¹⁶ wide differences are encountered. This is to be expected due to the great variability of island climates, accentuated by a great many differences in geological and topographical conditions which reflect themselves in the formation of a wide variety of soils.

Aguadilla is located in the northwestern corner of the Island with a sub-humid climate and Jayuya is in the rainy region of the interior of the Island.

Even though there is wide variation in soil, topographic and climatic conditions between these municipalities, the patterns of land utilization show certain similarities. Some are due to the wide adaptation to varied conditions, characteristic of some of the tropical products as is the case of the minor crops. Other similarities are due to the effect of institutional and economic factors. In this comparison there is a beautiful example of how these types of factors have caused the expansion of a crop--sugar cane in this case--to lands which can be considered climatically, topographically and edaphologically sub-marginal.

¹⁶ There are approximately 40 air miles between Jayuya and Aguadilla.

This is just the case where the distribution of land does not correspond as closely as do soils and climate, even though the distribution of climates and their associated soil and vegetative types provides the basis upon which all agricultural land utilization rests.¹⁷

The stage of cultural, social, and economic advancement is of primordial importance in the establishment of the land utilization pattern. The same kinds of soils are used differently throughout the world:¹⁸

On the sub-humid Chernozem lands of India the Hindu peasant raises cotton. On similar lands in Africa the Buganda natives raise cattle. In northeastern Australia the natives left the sub-humid Chernozem lands untilled and virtually unused prior to the arrival of Europeans. In our country these same lands provide the most productive areas for commercial wheat farming and cotton production that the continent possesses. It may seem, then, that there is no one use to which land can or should be put. The economy of the culture determines what constitutes optimum use, and even optimum use varies with fluctuations in economic conditions.

It is true that land utilization is greatly affected by the economy of the culture, but not less true that any evaluation of a land utilization pattern has to be judged after the definite inclusion of the economic factor. Once the capabilities and capacity of a given type of soil under given conditions of climate are determined, the next step will be to proceed to analyze the economic factor with the different alternatives. The best land utilization, then, will be that which returns the most, measured in economic terms, provided the future productive capacity of land is not endangered. In cases of extreme pop-

¹⁷ United States Department of Agriculture, Yearbook of Agriculture, 1941, Climate and Man, United States Government Printing Office, Washington, D. C., pp 121-122.

¹⁸ Ibid., p 122.

ulation pressure and relative scarcity of land, social incomes¹⁹ could also be included.

The problem, as in the case of Puerto Rico, will mainly consist in the elaboration of such tools or methods which will orient toward a more sound land utilization taking in consideration the economic and social returns. Once the right direction is established, planning can be conducted along those lines taking in consideration the future political and economic changes.

With such criteria in mind the task of evaluating the land utilization pattern of a region should be easier and goals or objectives for the future can be established.

Objectives

The purpose of this study is to present a critical analysis of the land use and development problems as they impinge on the Puerto Rican economy. Not only can they be presented to demonstrate the seriousness of the problems, but some light will be thrown as a help in their understanding.

The objectives may be summarized as following:

1. To discuss the uneven contribution of the different agricultural areas to the economy of the Island. Effects, trends, and potentialities will also be included.

¹⁹Social income is to include incomes that may not result in higher net returns per acre but will provide better distribution of gross returns, and all others that result in a gain for society. Such could be the case in high labor requiring crops as well as those which help in building up the fertility level of the soil.

2. To point out the necessity of having more input-output studies with the inclusion of the economic factor.
3. To determine the need of better cultural practices and prevention of land misuses.
4. To present the marketing structure of the Island and determine its effect on efficient land utilization.

The mentioned objectives should not be considered as an attempt to discuss, analyze and present all of the problems affecting land development and utilization in Puerto Rico. Shortage of time and lack of adequate data will limit the study in this sense, and not all of the facts having full bearing can be presented.

Generalizations will be made for the Island, and for coffee and sugar cane growing regions. As such, they will not have application for individual problem areas. The coffee and sugar regions will, generally speaking, be represented by the municipalities of Aguadilla and Jayuya as far as land use is concerned.

Individual problem areas, or problems at the farm level, could be covered by some other study with good possibilities of obtaining adaptable or flexible farm management and planning schemes according to their necessities. Such a study would consider the position and potentialities of the farm or the area in the developmental scheme.

In this study emphasis will be made on the possibilities of further development of both areas for higher production and better utilization of natural resources. However, the analysis will not rest

only on information drawn from the specific areas, but also other sources which bear on the matter will be utilized as well.

CHAPTER II

Setting the Framework

Location

Puerto Rico lies at the eastern extreme of the West Indies group known as the greater Antilles, which includes Cuba, Jamaica, Hispaniolia (Haiti and the Dominican Republic). The island is nearly rectangular and at its greatest dimension is 113 miles in an east-west direction. The average width north and south is about 41 miles. Including all the small islands under its jurisdiction, Puerto Rico has an area of approximately 3,435 square miles.¹

It has an approximate latitude of 18° north and about 66° west, longitude. Its position in the Caribbean area can be clearly seen by referring to Figure II, page 18, and its position in the Western World by referring to Figure III, page 18.

Puerto Rico is approximately 1600 miles southeast of New York, one thousand miles from Miami, sixty-five miles east of the nearest part of the Dominican Republic, and four hundred and fifty miles north of Venezuela.

History

On his second voyage to the New World, Columbus discovered the island (November 19, 1493) and took possession of it in the name of Spain.

¹Roberts, R. C., Soil Survey of Puerto Rico, United States Department of Agriculture, Bureau of Plant Industry, Series 1936, No. 8, Government Printing Office, Washington, D. C., 1942, p 2.

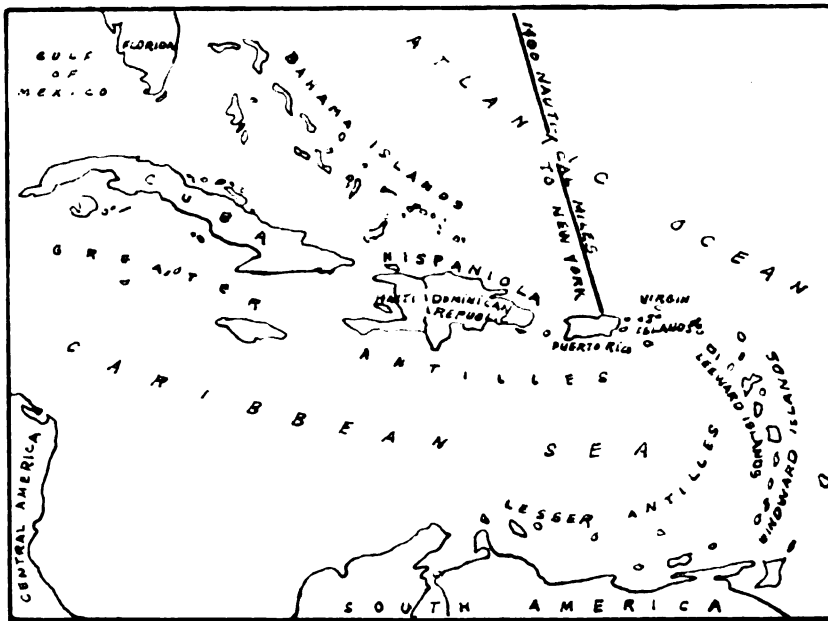


Figure II - The Place of Puerto Rico in the Caribbean Area

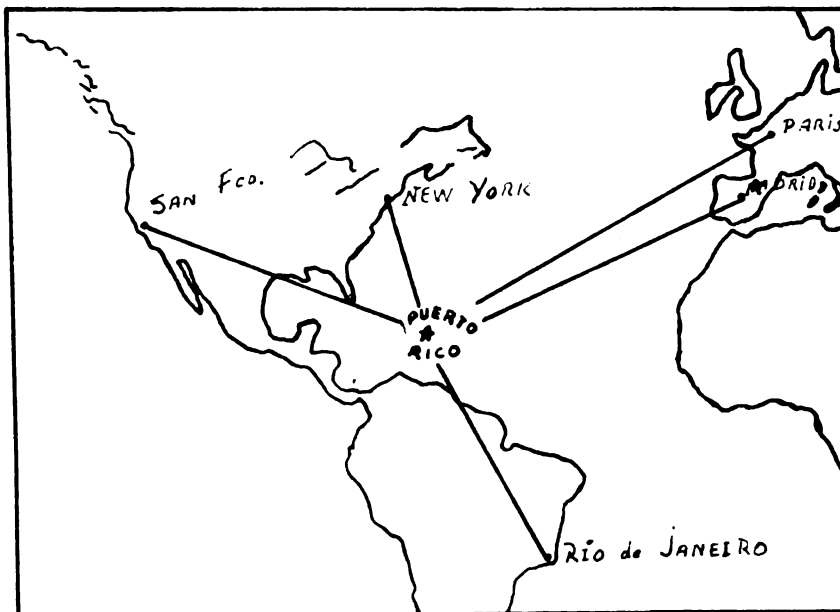


Figure III - The Place of Puerto Rico in the Western World

For four centuries Puerto Rico remained a part of the Spanish empire. In 1812, it was declared to be a province of Spain on an equal basis with the provinces in the Iberian peninsula. In 1897, the island was granted a self-government constitution and it became a virtual dominion.

The United States occupied Puerto Rico on October 18, 1898, during the Spanish-American War. Spain ceded sovereignty over Puerto Rico to the United States under the Treaty of Paris, proclaimed April 11, 1899. In that way Spain lost her last foothold in the Western Hemisphere.

From 1898 to 1900 Puerto Rico was administered by the War Department. In 1900 a civilian government was organized in accordance with the provisions of the Foraker Act. In 1917 this Act was superseded by the Jones Act under which the present government of Puerto Rico is organized. Under this Act all Puerto Ricans were made citizens of the United States.

In 1946 President Truman appointed the first island-born Puerto Rican as Chief Executive (Governor) of the Island. Next year the Organic Act was liberalized to permit the election of governor by the people and in 1949 the first governor was elected.

Another grant of greater autonomy came in 1950 when President Truman signed a Congressional Act authorizing Puerto Rico to draft its own constitution providing for full Puerto Rican control of insular political affairs. Under this Constitution Puerto Rico became the Commonwealth of Puerto Rico, with full control upon its insular affairs, as of July 25, 1952.

Physical and Climatic Description of the Island

Physiographic Description

Puerto Rico may be divided roughly into three principal physiographic divisions, each having its own geologic relationships. The most extensive division consists of the complex mountain ranges. The coastal plains, and the Playa plains complete the group of three.²

The island is divided into a southern and a northern part by an east-west mountain range, the crest of which is somewhat toward the south. This can be better observed by referring to Figure IV, page 21. This figure is a cross sectional representation of Puerto Rico showing configuration and the respective land uses.

To the south of the crest the relief is rugged and it is characterized by steep slopes. There are many ridges and ravines and it is common to find abrupt waterfalls. The north side of the crest, and extending toward the coastal plains, gradually becomes less rough. Cascades and waterfalls are also found on this side of the crest.

This extensive physiographic division is characterized by steep soil-covered slopes, A-shaped ridges, and V-shaped ravines that gradually change toward the coastal plains and interior valleys, to gently rolling hills and sloping ravines. The hills and mountain ranges do not have a uniform definite trend as do the hills in the coastal plain along the northern coast, but they have been deeply dissected by a dendritic system of stream development, and many of the divides are

²Ibid., p 3.

separated by gorge-like valleys ranging from 500 to 1,000 feet in depth. Many excellent dam sites for hydroelectric plants occur along the rapid-flowing rock-bottom mountain streams.³

Geologically the mountain ranges are of volcanic origin. The most abundant and widely distributed rocks are tuffs and shales. Due to a low content of quartz the weathering of these rocks produces a soil that is high in clay, medium low in silt, and low in sand.

Granite ranks next in extent to tuffs and shales, with serpentine predominating on the western part of the island. The granite produces friable soils, subject to erosion and usually requires continuous fertilization. Soils produced from serpentine rocks are very resistant to erosion but are not too fertile.

The coastal plains parallel nearly the entire coast line. They occupy a much more extensive area on the north than on the south, and only occupy a very few square miles on the east and west coasts.

The region at its maximum elevation is only 1,500 feet above sea level, but some of the roughest spots are found in this section due to caves and sinkholes caused by underground solution. The parent material is limestone and according to its composition distinct topographical belts are formed.

The playa plains include the level alluvial flood plains, the lagoon deposits, and the elevated beach sands. The flat alluvial flood plains occupy the largest area and comprise the most valuable agricultural land. The soils are developed from transported material and,

³ Ibid., p 7.

therefore, range in texture from coarse sands to clay. They occur at very low elevations, generally not more than 10 feet above sea level.⁴

The lagoon deposits are found on the coastal lowlands. They are not too good for agricultural purposes, as they are generally either under water or the drainage problem is too great. A sandy beach is found almost along the entire coast line. It ranges from a few feet wide to more than a mile. It also lacks agricultural importance.

Climate (Rainfall, Temperature, and Hurricanes)

Puerto Rico, as could be expected, has an oceanic climate, under which ideal rainfall conditions would be thought to prevail. But, in this case, due to its topographical configuration there are wide variations in the amount of rainfall that falls in the different regions of the island. A clearer picture can be obtained by referring to Figure V, page 24, for an observation of the many geographic regions which are present, although the area is quite limited.

The average annual precipitation ranges from less than 30 inches in the southwestern part of the island to nearly 200 inches on the highest peaks in Sierra de Luquillo.⁵

This would mean more for agricultural purposes if interpreted in terms of effective precipitation, as the amount of water left to be

⁴Ibid., p 14.

⁵Ibid., p 47. Climate and Man, Yearbook of Agriculture of 1941, reports a maximum annual precipitation of 136 inches and a minimum of 27 inches. There is not much difference, however, between these data and those reported by Roberts and others.

PUERTO RICO

GEOGRAPHIC REGIONS

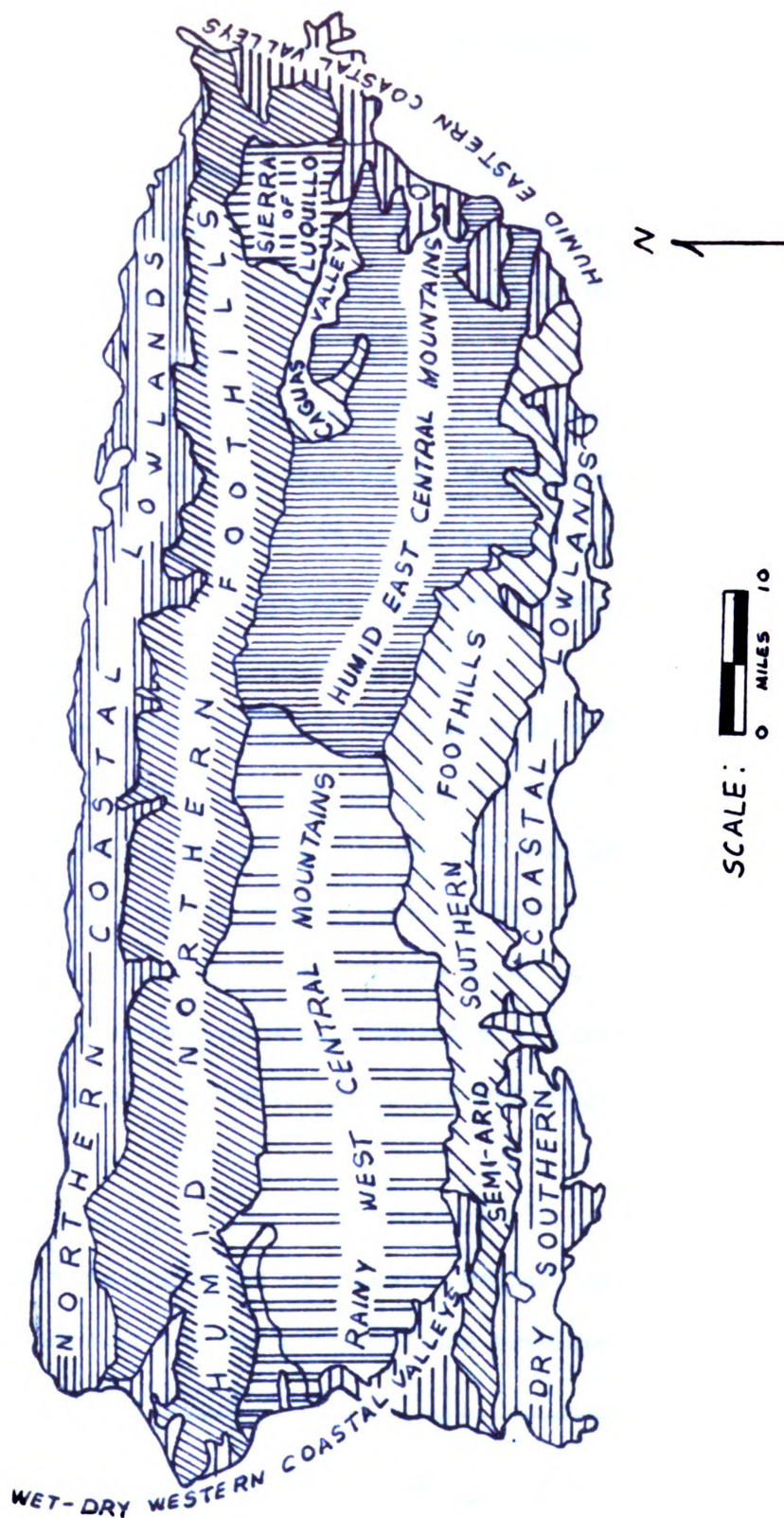


Figure V

Source: Adopted from Donald P. Dyer, Ph.D. Thesis. Cp. Cit. p. 11. (After map of Geographic Regions by Pico')

used by crops is dependent upon the temperature, wind, and type of soil. This is even more important when the intensity of rainfall is considered, as well as its distribution.

There are no definite seasons in Puerto Rico as far as rainfall distribution is concerned. There is a rainy period from May to November characterized by intensive rains and a dry season during the other six months.

The mean winter temperature of the northern and eastern coastal towns is about 75° F. and the mean summer temperature about 80° F. Mean temperatures are probably 2° or 3° higher on the drier southern coast in both seasons. In the mountains, temperatures average from 5 to 10 degrees lower.⁶

Another climatic factor that has greatly affected Puerto Rico, and one not often thought of, are the hurricanes. But they, without any doubt, have been a hazard in the agricultural development of the island, particularly in the coffee region. Violent storms of this type visit some part of the island about every seven to ten years, and hurricanes of less intensity come more frequently.⁷ These storms are violent enough to destroy most forests, crops, and buildings in their path.

Soils

Such a wide variation in climate, relief, parent material and the native vegetation has brought about the development of a broad soils

⁶ U. S. Department of Agriculture, Op. Cit., p 221.

⁷ Ibid., p 223.

complex. "Many of the world's great soil groups are represented in Puerto Rico by some of the 115 soil series (including 352 soil types and phases). This is an unusually large number of soils for an area smaller than some of the western counties in continental United States."⁸

Variability is the rule, not the exception. Since soils are the most important part of the physical setting within which land use operates, we should account for the factors that have direct influence on the variable pattern of soil formation in Puerto Rico.

The native vegetation ranges from the desert shrub type to the typical rain forest type. The elevation ranges from sea level to 4,398 feet above sea level on Cerro de Punta south of Juyuya. The relief varies from level to precipitous. The age of the soils ranges from that of the recent alluvial deposits along streams and young soils on steep slopes to that of the very old soils developed on nearly flat remnants of ancient plateaus. The parent material has been produced from different kinds of rocks. Climate and its variabilities have already been presented.

Soil scientists will be more interested in soils from an agrological or edaphological point of view. The economist will look to it as land--as a factor of production. Once the characteristics and capabilities of that land are interpreted by the soil scientist they are passed on to the agricultural economist, who with the objective of a more efficient utilization investigates the alternatives, and proceeds in the proportioning of those factors for the accomplishment

⁸ Roberts, Op. cit., p 171.

of that end.

To both, it is of primary importance to know the productive capacity of the soil—it represents a milestone and it is a good starting point in the process of utilization.

Information of this kind on Puerto Rico is presented in Table I, page 28. It represents an inventory of the productive ability of the soils in the areas included. As this type of general information fits the purpose of the study, specific information in regard to the minor units used in soil classification has been disregarded.⁹

The unit used in measuring the productive capacity of the soils is reported in the tables as the productivity ratings. A clear understanding of this concept must be secured in order to make it more useful for economic studies and meaningful to the eyes of all agricultural workers.

All relevant facts to this item will hereby be included, as presented by Roberts and others.¹⁰

The ratings compare the productivity of each of the soil types or other mapping units on the island for a given crop to a standard, namely, 100. This standard represents the average acre yield obtained from the most productive soil type or types producing the given crop under current practices. A soil with an index of 50 produces an acre yield of about one-half of that produced by the soil having the standard index. In some instances, owing to irrigation or very favorable conditions for the growth of certain crops, some soils have an index exceeding 100.

⁹If specific information is desired refer to the Soil Survey of Puerto Rico, pp 392-407, where specific information on productivity ratings of soil series, types, and phases is given.

¹⁰Roberts, Op. cit., p 408-409.

Table I: Soil Areas of Puerto Rico, By Geological Formations, Percent of Total Area, and Average Productivity Rating for Each Formation

Geological Formation	Area in Cuerdas ¹	Percent of Total	Average Productivity Rating ²
Hills and Mountains	1,540,608	71.2	7.7
Inner Plains	104,320	4.8	3.6
Terraces	86,656	4.0	3.8
Alluvial Fans	35,136	1.6	2.2
Flood Plains	153,920	7.1	2.6
Flood Plains and Coastal Plains	28,224	1.3	2.5
Coastal Plains	124,800	5.8	5.3
Coastal Lowlands	61,056	2.8	5.8
Swamps	<u>30,336</u>	<u>1.4</u>	<u>9.9</u>
Total All Formations	2,165,056	100.0	6.6

¹One cuerda equals .9712 of an acre.

²Most productive soil has a productivity rating of 1 and the least productive of 10.

Source: Colon-Torres, R., Soils of Puerto Rico Classified by Geological Formations, Series, Types and Phases, with Productivity Rating of Each Based on Inherent Qualities of the Land, Area and Percent of Total Area, University of Puerto Rico Agricultural Experiment Station, Mimeographed Report No. 19, November 1941.

The factors influencing the productivity of well-managed land are mainly those of climate, soil and relief; and all are concerned in the determination of the productivity ratings. Crop yields from well-managed farms furnish the best available summation of the factors contributing to soil productivity, and therefore they have been made the bases, so far as information is available, for the determination of the indexes. Some soils, such as the Toa, Coloso, San Anton, and Altura are used almost entirely for the production of sugar cane. These soils are the most productive for many crops, but they are rated only for sugar cane. Most of them undoubtedly would have a rating far exceeding 100 for many truck crops, such as yautias, beans, pigeonpeas and bananas, but as these crops can not compete with cane on this valuable productive land they are not grown, and therefore any rating given crops other than sugar cane on this land would be estimated.

The most productive land has a rating of 1, and the least productive rates 10. It must be clearly understood that the productivity ratings are not to be interpreted directly into specific land values. The intention is to confine attention to essentially permanent factors of productivity and not to include transitory economic considerations.

Information is also given in terms of approximate yield for each rating in the Soil Survey of Puerto Rico.¹¹ It will serve to make comparisons, particularly at the farmer level and he will be in a position to recognize where he stands as compared to the other growers or conditions.

In assessing the productive capacity of the island soils it can be noticed that the most extensive area is the least productive with an average productivity of 7.7. It is only exceeded by the area in swamps with an average productivity of 9.9, only .1 from the non-productive category. As far as amount of area is concerned the soils of

¹¹Information is also presented on page 410 of the preceeding source regarding the numerical acre yields that have been set up as standards of 100 when applied to the soil types of significant acreages that produce the highest yields of a specific crop.

Table II: Soil Areas of Puerto Rico, By Productivity Rating, With Percent of Total Area

Productivity Rating	Area in Cuerdas ¹	Percent of Total	Cumulative Percentage
1	129,152	6.0	6.0
2	46,976	2.2	8.2
3	136,768	6.3	14.5
4	129,024	6.0	20.5
5	167,936	7.7	28.2
6	293,184	13.5	41.7
7	358,656	16.6	58.3
8	399,680	18.5	76.8
9	113,600	5.2	82.0
10	<u>390,080</u>	<u>18.0</u>	<u>100.0</u>
Total all Soil Areas--6.6	2,165,056	100.00	100.00

¹One cuerda equals .9712 of an acre

Source: Colon-Torres, R., Soils of Puerto Rico Classified by Geological Formations, Series, Types and Phases, with Productivity Rating of Each Based on Inherent Qualities of the Land, Area and Percent of Total Area, University of Puerto Rico Agricultural Experiment Station, Mimeographed Report No. 19, November, 1941.

... and the soil is a precious item. It is not only the soil but the very low level of the water table, and the fact that the soil is not of the best caliber, if compared to many of the other countries where land is a precious item.

In general it has been shown that there is great variability of the soils of the Island. This information has been complemented with some data on productive capacity of the soils. These measures are in physical terms only.

We must also use the term, economic productive capacity, to incorporate such factors as price level, transportation, marketing facilities available, and all other factors that affect agricultural returns.

Kellogg comments:¹³

There is no best use for any combination of soils and climate in the abstract. The range of possible uses is greater with some soils than with others, but many soils can be used in a dozen or more different ways, and which one is chosen depends on prices of farm products, available credit, transportation, and various other factors—including what the farmer can do best and wants to do most.

In the absence of information in economic terms we can grow successfully on the type of information presented regarding the physical qualities of the soils. It will be a delicate task but with proper action, desired ends can be attained.

¹³ United States Department of Agriculture, op. cit., p. 10.

1.1. The Agricultural Sector

"Prior to 1898, when the island was discovered in 1493, the Puerto Ricans were raising corn, sweet potatoes, cassava, and other vegetables and fruits."¹⁴

Since then Puerto Rico has been an agricultural area. In view of the lack of other natural resources and other handicaps, the creation of the little, to present, the national economy is based on its efforts on the extraction of agricultural products from the land.

"In or about the year 1898, sugar cane was introduced to Puerto Rico from the Dominican Republic and the sugar industry started about 1927 when the first sugar mill was built near the mouth of the San Juan River."¹⁵ This industry did not really expand until 1931. This recent expansion resulted from a favorable position for sugar cane in the market by the inclusion of Puerto Rico within the United States tariff system under the provisions of the Tariff Act. From there on, the industry flourished under this protection, plus many other factors that made it very favorable. The sugar industry accounted for 52 percent of the products exported during the fiscal year of 1949-1950.¹⁶

¹⁴ Echeverría, Cuesta J., Puerto Rico Past and Present: The Island After Thirty Years of American Rule, New York, 1928, p. 10.

¹⁵ Barbosa, P. J., "Historical Background of the Sugar Industry in Puerto Rico," Revista de Historia, Vol. 1, No. 1, 1941, p. 101.

¹⁶ Cohen, Morris R., Informal Colonialism: A Study of the Economic and Social Relations of Puerto Rico to the United States, New York, 1958, p. 101.

The progress of this industry was very slow prior to 1900 due to lack of an adequate system of transportation, and inefficient and small sugar mills. These inadequacies did not permit enough capital accumulation for the development of both the agricultural and manufacturing phase of this industry.

Tobacco became a commercial crop in 1637.¹⁷ This is an agricultural industry that has varied widely in Puerto Rico. It has contributed to the value of products exported from a low of 4.44 percent in 1895 to the highest of 19.32 percent in 1921. In 1946, it constituted 13.25 percent of the value of the Puerto Rican exports.¹⁸ Currently, it is the second most important agricultural enterprise.

In 1755, the cultivation of coffee was begun¹⁹ and under Spanish domination it rapidly grew to be the island's most important agricultural product. However, this industry has become relatively unimportant in export channels in recent years.

The peak in coffee production came in 1895-96, when 58,000,000 pounds were exported and amounted to 60.30 percent of the Puerto Rican exports. Until that time the industry had enjoyed a steady growth, but it declined to 19.56 percent of total export in 1901 and 4.77 by 1921.²⁰ Since then it has never contributed as much as one percent of the value of products exported. In 1946, there was no exportation at all and since

¹⁷Office of the Government of Puerto Rico, Puerto Rico, Office of Puerto Rico in Washington, Washington, D. C., January 1, 1951. p. 9.

¹⁸Perloff, Cp. Cit., p 136-137.

¹⁹Office of the Government of Puerto Rico, Cp. cit., p. 9.

²⁰Perloff, Cp. cit., p 93, 136-137.

When whenever there was coffee left for exportation it was a negligible amount. The production for 1949-1950 amounted to 25,000,000 pounds.

Effect of Physical Environment

The early period in Puerto Rican Agriculture was characterized by the production of subsistence crops, with very little production for export. The island had few precious metals, and as early as 1570 its gold deposits appeared exhausted and mining ceased.²¹

At that time the only plentiful resource was land. Mineral resources were scarce and of low quality. However, there were abundant quantities of limestone, sand, and clay of various kinds adapted to the manufacture of ceramics and construction materials. The sources of power were not plentiful, although the potentialities for a hydro-electric development are great.

In the early stages of development "know-how" was lacking and the capital requirements were so great as to discourage the utilization of the existing resources by manufacturing enterprises.

There were fertile valleys in the coastal areas and very good conditions for the agricultural exploitation. The interior of the island provided good climatic conditions for the growth of coffee and tobacco. The alluvial valleys were generally dedicated to sugar cane, and in the areas where rainfall was insufficient for cane, cattle were raised on an excellent pasture. Therefore, under these circumstances, Puerto Rico grew and developed into an agricultural economy.

²¹Office of the Government of Puerto Rico, Op. cit., p 9.

Under these circumstances where there was not too much gold to be mined and lacking almost all of the other natural resources for industrialization, the settlers diverted toward agriculture.

The conditions for this kind of exploitation were auspicious in the early stages. There were enough lands that were endowed with the physical and climatic characteristics for growing products with foreign demand. Sugar was grown in the coastal valleys, and coffee and tobacco in the cooler uplands.

The pattern of agricultural development was greatly affected during early stages by the extension of the transportation facilities, which to some extent was influenced by the topographical features. After the improved transportation system was developed, the different regions specialized in the products of greatest economic advantage, instead of producing the product best suited to the earlier transportation facilities.

In Puerto Rico, as well as in other areas of complementary production, there is basic agreement with the Von Thunen theory of agricultural enterprise location. As Renne asserts: "In agricultural production, geographical position of agricultural land relative to available transportation, cities, and consuming centers plays an important part in determining the types of farm products to be raised in different areas."²²

In accord with this idea, coffee growing was developed in the interior of the island where modern transportation facilities were

²² Renne, Op. cit., p 195.

... Of course, it is a certain amount of money which is...
... In 1910, the coffee was the dominant crop and it was...
... to the transportation system. Its quantity and high value per bushel...
... that this crop profitable even though it had to be transported long...
... distances on pack animals. It can thus afford to pay higher transportation...
... costs than other adaptable crops. This is a case where the in-...
...herent characteristics of a product make its production possible at...
... far distances from the market, despite the lack of transportation fac-...
...ilities.

Sugar cane, a "bulky" product, had to be grown close to the...
... hills, and in flat or slightly rolling areas where transportation was...
... made easy. Here again is found a basic similarity with the von Thunen...
... theory that emphasized the nature of the product as a determinant of...
... the location of agricultural enterprises.⁴³

In considering enterprise location we have to recognize that...
... even though in essence there are similarities with the Von Thunen theory...
... in detail the dissimilarities are great in regard to the land utilization...
... brought about by the agricultural development. This is to be expected...
... when it is considered that conditions, assumptions, and nature of the...
... products grown in both cases are different.

In Puerto Rico as transportation expanded, sugar cane has...
... expanded. Coffee had contracted because there has been less competi-...
... tion of sugar cane for coffee as the former gained an advantageous...
... economic position in comparison to the latter. The decrease in coffee

⁴³ Ibid., p 196.

production has been due to the destructive effects of the hurricanes, declining productivity of the soils, and some other factors with a higher degree of relevancy than that brought about by substitution. They will be discussed under the next heading as they belong to a different category.

Economic and Political Changes as an Influence

Physical, biological, and climatic factors have been of importance in the agricultural development of the island, but by far the most important have been the economic and political.

Puerto Rico under Spanish domination was highly dependent upon coffee. Under American domination its agriculture has grown, with sugar becoming the major cash crop.

During the last decade of Spanish rule, around 70,000 tons of sugar were produced per year. Twenty years after the introduction of American capital, sugar production was increased to 500,000 tons annually. Since 1940, the annual production has been above 1,000,000 tons.

This was to be expected due to the high exchange value that sugar has enjoyed. Zimmerman estimated that the proceeds of the sale of Puerto Rican sugar extracted from the cane grown in one acre bought, in terms of corn, oats, rice, wheat, dried beans, and potatoes, the produce of 8.2 acres in the United States.²⁴

An acre of sugar cane whose product is sold in the international market will not have such a high buying capacity. But Puerto

²⁴ Zimmermann, Erich W., "Staff Report to the Interdepartmental Committee on Puerto Rico," Washington, D. C., September, 1940: unclassified, pp 79-81.

Rican sugar producers do enjoy a protective tariff and compensatory payments under the Sugar Act of 1948.

On the other side of the picture is the coffee industry. Prior to the change of government that took place officially on December 10, 1898,²⁵ when Spain ceded sovereignty over Puerto Rico to the United States, coffee was the leading agricultural industry. As a result of this change there was a shift in markets for Puerto Rican coffee. The high-quality Puerto Rican coffee had been sold at a premium in European markets where the tastes demanded stronger coffee varieties. The United States then came to be the first market--by virtue of the political change-- but it did not have a high demand for this kind of coffee. Americans were accustomed to less strong varieties produced in South American countries which had practical control of this market.

At the same time a severe hurricane swept the Puerto Rican coffee producing area. Production declined rapidly as plantations were damaged.

Other factors of an economic nature also developed favorable conditions for sugar, and conditions for coffee production became less favorable. Coffee did not enjoy a protective tariff or compensatory payments as did sugar. The sugar industry also enjoyed better credit facilities, security of market, and a better marketing structure which also counted for a gradual conversion of resources from one industry to the other. In consequence there was a gradual shift in importance from coffee to sugar.

²⁵ Office of the Government of Puerto Rico, Op. Cit., p 16.

Population

Population of the Island and Selected Areas

In studying the island's problems, a careful examination of the Puerto Rican population is necessary. In this study it is of particular importance for two reasons. First, it provides one of the production factors--labor; and second, the relationships among men and the use that they make of land determine the stage of agricultural development and patterns of land utilization.

In this section, therefore, facts and characteristics of population which impinge upon land utilization and development will be presented.

According to the 1950 census, Puerto Rico has a population of 2,210,703²⁶ in an area of 3,435 square miles. That represents a population density of approximately 644 persons per square mile.

Nevertheless, as we study the areas, different distributions of population can be observed, consequently a difference in impact of population pressure on the land. Jayuya, the selected municipality of the coffee growing region, has a population of 15,113²⁷ in an area of 45²⁸ square miles. That represents a population density of 336 per

²⁶ U. S. Department of Commerce, Bureau of the Census, 17th Population Census, Advance Reports, Washington, D. C., May 15, 1954, Series PC-11.

²⁷ A municipality is approximately the same as a county in the United States.

²⁸ The Economic Development Administration and the Department of Agriculture and Commerce, Annual Book of Statistics of Puerto Rico, Fiscal Year 1949-1950, San Juan Puerto Rico, Sección de Publicaciones e Impresos, Departamento de Instrucción, p 1.

square mile. On the other hand, Aguadilla, the sugar producing area, with an area of 37 square miles supports a population of 44,957,²⁹ which gives a population density of 1,267 per square mile. This difference will show not only when urban population is considered, but also when the number of rural inhabitants per square mile are compared. The rural population density for Jayuya is only 284 as compared to 705 for Aguadilla. The difference in rural population density as would be expected is not so great as the urban density difference, but the figures do show the difference in population pressure to which the land has been subjected. In comparing the growth of population of both municipalities and Puerto Rico, the following table can be observed.

Table III: Population Increase in Puerto Rico, Aguadilla and Jayuya, Between 1940 and 1950

Area	1940	1950	Percent of Increase 1940 to 1950
Puerto Rico	1,869,255	2,205,398	18.0
Aguadilla	34,956	43,748	25.2
Jayuya	14,589	15,062	3.2

Source: U. S. Department of Commerce, Bureau of the Census, 17th Population Census, Preliminary Reports, Washington, D. C., August 1, 1950, Series PC-4, No. 5.

Definite trends can be observed in the distribution of a population that has been increasing at a more or less uniform rate during the last fifty years. The percent increase has fluctuated around 18

²⁹ Bureau of the Census, Op. Cit., P.C. 11, No. 5.

percent for the island as a whole, with very little variation in either direction. See Table VI, page 45.

When specific regions are studied, interesting characteristics can be observed.

The municipalities of the coffee growing region show very little increase in population, if any, and generally their population has decreased. The municipalities in the sugar cane growing region show an increase fluctuating between 10.3 and 25.2 percent, as presented by Tables IV and V, page 43. A higher percentage increase in Aguadilla, as compared to the average for Puerto Rico, may be explained by the fact that many moved there to work in the construction of an air base, which provided a great deal of employment. The movement was greater during the late 30's and early 40's. The comparatively high population increase of the Island when taken as a whole is accounted for by a considerable increase in the metropolitan area³⁰ and relatively high increase in large cities and towns that have military installations nearby, and where the employment opportunities are somewhat better. The urbanization movement has been tremendous and in many cases facilities have been outgrown.

The 1950 Census Reports state:³¹

As at other censuses of Puerto Rico the rural population in 1950 exceeded the urban population. The urban population, however, has been increasing at a more rapid rate than the rural population in every intercensal period since 1899. The 1950 urban population between 1940 and 1950 accounted for 90 percent of the increase in the total population of Puerto Rico and represented a gain of 58.0 percent over the 1940

³⁰Metropolitan area is to include the capital city and the neighboring towns.

³¹Bureau of the Census, Op. cit., Series PC-11, No. 5.

Table IV: Population Change Figures by Regions, 1940 to 1950

Coffee Growing Region	1940	1950	Percent of Increase 1940 to 1950
Jayuya	14,589	15,062	3.2
Adjuntas	22,556	22,415	*-0.6
Lares	29,914	29,921	---
Olinda	22,906	19,423	-15.2
Maricao	7,724	7,353	-4.8

* A minus sign denotes a decrease; percent not shown where less than 1.1.

Source: U. S. Bureau of the Census, Preliminary Counts, 17th Population Census, August 1, 1950, Series PC-4, No. 5.

Table V: Population Change Figures by Regions, 1940 to 1950.

Sugar Cane Growing Region	1940	1950	Percent of Increase 1940 to 1950
Aguadilla	34,956	43,748	25.2
Camuy	18,922	20,865	10.3
Mayaguez	76,487	87,038	13.8
Guayanilla	15,489	17,373	11.5
Huacabo	29,633	34,265	17.2

Source: U. S. Bureau of the Census, Preliminary Counts, 17th Population Census, August 1, 1950, Series PC-4, No. 5.

urban population of 500,357. In two municipalities, Caguas and Rio Piedras the population more than doubled over the 10-year period. The combined gain of San Juan, Ponce, and Rio Piedras accounted for well over the two fifths of the increase in population of Puerto Rico.

Thus, the higher increase of population in urban centers and large cities is mainly responsible for the 18 percent population increase for all the Island.

These population changes in the different regions indicate the internal migration in the Island. If only the natural increase is considered, there should be higher population increase, particularly in the coffee growing region. Therefore, it shows the lack of opportunities and failure of the land to provide an adequate sustainment for a fast increasing population, which constantly adds new laborers into an already flooded market.

The population of Puerto Rico has more than doubled during the last fifty years. It is, undoubtedly, one of the fastest increasing populations in the world. Table VI presents its growth since 1765 up to the 1950 census with the respective increases over the preceding censuses. This fast and continuous increase in population has resulted from a high birth rate and a low death rate in recent decades, due to the improvement of public health facilities. Thus, it presents an idea about what could be done in the so-called "underdeveloped areas" with high mortality rates.

What about the future? How will the population picture look in 1960? This is presented in the following table, Table VII, page 40, which was adapted from Descartes, Basic Statistics on Puerto Rico.

Under the given assumptions and considering the different rates

Table VI: Population of Puerto Rico and Annual Rate of Increase,
1765 to 1950

Census Year	Population	Increase Over Preceding Census	
		Number	Percent
1950*	2,205,398	336,143	18.0
1940 (April 1)	1,869,255	145,721	8.5
1935 (December 1)	1,723,534	179,621	11.6
1930 (April 1)	1,543,913	244,104	18.8
1920 (January 1)	1,299,809	181,797	11.3
1899 (November 10)	953,243	154,678	19.4
1887	798,565	66,917	9.1
1877	731,648	148,340	23.4
1860	583,308	135,394	30.2
1846	447,914	117,863	35.7
1832	330,051	109,159	49.4
1815	220,892	65,466	42.1
1800	155,426	85,176	131.2
1775	70,250	25,367	50.2
1765	44,883	-----	-----

* 1950 data from 1950 Population Census

Source: Descartes, S. L., Basic Statistics on Puerto Rico, Office of
Puerto Rico, Washington, D. C., 1946, Table I-2, p 5.

Table VII: Population Estimates for Puerto Rico, 1940

Factors	Actual 1940	Estimated for 1940 by Census Bureau		
		High	Medium	Low
I Population	1,869,255	3,153,000	2,869,000	2,541,000
II Determined by				
Birth rate of:	38.7	40.0	39.4	36.7
Death rate of:	18.4	14.1	18.3	22.2
III Rates based on				
Fertility Factor:		As at present	The 1948 "low" fertility rate*	As in northwest Europe 1875-1900
Mortality Factor:		As in Arizona and New Mexico	Midpoint between "high" and "low"	As at present
Migration Factor:		No net emigration	Net emigration of 3,000 per year	Net emigration of 6,000 per year

*Based on 1939 birth rate of 39.6, since 1940 rate of 38.7 actually is lower.

Source: Descartes, S. L., Basic Statistics on Puerto Rico, Office of Puerto Rico, Washington, D. C., 1946, Table 1-5, p 4.

affecting population growth, it shows the vital importance of a problem which is already serious. In the light of the figures presented, due consideration must be given to the population problem in planning the future development of the Island.

Comparison With Other Countries

How does the population growth situation compare with other countries? This is illustrated by Table VIII, page 46. It could include more countries and areas. With such variability the population characteristics of the island will easily stand out, and its peculiarities can not be easily overlooked.³² The table will, nevertheless, serve to show how Puerto Rico compares with other countries having similar problems, and countries with low population densities. Thus, it can be observed that the island stands highest in birth rates — only to be exceeded by a few countries in some years, i.e. Mexico. The death rate shows a steady decline, reaching 12.4 per thousand inhabitants in 1950.

This high birth rate accompanied by a low death rate has made the Island one of the most densely populated areas of the world. By referring to Table IX, page 49, a comparison can be established with other countries and areas.

One of the facts that bears directly on socio-economic studies is the relationship of population to the kind and amount of productive

³² For a wider comparison with other countries and areas refer to Descartes, Basic Statistics on Puerto Rico, Table I-11, pp 9-11.

Country	Year	Total Shipments	Per Cent	Year	Total Shipments	Per Cent
United States	1900	11,901,520	-	1901	11,901,520	-
	1901	11,901,520	-	1902	11,901,520	-
	1902	11,901,520	-	1903	11,901,520	-
	1903	11,901,520	-	1904	11,901,520	-
	1904	11,901,520	-	1905	11,901,520	-
	1905	11,901,520	-	1906	11,901,520	-
Belgium	1900	11,901,520	-	1901-12	11,901,520	-
	1901	11,901,520	-	1902-13	11,901,520	-
	1902	11,901,520	-	1903-14	11,901,520	-
	1903	11,901,520	-	1904-15	11,901,520	-
	1904	11,901,520	-	1905-16	11,901,520	-
	1905	11,901,520	-	1906-17	11,901,520	-
Netherlands	1900	11,901,520	-	1901-12	11,901,520	-
	1901	11,901,520	-	1902-13	11,901,520	-
	1902	11,901,520	-	1903-14	11,901,520	-
	1903	11,901,520	-	1904-15	11,901,520	-
	1904	11,901,520	-	1905-16	11,901,520	-
	1905	11,901,520	-	1906-17	11,901,520	-
Japan	1900	11,901,520	-	1901-12	11,901,520	-
	1901	11,901,520	-	1902-13	11,901,520	-
	1902	11,901,520	-	1903-14	11,901,520	-
	1903	11,901,520	-	1904-15	11,901,520	-
Puerto Rico	1900	11,901,520	-	1901-12	11,901,520	-
	1901	11,901,520	-	1902-13	11,901,520	-
	1902	11,901,520	-	1903-14	11,901,520	-
	1903	11,901,520	-	1904-15	11,901,520	-
	1904	11,901,520	-	1905-16	11,901,520	-
	1905	11,901,520	-	1906-17	11,901,520	-

a. Estimated

b. Data not available

c. Including military stores

Sources: Office of the Government of Porto Rico, Puerto Rico, London, D. C., 1911, Table A, p. 11.

United Nations, Demographic Statistics of the World, Department of Economic Affairs, New York, 1950, p. 11.

U.S. and Foreign Trade in Manufactures, 1947-1950, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, D. C., 1952, Table 1-10, p. 10.

Country or Area	Year	Imports (Dollars in millions)	Exports (Dollars in millions)
United States	1950	4,711,140	2,141.1
Canada	1950	1,000	140.4
Massachusetts	1950	7,241	740.2
Maryland	1950	2,301	210.4
Texas	1950	260,444	290.0
Connecticut	1950	4,039	120.1
New Mexico	1950	121,571	100.0
Belgium	1950	11,770	100.1
Netherlands	1950	18,711	110.0
England and Wales	1950	58,340	720.0
India	1951	1,246,000	240.0
Ceylon	1951	147,170	100.0
Cuba	1950	11,217	110.0
Dominican Republic	1950	17,332	100.1
Canada	1949	8,501	100.0
Barbados	1949	134	1,100.0
San Jose	1950	700,001	100.0
Colombia	1950	439,991	100.0
Venezuela	1950	24,370	100.0
Puerto Rico	1950	1,400	100.0

Sources: Devos, J. L., Trade in Manufactures, 1947-1950, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, D. C., 1952, Table 1-10, p. 10.

The World Almanac and Book of Facts for 1952, New York: World Telegram, New York, 1951, pp. 344-345.

labor produced by this population by the given conditions. This is where the underdeveloped and overpopulated countries demonstrate their weaknesses as compared to industrialized and developed areas.

This is shown by Table X, page 51, where the island population is compared by age groups to the United States. It clearly shows that Puerto Rico has a higher percentage of its population in the unproductive age groups as compared with the United States. Puerto Rico has 15 percent of its population under 5 years, 13.5 percent between 5-9, and 12.2 between 10-14 years of age as compared to 6.1, 8.1, and 8.9 for the United States, respectively. It does mean that at a given time, a higher percentage of the United States population is capable of performing productive work, as compared to the population of Puerto Rico.

Migratory Movement

Previous mention has been made of the internal migratory movement occurring in the Island, from rural to urban areas, and from small towns to the large urban areas. There is also a great deal of migration from the Island to the mainland. Usually the migrants settle in New York where there is a large Puerto Rican neighborhood. The living standards of this group are not at all desirable and further crowding of this neighborhood should be controlled for social, economic, and cultural motives.³³

³³ Alera Montalvo Manuel, The Puerto Rican Migrants of New York City: A Study of Anomie. Unpublished M.A. thesis, Columbia University, 1951.

Table 1: Comparative Population by Age Group, 1950 and 1970, U.S.

Age	1950		1970	
	Number	Percent	Number	Percent
Total....	1,000,000	100	100,000,000	100
Under 5	10,000,000	10	10,000,000	10
5 - 9	25,000,000	25	25,000,000	25
10 - 14	22,000,000	22	22,000,000	22
15 - 19	20,000,000	20	20,000,000	20
20 - 24	18,000,000	18	18,000,000	18
25 - 29	16,000,000	16	16,000,000	16
30 - 34	14,000,000	14	14,000,000	14
35 - 39	12,000,000	12	12,000,000	12
40 - 44	10,000,000	10	10,000,000	10
45 - 49	8,000,000	8	8,000,000	8
50 - 54	6,000,000	6	6,000,000	6
55 - 59	4,000,000	4	4,000,000	4
60 - 64	3,000,000	3	3,000,000	3
65 - 69	2,000,000	2	2,000,000	2
70 years or over	1,000,000	1	1,000,000	1

Source: Bureau of Economic Analysis, 1970, p. 5.

*Data for 1950 not available.

According to C. Wright Mills, et. al., three sets of factors play into the reason for the Puerto Rican migration to New York City: the push from the homeland, the pull of the new country, and the sources of information about the new."³⁴ Mills and many others have concluded that the crucial force in motivating the movement is economic conditions. Recent years show record breaking figures in regard to the number of people leaving the Island. For a clearer picture refer to Table XI, page 52, which shows the great increase in people leaving the country after World War II.

Migration is one of the different ways by which population pressure can be eased, but if this migration is not well controlled the solution could be worse than the problem itself. However, at the present time measures are being taken to direct the migrants coming into the United States to situations and areas where they will have better opportunities. Nevertheless, there is much room for improvement. This point deserves special attention, as it may be a very efficient tool in the betterment and reconstruction of the Puerto Rican situation.

The size of this movement can be better understood if we consider that in 1949 the unemployment figure was 63,000 out of a labor force of 630,000.³⁵ It should be further mentioned that during the war and the immediate postwar period the income of the Puerto Rican people reached its highest peak, although it is relatively low by

³⁴ Mills, C. Wright, et. al., The Puerto Rican Journey, Harper and Brothers, New York, 1950, p 43.

³⁵ Office of the Government of Puerto Rico, Op. cit., p. 11.

Table XI: Movement of People Entering and Leaving Puerto Rico,
1909 to 1949

Year Ending June 30th	Incoming	Outgoing	Balance	
			Gain	Loss
1909-1913	25,654	17,251	8,303	
1914-1918	39,900	47,300		7,400
1919-1923	82,572	90,534		7,962
1924-1928	86,200	112,551		26,351
1929-1933	96,834	101,319		4,485
1934-1938	102,626	111,005		8,379
1939-1943	120,351	132,157		11,806
1944	22,416	29,964		7,548
1945	22,727	37,521		14,794
1946	45,388	69,613		23,725
1947	101,119	136,166		35,047
1948	104,491	132,522		28,031
1949	124,275	157,328		33,053
Total	975,053	1,177,375		200,326

Source: Office of the Government of Puerto Rico, Puerto Rico, Office
of the Government of Puerto Rico, Washington, D. C., 1951, p. 11.

United States standard.³⁶ By April 1950 there were 191,200³⁷ unemployed, but after the Korean outbreak this situation improved greatly.

Land Utilization

For the Island

Land use in Puerto Rico has always had an everchanging pattern. In 1830 there were only about 121,000 cuerdas³⁸ under cultivation, and the greater amount was occupied by minor crops. As the years passed, land under cultivation increased to 189,000 cuerdas in 1862, and to 282,000 in 1896. The increase was mostly devoted to the growing of the major crops, coffee and sugar.³⁹

The changes in use of crop land can be better observed by referring to Table XII, page 54. It shows how land used for crops has not changed appreciably in the last few decades, even though there has been substitution of one crop for another. It can be noted how sugar cane production has increased tremendously. There has also been a very wide fluctuation in the number of cuerdas used for any single crop. Some of the fluctuations show a steady trend, while in others there is a haphazard fluctuation as a response to economic and institutional changes.

³⁶Office of the Government of Puerto Rico, Op. Cit., p 41.

³⁷Puerto Rico Planning, Urbanizing and Zoning Board, Economic Development of Puerto Rico, Office of the Governor, San Juan, Puerto Rico, 1951, p 7.

³⁸One cuerda equals .9712 of an acre.

³⁹Perloff, Op. cit., p 14-15.

Table XII: Changes in Use of Crop Land for Principal Crops by Census Years, Puerto Rico

Crop	Census Years					
	1909	1919	1929	1938	1949	1950
Sugar Cane	115,433	227,615	227,758	245,154	229,711	170,000
Coffee	186,375	193,561	191,712	182,316	181,186	170,000
Tobacco	22,112	39,068	52,947	45,720	28,584	20,000
Pineapple	1,808	677	1,305	1,062	1,912	3,500
Cotton	1,425	2,700	10,282	934	3,081	2,700
Dry Beans	11,693	16,095	25,165	25,292	31,543	18,000
Corn	27,400	21,656	32,309	25,298	32,236	24,000
Pigeon Peas	a	a	a	18,450	27,322	45,000
Sweetpotatoes	a	22,313	33,913	31,759	35,990	25,500
Yams	a	a	7,049	11,468	12,311	12,500
Tanniers	a	a	17,334	20,686	24,189	21,000
Total			610,274 ^b	608,049	608,324	679,000

¹One cuerda equals .9712 of an acre.

^aNot available.

^bNot considering pigeon peas for 1929.

Source: Bureau of the Census, U. S. Department of Commerce, Preliminary 1950 Census of Agriculture, Farm Census Shows Changes in Puerto Rico, Series AC 50-1, p 4.

Hill, E. B., and Descartes, S. L., An Economic Background for Agricultural Research in Puerto Rico, Bulletin 51, University of Puerto Rico Agricultural Experiment Station, 1938.

of 1930, a total of 574,000 "cuerdas" were under cultivation which amounted to 47.3 percent of the total area in Puerto Rico. About 50,000 "cuerdas" were in clear permanent pastures and 140,000 were wooded pastures. Only 11.9 percent, 284,153 "cuerdas," are devoted to services or considered unsuitable for agricultural uses. See Table XIII, page 56. The pattern of land utilization in Puerto Rico shows how it grew and developed from a subsistence economy in early years to a more specialized economy oriented toward foreign markets. This process was easily accelerated as more could be brought into the production of a acre of land in commercial use than if it were used for a subsistence crop. This will not be the case if there is a price increase favorable to a subsistence crop. Recent events provide an excellent example of how price changes influence the transferring margins of various types of crops. The food crop area increased during the war years from around 230,000 "cuerdas" to over 300,000 at the end of the war. In the last few years of the last decade the food crop area has been reduced to the 1939-40 level.⁴¹ As war curtailed the importation facilities, demand for home produced products went up enough to create an increase in the food prices, therefore making it a profitable enterprise. Land that otherwise would have been semi-marginal for that use was then cultivated profitably.

Table XIII and XIV present the latest and most dependable information regarding land utilization in Puerto Rico. Table XIV

⁴¹Ibid., p 50.

Table XIII: Use of Land, Puerto Rico, 1950

Use	Cuerdas ¹	
	Number	Percentage
Total area in farms	1,907,009	100.00
Total area in crops	901,853	47.30
Clear permanent pastures	560,153	29.40
Wooded pastures	160,910	8.40
Waste land, roads, fences, buildings, swamps, etc.	284,153	14.90

Table XIV: Distribution of Area Under Cultivation According to Crops
in Puerto Rico - 1950

Use	Cuerdas ¹	
	Number	Percentage
Sugar Cane	409,612	45.4
Coffee	173,247	19.2
Bananas	61,238	6.8
Sweet Potatoes	45,146	5.0
Corn	37,045	4.1
Tobacco	35,028	3.9
Plantains	29,175	3.2
Taniers	25,799	2.9
Coconuts	15,000	1.7
Yams	13,603	1.5
Rice	5,300	.6
Pineapples	3,984	.5
Cotton	3,916	.4
Other Crops	43,730	4.8
Total	901,853	100.00

¹ One "cuerda" is equal to .9712 of an acre.

Source: The Bureau of Agricultural Economics of the Department of Agriculture and Commerce of Puerto Rico.

privately owned, and the land devoted to crops is not sufficient to support the population without the extension of the territory.

The principal crops are sugar cane, coffee and banana, which occupy 75 percent of the total crop land. The remaining area is mostly devoted to food and forage crops. The food crops are mostly of a starchy nature and constitute a great part of the Puerto Rican diet. The forage crops are mostly members of the Gramineae family. A lack of highly nutritive leguminous forage crops is apparent with the exception of some tropical animals.

For the Selected Areas

Land utilization for the selected areas, Aguadilla and Caguas, is presented in Table XV. It will provide the basis for a comparison of land use between both municipalities and between these two areas and the Island. Therefore, the information hereafter included is limited to the use given to the land. However, there is more information regarding both areas in a more detailed form.¹⁵

In this dissertation an attempt has been made to present the information on Table XV, in such a way that the striking features of land utilization patterns in both regions can be easily observed.

In comparing the two municipalities on farm and ranching lands, it can be observed that the percentage of crop land in both

¹⁵The Rural Land Utilization Division of the Department of Agriculture and Commerce of Puerto Rico has gathered land utilization information from both areas and many others where land use is of importance. Collection of some other pertinent information is being made.

Table IV: Land Use for the Selected Areas mentioned in "Introduction"
and as Percentage of Total Area in Each Municipality

Land Use	Aguaquilla		Jaysa	
	Percentage of Total "Cuernavaca"	Amount in "Cuernavaca"	Percentage of total "Cuernavaca"	Amount in "Cuernavaca"
Crops				
Sugar Cane	27.22	6,279	5.00	1,141
Cane and Coconuts	.43	101	.90	200
Cane and Grapefruits	.65	152	.33	74
Cane and Minor Crops inter- planted	.22	51	—	—
Coffee and Minor Crops, Adjacent Plots	1.43	329	—	—
Coffee with Bananas, Oranges and Forest	.43	101	—	—
Coffee with Minor Crops	1.53	354	1.68	372
Coffee	—	—	4.72	1,050
Coffee, Bananas, Oranges	—	—	26.74	5,947
Coffee in Forest	—	—	5.91	1,300
Coconuts	.11	25	—	—
Coconuts and Pasture	1.21	279	.38	84
Coconuts and Minor Crops	.55	127	—	—
Plantains	—	—	.38	84
Bananas	—	—	.38	84
Plantains and Bananas	—	—	.41	91
Grapefruit and Pasture	.22	51	—	—
Cotton	.22	51	—	—
Cotton Interplanted	.11	25	—	—
Truck Crops	.33	76	.65	144
Minor Crops	3.07	709	.25	55
Minor Crops, Pasture, Brush and Forest Plots	<u>4.83</u>	<u>1,114</u>	<u>5.91</u>	<u>1,300</u>
Total in Crops	42.59	9,824	52.95	10,241
Pasture and Harvested Forage				
Rotation Pasture	.11	25	2.30	510
Harvested Forage Grasses	.65	152	.36	80
Improved Natural Pasture	.22	51	1.50	330
Unimproved Natural Pasture	8.56	1,975	10.31	2,300
Brush Pasture	17.96	4,051	11.30	2,500
Woodland Pasture	<u>.55</u>	<u>127</u>	<u>.90</u>	<u>200</u>
Total	27.60	6,381	26.25	6,040

(continued on following page)

Table XV (continued)

Land Use	Aguadilla		Mayagüez	
	Percentage of Total "Cuerdas"	Amount in "Cuerdas"	Percentage of Total "Cuerdas"	Amount in "Cuerdas"
Forest and Brush				
Forest	9.11	2,101	16.57	1,111
Brush	<u>4.72</u>	<u>1,089</u>	<u>3.69</u>	<u>1,113</u>
Total	13.83	3,190	20.26	2,224
Public Land				
County and State	.22	51	--	2
Federal Property	.33	76	--	5
Cemetery	.11	25	--	2
Military Reservation	<u>14.16</u>	<u>3,266</u>	<u>--</u>	<u>27</u>
Total	14.82	3,418		
Urban Land	--	2/	.25	1
Wasteland	<u>1.10</u>	<u>253</u>	<u>.33</u>	<u>1</u>
GRAND TOTAL	100.00	23,066	100.00	10,145

(--) Not present.

1/ One cuerda is equal to .9712 of an acre.

2/ Not reported.

Source: Data collected by the Rural Land Utilization Division of the
Department of Agriculture and Commerce.

and Aguadilla does not deviate much from the average of 47.2 percent for the Island. Jayuya is somewhat high (52.95 percent) as compared to the Island, but Aguadilla has only 42.59 percent of its land under crops. However, this figure would undoubtedly be higher, if it were not for the fact that the military reservation was included when calculating the total area for the municipality. This will tend to limit somewhat the accuracy of the estimates. In the absence of this institutional factor limiting agricultural use, the percentages for many crops could have been greater as this area was brought into consideration. Nevertheless, for comparative purposes this weakness can be disregarded.

Both areas rank about the same in pasture and harvested forage, but are lower than the average for the Island. As it could be expected Jayuya shows a higher percentage in forest and brush. This type of vegetation has more favorable conditions for better growth in Jayuya than Aguadilla. The topography also has to be considered, as areas which otherwise could be cultivated are left untouched due to their rugged relief. As far as land used for service purposes is concerned, a factual comparison can not be made, as information on this type of land use has not been reported in many cases. However, it is reasonable to expect that Aguadilla provides more and better facilities because of the requirements of its larger population. Aguadilla, besides having a strategic position which stimulated the Federal Government to improve its transportation and community services, has been aided by the factors of location and accessibility, as compared to Jayuya and some other areas of the mountainous part of Puerto Rico.

In analyzing the cropping systems in both areas, interesting observations can be made, as far as the systems of farming are concerned. In Aguadilla as well as Jayuya, and in many other sugar cane growing areas, it is common to find sugar cane interplanted with many crops and fruits. This is only typical in places where the soil or environmental conditions are not good enough to provide for a high enough return using a single crop - sugar cane. Hence, the farmer in the hope of better exploitation of his soil resources, uses another crop to go together with sugar cane. This in many cases results in a very sound land utilization process, as higher returns are obtained per unit of area without endangering the future productive capacity of the soil. In cases where flexibility and some degree of diversification is desired, it also has wise application. This will result in a lower, but more stable income.

Sugar cane is the main cash crop in Aguadilla and this crop occupies around 28.5 percent of the total area, as compared to 6.2 percent for Jayuya. In both cases cane with some other crop interplanted are considered under the same category, for arriving at the total percentage of the area which is planted to cane. On the other hand, Jayuya's main cash crop is coffee, but sugar cane has commercial importance in this area also. The same can not be said of the coffee grown in Aguadilla which there lacks commercial importance. In using the terminology of the ecologist it could be said that coffee is just a "relique" in that area. The extension of the area in which coffee is grown in Jayuya adds up to 38.5 percent, when the different combinations of coffee and other crops are put together. The combi-

of the two areas, the 1st ranked area is more densely populated and has a higher percentage of land devoted to agriculture. The 2nd ranked area is less densely populated and has a lower percentage of land devoted to agriculture. The 1st ranked area is more densely populated and has a higher percentage of land devoted to agriculture. The 2nd ranked area is less densely populated and has a lower percentage of land devoted to agriculture.

In spite of the fact that sugar cane and coffee are the main crop for each of the two areas, it may also be observed that there is a varied pattern of land utilization in both areas. It shows the flexibility of uses within and between the two areas studied. Efforts to improve and still conserve will have a lot to do with the shaping of this pattern of land utilization. The farmers, however, in determining what to plant, what to plant, where to plant and when to plant, rely on a number of factors. These factors may be of economic, institutional or even of psychological nature. This kind of information is not available. It will be very helpful in the determination of the degree and kind of flexibility in the land use pattern, and its usefulness.

The breakdown provided in the second type of land use pattern for converted forage - also presents some striking results. It is again a very high percentage of land devoted to agriculture and to pasture and forage. There is only a difference of 1.4% between the two areas, but this rank low when compared to the 1st area as a whole. This is so as the larger pasture and forage areas are located in the arid southern and southwestern coast.

⁴³ These crops which are interplanted with coffee are not the main crop for each of the two areas. The 1st ranked area is more densely populated and has a higher percentage of land devoted to agriculture. The 2nd ranked area is less densely populated and has a lower percentage of land devoted to agriculture.

both areas have a very small percentage in rotation pastures and improved natural pasture with Jayuya having a few more "caderales" than Aguadilla. As far as harvested forage crops, Aguadilla has three times as much. This is due to the fact that in this municipality there is a better market for milk; therefore, the dairying enterprise in Aguadilla can be carried on more intensively. It will be low, however, if compared with the milk-shed areas. The important fact that shows this breakdown is the high proportion of area in low quality pastures; namely, brush pasture and unimproved pasture.

There is not much difference when comparing the extension of brush in both areas. This is not the case when forests are considered and as expected there is almost twice as much forest in Jayuya as in Aguadilla. This condition has been favored by a beneficial climate and topography.

For lack of available information it will be impossible to make a comparison of public land in both municipalities. However, there is an outstanding fact that must not be overlooked as it impinges directly on development and utilization. Mention is to be made in regard to the military reservation located in Aguadilla. It has been a major factor in the developmental organization of the municipality and neighboring communities. To the extent that it depends upon the amount and degree of utilization of the civilian resources. It has been a source of employment and a market for many of the products locally grown. It has undoubtedly been an important factor in the betterment of the living conditions in the community.

AGRICULTURE IN THE DEVELOPMENT OF PUERTO RICO

In view of the fact that agriculture has been the backbone of the island, any developmental scheme should consider the improvement of efficiency and a wise allocation of resources within agriculture. These ends can not be attained if there is not sound utilization. To make these goals feasible there should be progress in the other sectors of the economy, but since agriculture is the main asset of the island, all plans for development should take this factor into consideration.

41.
Nazario, et. al. comment:

Puerto Rico's economy is, and will continue to be, mainly agricultural. Most of the economic activity is the production of raw materials about the cultivation, processing, transportation and distribution of agricultural products. Agricultural production in 1950 accounted for a little less than one-fourth of the total national product of Puerto Rico in 1949. The total value of agricultural production was close to 200 million dollars in the years 1943, 1949 and 1950 of which sugar cane constituted more than one half. The profit from cane production increased considerably during the last decade from less than 40 million dollars in 1940-49 to around 80 million dollars in the last two years of the decade.

The sugar cane industry, from transportation and processing of agricultural products and the processing of sugar and other crops, accounts for about 15% more of the national product so that agriculture direct or indirectly provided about 40% of our national income.

The island production of raw materials originating in agriculture as compared with that coming from manufacturing has been nearly constant.

42.
Nazario, Luis N., et. al., The People and the State, mimeographed report, Department of Agriculture and Commerce, Commerce, Puerto Rico, p. 1.

ing in recent years."⁴⁵ This means that even though agricultural productivity has increased it has not kept up with the increase of productivity in manufacturing which is going at a faster speed than agriculture. It represents a desirable condition as there can not be an increase in efficiency within agriculture unless there is an industrialization program which will employ the excess of labor and provide the people with increased purchasing power and better standards of living.

⁴⁵ Perloff, Op. Cit., Appendix A-2.

PROBLEMS IN LAND UTILIZATION AND DEVELOPMENT

This chapter will be devoted to the presentation, discussion, and analysis of four problems of paramount importance in the development and rational utilization of land for the betterment and improvement of the island's agriculture. The discussion is limited to four topics, (the four sub-headings of the chapter) but this does not mean that they are the only problems that hinder sound development and efficient land utilization. Allowance is not made in this study for a discussion of tenure problems, but this does not mean that the tenure problem lacks importance. Since land tenure and other concepts such as property rights and freedom of action have a close relationship to the manner in which land is held and used, it is important that we keep these factors in mind in the analysis of land utilization. Some of the important aspects will not receive separate discussion even though their importance is recognized. Time limitations and the scope of the study make impossible their analysis and discussion in this dissertation.

Uneven Contribution of the Different Agricultural Areas
to the Economy of the Island

This section will be limited to a discussion of the coffee growing and sugar cane growing regions. These are the two most important crops in the land use pattern of Puerto Rico. Certainly, these crops have always been of utmost importance to the Puerto Rican economy.

... of the island's agricultural production. ...
... of the island's agricultural production. ...
Table XVI, page 49.) Most of the sugar cane is grown in the coastal
areas. Some sugar cane is also produced in the interior of the island
but its importance is small as compared to coffee production. Vega
municipality, for instance, is in the coffee growing region and has
only 1.2 percent of its land planted to sugar cane.¹

Sugar cane is the most important product for the Puerto Rican
agriculture and in many years its export value has accounted for more
than 60 percent of the total value of exports of the island. Coffee,
on the other hand, has lost its value as an export product. Never-
theless, it is still an important enterprise. Its economic importance
to the Island is indicated by the fact that 300,000 persons depend
directly or indirectly upon this industry for their livelihood.² Most
of the coffee produced in 1950-51 was used for local consumption.

Table XVI shows the total agricultural production, production
for the principal crops, and value of these crops for the fiscal years
1949-50 and 1950-51. This tabulation illustrates the highly significant
fact that Puerto Rico is mainly dependent for its maintenance and
welfare upon a single crop - sugar cane. This is not only true of
these two years but of many others as well.³

¹ Refer to Table XV, page 30, where land utilization of the island
is given.

² Serra Guillermo y Fierro Manuel, Estadística de la Agricultura
de Puerto Rico, Universidad de Puerto Rico, Oficina de Estadística,
Bureau of Experimental Agriculture, San Juan, Puerto Rico, 1949.

³ See Table XVI, page 49, for a comparison of the value of the
principal crops of the island for the fiscal years 1949-50 and 1950-51.

ness, and the fact that the coffee area is smaller than the sugar area is not sufficient to insure that the coffee area will be able to produce a surplus, even though the coffee area is larger than the sugar area. It is not implied that the area of coffee is equal to the area of sugar. In the same way, returns on production for coffee are not expected to be close, or to be the same in both areas. That would be an unreasonable expectation as natural resources, economic, technical, and institutional factors are different in both regions. However, it is reasonable to hope for a closer balance in the contribution from both regions. Three times as much land is used for sugar as for coffee production as for coffee, but the value of sugar production is only twice as much as the value of coffee production. This is so in years when coffee has had exceptionally good prices, but in previous years the ratios of values between both crops would have been even wider.

Table XVI presents a picture of an unbalanced agriculture, typical of the so-called monoculture economic areas. This situation is not desirable at all, in the establishment of a firm basis for economic and social progress with some degree of stability. Monoculture economies are plagued with uncertainty, instability, and many other undesirable features which affect farmers as well as other sectors of the economy.

In Puerto Rico about two fifths of the total employed land, most of the best soils are planted to sugar cane. Since the economy is largely dependent upon a sugar economy, Puerto Rico has high unemployment, as well as a small number of workers with high wages.

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A combination of factors, both physical and chemical, is responsible for the relatively low yields from these soils.

Of greater importance is the economic factor involved in the more intensive cultivation. Since much of the land in this area is cultivated by relatively small holdings, the cost of the more intensive cultivation is a factor which is not so much in this area as it is in the more intensive cultivation.

⁶ Johnson, Robert Bruce, The Soil and the Farmer, 1914, p. 100. This is a study in rural land use, published by the U.S. Department of Agriculture, Washington, D.C.

⁷ Ibid., p. 100.

Table A-1: Crop Yields on the Major Soils of the Western Portion of the Subhimalay Plain

	Inherent Productivity ¹ in tons per acre	Actual Yield in tons per acre
Compact Soils:		
Almirante Clay	30	26
Vega Alta Clay	33	27
Vega Alta Clay loam	35	26 to 31
Friable Soils:		
Coto Clay	39	30
Espinosa clay and sandy clay	31	24
Vega Alta Sandy clay loam	33	26 to 31
Very Friable Soils:		
Vega Alta fine sandy loam	18	14
Espinosa loam sand	18	12 to 18

¹Inherent productivity of these soils was established during 1936, Soil Survey of the Island, conducted jointly by the Federal and Insular Governments.

²Actual yields on these soils were obtained by interviewing 182 farmers in the area.

Source: Batchelder, Op. Cit., p 118.

...the present circumstances and taking into consideration the future increase in population, it will be desirable to make an adjustment in sugar cane expansion according to the market possibilities and production allotments to allow for a higher degree of diversification. This, if properly accomplished, will not result in a reduction of agricultural production, but instead will result in the diversification which will be the provision of a higher degree of stability and security. It will stimulate higher production and an increase in productivity. A readjustment should be made with the objective of shifting the surplus lands from sugar cane to some other profitable use. These surplus lands will be the first to suffer in case of a downturn in demand for the sugar industry. By accomplishing that, this industry will be a backbone of the island economy will be a source of income for the

Under the present circumstances and taking into consideration the future increase in population, it will be desirable to make an adjustment in sugar cane expansion according to the market possibilities and production allotments to allow for a higher degree of diversification. This, if properly accomplished, will not result in a reduction of agricultural production, but instead will result in the diversification which will be the provision of a higher degree of stability and security. It will stimulate higher production and an increase in productivity. A readjustment should be made with the objective of shifting the surplus lands from sugar cane to some other profitable use. These surplus lands will be the first to suffer in case of a downturn in demand for the sugar industry. By accomplishing that, this industry will be a backbone of the island economy will be a source of income for the

changes that might interfere with the economic functioning and welfare of many sectors within the agriculture of Puerto Rico. The mentioned readjustment should be accompanied by a program to promote a greater degree of intensification in the lands devoted to sugar cane, after the readjustment is made. The intensification will be necessary in order to prevent a reduction in sugar production. That can be accomplished with the help of higher lime and fertilizer applications, better cane varieties, better cultivation practices and improvement of extraction process in the sugar mill. This program and all others involving the development of land and shifting land uses almost invariably involve the expenditure of time, labor and capital as well as management and foresight. Therefore, if they are to work it will take time, patience, guidance, research, and a great deal of cooperation and coordination between the agencies involved in the process of planning for a better and more scientific agriculture. Such a scheme will serve as a milestone in the organization of the Island's future agriculture, to partially⁸ cope with the needs of a rapidly increasing population.

Development of the Coffee Growing Region

The coffee growing region has 300,000 persons depending directly or indirectly upon the coffee industry. As shown in Table IV the population has remained static between 1940 to 1950 even though population increase occurs normally throughout the area. Moreover, population

⁸ The word partially is used as not all the progress can come from agriculture alone. In fact is the development of industry the one highly responsible for an increase in efficiency and productivity, to the extent that it will be able to employ the excess of labor from agriculture.

[illegible]

Under present conditions there appears to be only one alternative for the improvement of the coffee growing region. The alternative is to develop this region and in doing so, return it to economic and social prosperity. The basis of this conclusion is sustained by the following facts, namely:

1. To avoid excessive movement into the already crowded areas of the coast and city slums.
2. To provide for a more diversified system of agriculture in the whole island.
3. To improve the economic, social and living conditions of the inhabitants of the region.
4. To establish a sound basis for progress and economic development by providing better and higher utilization of natural resources.
5. To insure an adequate conservation of natural resources.

This program of development should center around the reorganization of the coffee industry. This industry has lately received much attention in a government program but it has not been strong enough. It lacks proper coordination and orientation. However, it has provided employment, but the capabilities which this region is rich in and have not been fully exploited.

...the coffee area will be developed in a more systematic manner, and this will avoid the concentration of the population in zones already crowded. This movement will represent a certain partial degree of decentralization which will be necessary in order to obtain an increase in labor productivity. Once this is realized, the raising of wages and income is more feasible for a better satisfaction of social needs and wants. Movement of the grants from the interior into sugar brings problems of social undesirability, aside from health, education and related problems. This will all handicap the development of the individuals so necessary in a movement of social and economic advancement.

By developing this region there will be created a more diversified agriculture with a higher degree of stability brought about by diversification and efficient utilization. Coffee can certainly be a very productive enterprise if there is a proper combination of production factors following the systems imposed by scientific farming. Studies made by Serra and Pinero show how the costs per hundred pounds of coffee increased and the profits increased when the yields of coffee per "cuerpo" were increased.⁹ Not to mention the other products which can be successfully grown in this region provided the necessary steps in the development are taken. In this way there will be a higher contribution from this region to the island economy so that it will not rely completely on the sole production of sugar cane.

Improvements in social, economic, and living conditions will make the coffee area a more desirable place to live. The people will

⁹ Serra Guillermo y Pinero Manuel, Estudio sobre el cultivo del café en Puerto Rico, 1916-17, Universidad de Puerto Rico, San Juan, 1917, pp. 10-11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

...the way, they are the cause of artificial scarcities, and the cause of economic crises, and of the consequent unemployment and poverty, production. Social and living conditions are also a great factor in regard to the kind of people that develops for different duties of citizenship and entrepreneurship. No sound development can ever be attained in material resources if there is no parallel development of human beings and personalities to accomplish the desired and necessary work.

The economic and social progress of Puerto Rico is dependent upon balance, and full utilization of resources. This region possesses a great deal of resources, agricultural and other than agricultural, that can very well be utilized for the profit and benefit of all its inhabitants. Any incomplete utilization is a waste, something that cannot be afforded under high conditions of scarcity and low standards of living.

So far as conservation of natural resources is concerned, it should be said that it is necessary to maintain soil productive capacity and improve it whenever possible. In the economic sense, conservation of water resources calls for more intensive utilization of hydroelectric sources. Conservation of this resource will only be attained when it is used extensively and more efficiently. The important phase in the conservation of biological¹⁰ resources will, on the other hand, be the maintenance of an adequate equilibrium.

¹⁰ To include those resources as forests, pastures, and so on.

The best approach to soil conservation is that which considers and adjusts land to the use for which it is best suited and most capable of performing. By doing so the natural balance is not disturbed and soil productivity is thus maintained. The best conserved soils on the Island are found under coffee plantations, therefore, primary attention should be given to the growth of this crop in a very intensive way. Pasture and forage are also suitable for steep and slopy areas like those typical of this region. Livestock can thus be advantageously produced, as livestock production is very important to Puerto Rico; in any developmental scheme this enterprise has to be considered for more than one reason. The importance of pasture improvement in this region will be two-fold: to provide for the marketing of a product - pasture and forage crops - in a more efficient manner than would have been usually accomplished, and to provide sound soil conservation through adequate utilization.

Lack of Input-Output Studies in an Agrarian Economy Plagued with Overpopulation

Farm production consists in bringing the necessary inputs¹¹ together in such a way that the physical processes of nature bring the outputs needed or desired. The amount or the proportioning of the production factors may not always be the most appropriate for an efficient utilization and adequate exploitation of the potentialities possessed by the factors used in production.

¹¹ Inputs are the factors used in production or the so-called production factors.

The entrepreneur, if he is to be successful, must select from the many different alternatives that organization which pays best. That pays best at any given time depends upon the response in physical output to the changes in the production process, and upon the changing prices of the various inputs and outputs. Therefore, in actual production he is confronted constantly with the problem: How much does it pay to use? How many men or machines? How much fertilizer? How much feed? and many other relevant questions.¹² Since there are many questions to be answered, there are many variables to be determined. Therefore, for any efficient process there must be a great deal of research employed, tied with a great amount of ingenuity in the process of finding the proper combinations and amounts of production factors essential for more efficient utilization.

This is of particular importance in Puerto Rico where the population pressure is such that agriculture has to be conducted on an intensive basis if any socio-economic progress is to be made. Under these circumstances an inventory has to be made of the assets available for production purposes. There is on the Island an excessive amount of only one resource - labor. The relative scarcity of the other resources is high as compared to the existing labor. Therefore, with the Island conditions sound utilization is more imperative than selective, in order to get the most out of whatever is available.

¹² Jensen, Einar, et. al., Input-Output Relationships in Milk Production, United States Department of Agriculture, Washington, D. C., Technical Bulletin, No. 815, 1942, p 2.

in the process of efficient production and of intensive utilization, input-output studies will play a very prominent role. Unfortunately, not much of this kind of research has been conducted on Puerto Rico. Stagnation in this field suggests slow and sluggish movement towards higher and more efficient production.

Intensification of Agriculture

Intensification refers to the application of great quantities of capital and labor per unit of land. Many of the agricultural enterprises of Puerto Rico are cultivated on an intensive basis. This is true of the sugar cane industry where in many regions around \$200.00¹³ are spent to grow a "cuerda" of sugar cane. Only truck crops may be cultivated on a more intensive basis. Input-output studies will more than pay for themselves if properly oriented. Furthermore, they are of paramount importance in the efficient allocation of resources, particularly when their relative scarcity is greater and a high proportion of them is utilized per unit of production.

This kind of study requires some special skill, but they are successful enough in that they consider both the technical and economic aspects of production.

As Jensen, et. al. assert: ¹⁴

¹³ Universidad de Puerto Rico, Estacion Experimental Agricola, Departamento de Economia, Tablas Descriptivas del Estudio de Costes de Produccion de Cana en Puerto Rico, Rio Piedras, Puerto Rico, 1945-46, 1947.

¹⁴ Jensen, et. al., Op. Cit., p 3.

both technical and economic analyses are needed, but the economic research will be of a special kind. It will require physical data that will show as soon as possible the effects of the law of diminishing returns. These effects may show up as a decline in output per unit due to over-fertilizing; or they may show up in poor utilization of feed at heavy feeding levels, or in smaller increases in yields from additional units of fertilizer.

With such technical information, together with prices for cost factors and products, the most economical method of production under varying circumstances can be learned and how far it pays to go as conditions change. As a rule, it is fairly easy to obtain large crop yields by the lavish use of fertilizers, but a farmer must ask: Does it pay? Input-output information will enable producers to select the most economic practices under changing price conditions, and thus to increase their net returns.

The object of input-output research in farming then is to furnish more accurate and complete basic knowledge of how yield per acre, production per animal, or quality of product, is affected by changes in methods of production and rates of application of the input elements and to ascertain by economic analysis how the relationships affect organization and adjustment of production.

Relationships of outputs to inputs exist physically and price of inputs to outputs will determine the intensity of use to be carried on under the different sale and economic conditions. This can be observed in Figure VI which was adapted from Fairchild.¹⁵

He comments:¹⁶

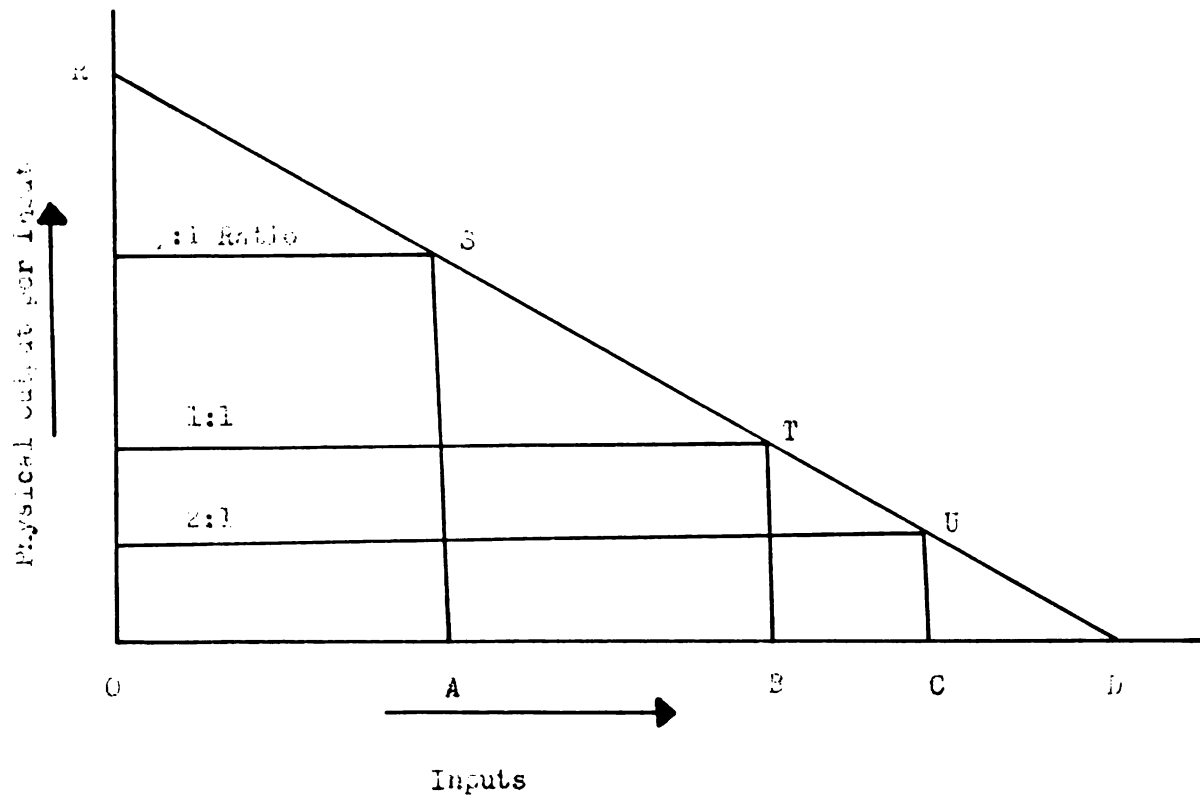
A given relationship of output to input exists physically as is shown on the curve. At a low price of output per input, production will be at OA inputs with an output equal to the area ORSA. With a higher price, inputs will increase to OB and output from the area ORSA to ORTS, an increase of ARTS. Finally with a very high price for output in relation to input, OC inputs will be used, causing an increase in production of output of the area TSUC or a total area of ORUC.

¹⁵Fairchild, Henry W., Some Relationships Between Land Use and Selected Natural Land Types in the Lansing Region of Michigan, Unpublished Ph.D. thesis, Michigan State College, East Lansing, Michigan, 1943, p 127.

¹⁶Ibid., p 126.

FIGURE VI

The Effect of the Ratio of Output to Input Price on the Intensity of Land Use



With any curve where diminishing physical productivity is the rule, there is a point of maximum physical returns, OD, where regardless of the ratio of prices of outputs to inputs, no further production can take place even though inputs can increase.

Trends and Potentialities in Intensification

In the previous section there was a short theoretical discussion on input-output studies and intensification. This section deals mostly with the relationships of these two aspects with a practical application necessary for any efficient utilization of the soil resources.

Puerto Rico will have to, and profitably can, intensify its agricultural production. However, in doing this a more accurate measurement of its soils resources and potentialities is mandatory. This can be very well done by a soil testing division. It will be able to help the farmer, or specialist in determining how high are the inputs available in terms of nutrients. From there it would be easy to determine how much should be added to attain certain desirable level of production, if it is necessary.

This soil testing could serve a good many purposes which are essential for an adequate land development toward higher intensification which presents itself as one of great possibilities in the future development of the Island's agriculture. The objectives to which this division can serve, are the following:

1. To avoid wastes in fertilization.
2. Help in the determination of the most profitable rate of fertilizer to be used.
3. To standardize areas of similar fertility and agronomic characteristics for the simplification of research and

practices measure the soil.

4. To conduct experimentation and follow-up recommendations with the input-output approach, to obtain more rational production.
5. To provide a more accurate inventory of soil productive resources.
6. To characterize areas that should receive similar soil management and agricultural treatment.

The advantages of such a program in Puerto Rico can not be overlooked. This can be better understood when the state of depletion of the Island soils and the high amount of fertilizers spent is considered. Amount spent for fertilizers in Puerto Rico's farming is only second to the expenses due to labor.¹⁷ The high expenditures realized in fertilizer utilization can be observed by referring to Table XVIII, page 84. These figures show that the annual expenditure for fertilizer increased from \$13 million to \$17 million over a space of one year. Providing there is no drastic change in the economic conditions, the amount of this annual outlay for fertilizer can be expected to further increase.

The soil testing program can be carried on with an insignificant cost to the public, as in Michigan, but the benefits obtained will be considerable. That has been the experience of the different states of the Mainland that use it, not to speak of the countries of Western Europe which carry on their farming on a highly intensified way, there-

¹⁷Perloff, Op. Cit., p 405.

Table XVIII: Sales of Fertilizers for the Different Crops, Fiscal Years of 1949-50, 1950-51

Crops	Tons Sold 1949-50 ¹	Value	Tons Sold 1950-51	Value
Sugar Cane	179,204	2/	237,615	2/
Coffee	10,593	2/	15,939	2/
Other	31,638	2/	30,039	2/
Total	221,635	\$13,000,000	283,393	\$17,000,000

1/ Annual Reports of the Bureau of Feed and Fertilizer Inspection Service of the Department of Agriculture and Commerce.

2/ The value of the fertilizer for the different crops could not be obtained. The total figures are an estimate of the Department of Agricultural Economics of the Insular Agricultural Experiment Station. For purposes of the study this is the only figure needed.

are conducting a very detailed progress of soil testing and following experimentation.

Need of Better Cultural Practices and Prevention of Misuses

Cultural practices and methods of utilization are determined by many factors, namely: (1) customs, habits and traditions, (2) degree of knowledge and farming education, (3) physical and climatic organization, (4) economic condition of the entrepreneur, and some others which have a more indirect effect. However, under conditions of extreme relative scarcity the economic condition of the operator exerts primary control over all other influencing factors. Furthermore, under these conditions the desirable degree of education is never attained, as the assets never allow for anything more than a bare living. Therefore, under the mentioned framework and in the struggle to make a living there is considerable preference of present over future income, the farmer being mainly interested in realizing an income, many times at, or a little above a subsistence level. This is especially true of many of the farmers of the interior of the Island and some of the coastal areas. It has inevitably led to the adoption of poor practices in production, and inefficient land utilization.

As Nazario, et. al. indicate: ¹³

The pressure of population has forced the cultivation of land with very steep slopes where erosion is very severe. Of the land in farms there are over a million acres with 75 percent or more of top soil removed by erosion. A large part of the

¹³ Nazario, et. al., Op. Cit., p 3.

cropland is being used intensively and the erosion problems are becoming more serious. The result is a serious soil deterioration and a consequent loss of productive capacity.

The use of improper cultural practices has also reduced the water absorbing and retaining capacity of most of our land soils, thus reducing further their productive capacity. Furthermore, the lack of adequate cover permits a rapid run off of rainfall which has resulted in the carrying down into streams of large amounts of top soil which are deposited as silt back of dams. The rapid run off also results in an uneven flow of water into reservoirs and a consequent scarcity of irrigation water during the dry season.

Thus, the general picture for the Island has been presented in regard to the seriousness of erosion and related problems. This is intimately connected with the cultivation practices and utilization of the land.

Conservation should be emphasized, not only of farm land resources, but other closely related resources such as forests. Productivity will thus be maintained over a long period of time. There should be an over-all conservation program with the educational aspect including the general problem and specific ones like those associated with the charcoal burner¹⁹ and "conuco"²⁰ type of agriculture.

¹⁹Charcoal is a very important fuel in Puerto Rico. Indiscriminate use in its production may cause forest and soil deterioration.

²⁰"Conuco" type of agriculture is the name given to the system employed by many of the Island rural workers. It consists of growing crops (mostly subsistence) in a certain patch of land for two to three years without the use of adequate practices of conservation or fertility maintenance. When the soil is not productive enough they move to some other area. By doing so the productive potential of the land is endangered in such a way that it will take years to make it usable again.

Expansion of Sugar Cane in Hilary Areas

Between 1935 and 1950 there was a tremendous increase in the amount of land dedicated to sugar cane. More than 150,000 acres were brought under the mentioned culture. This movement was efficiently catalyzed by a good credit structure for the industry, excellent marketing facilities, certainty and good returns in the investments.

Therefore, many farmers felt the urge of going into the sugar industry and expanding their acreage under sugar cane. Most of the better adapted soils to this crop were already growing it, so expansion took place along the hillsides of the coastal plains and in the mountainous region. Batchelder has called this expansion in the study he made of the Northwestern sub-humid plain of Puerto Rico: "A flagrant disregard of the unsuitability of this crop to these lands."²¹

As the problem seemed so serious he selected a farm to study this problem more closely. Besides illustrating the inadequacy of land utilization the following quotation also shows some of the social problems related with the matter.

Batchelder asserts:²²

The farm presents all of the characteristics and evils of sugar culture along the karst area of the subhumid plain. Formerly, the sandy clay soils of this section were cultivated in minor food crops and a little coffee by the families of twenty-two tenant wage-laborers. Approximately thirteen years ago these families were moved out when the owner decided to plant cane. Now only three families remain.

²¹ Batchelder, Op. Cit., p 125-135.

²² Loc. Cit.

When these lands were first brought under cultivation yields were good because the soils developed under a tree cover, were fairly deep and rich in organic content. However, even under careful land management, yields have diminished rapidly.

This explanation is beautifully presented by Table XIX, page 89, (adopted from Batchelder's dissertation).

The complete misfit of sugar cane under these conditions is obvious as shown by the figures presented on Table XIX. Batchelder further comments:²³

Even though this farmer uses 200 to 400 pounds more fertilizer than is the common practice elsewhere on the plain, his yields are rapidly approaching the point where the hill-sides will have to be retired from cultivation. Present yields on the steep slopes are almost marginal in relation of cost to profit. Previously, the acreage in hill cane was about one third greater, but within the short span of thirteen years some of these lands have been retired from cultivation and are now in brush pasture.

After sugar cultivation, these lands are unfit for any remunerative land use. Soil erosion proceeds at such a prodigious rate, that rock exposure may increase from eleven percent of the total area to over fifty percent in five years.

This is a man made disruption of the environment or "disclimax" as it is known in plant ecology. As expected, all kinds of worthless grasses and a great many undesirable weeds take over. Even hardy shrubs and forest species fail to thrive under the disturbed natural habitat.

These facts as presented by Batchelder are also true of many other areas, particularly in the interior of the Island. However, it is not implied that sugar cane can not be profitably grown in this region. In fact many of the sugar cane growers of the interior have

²³Ibid., p 133.

Table XIX: Crop Yields on the Diverse Land Types of the Selected Long
Utah Farm Basins*

Section of Farm	Acreage	Physical Land Type	Gran Cultura** 1937	Ratoon 1938	Ratoon 1939
Pindin	12	Sand clay soil, slope, 27°, well drained, no stones	38	30	25
Basin Floors	30	Plastic clay soil, slope, 7-12°, ade- quately drained, some stones, rock outcrops 10% of total area	12	35	30
Hill Slopes	18	Thin clay soil, 32 slope, 22-30°, well to ex- cessively drained very stony, rock outcrop, 11-50% of total area		20	15

*Average yields are given in tons per acre.

**"Gran Cultura" the initial crop, is characterized by high yields because it is cultivated 16 months and fertilized twice (in this case, 1600 pounds), whereas ratoons are harvested in 12 months and receive only one fertilization (1,200 pounds).

Source: Batchelder, Op. Cit., p 132.

better returns than many farmers of the coastal lands whose cane may be produced in marginal lands. The important thing to consider will be to avoid the repetition of cases like the one just quoted. It is perhaps the time to devise some kind of system or method to determine the profitability or limits in sugar cane expansion. Once this is determined land use regulation or recommendations may be put through by means of formal or informal means - that is, government or group action.

Society must be protected from developments that may provide temporary benefits for the individual, but which undermine the resource base and endanger social objectives tremendously. Misuses and poor cultivation practices will get to these extremes if not properly watched. If there is to be further land development, it will only come through better utilization and better cultural practices.

Lack of Adequate Marketing Structure

It seems that marketing and land utilization and development are unrelated in the agricultural organization. But, nothing is further from the truth. There can be no adequate land utilization or development if there is not an appropriate marketing structure to complement the production process.

"Markets are essential to economic growth, and economic growth creates markets."²⁴ If there is economic growth and there are markets the alternatives of utilization are broader, providing

²⁴ Norton, L. J., Role of Market Development in the Further Utilization of Agricultural Resources, Speech delivered at the 22nd International Conference of Agricultural Economists, Washington, D.C., August 15-22, 1952, p 4.

development can be attained in the absence of incentives and disincentives.

Puerto Rico could be producing many of the inferior crops with high labor requirements for exportation purposes, like fruits and vegetables, but the marketing facilities have been inadequate and only a fair degree of success has been attained in the production of these crops. These kinds of crops are highly recommendable for the Island as it would take care of some of the labor excess.

The marketing of locally produced foodstuffs has been characterized by a very slow progress in the adoption of techniques which increase the efficiency in marketing. There is also a lack of adequate facilities for handling the fresh crops at all levels from the farmer to the consumer.²⁶

The introduction of equipment, standardization methods, grading procedures, assembly centers, transportation facilities, processing and general organization of the marketing structure of the Island will undoubtedly increase the salability of agricultural products, particularly fruits and vegetables.

The canning and processing factories will be indispensable in any development of the system for the following reasons; namely:

1. They will take care of the excess production in periods of good production to avoid excessive price reductions which will otherwise curtail best land utilization by reducing producers' incentives.
2. To take care of an excess supply in case of an interruption in the flow of products along the marketing line. (The per-

²⁶ Nazario, et. al., Op. Cit., p 37.

- d. By increasing the number of products, the number of brands, and the number of sizes, etc. (e.g., the number of sizes of shoes, etc.)
- e. By increasing the number of brands, the number of sizes, etc. (e.g., the number of sizes of shoes, etc.)
- f. By increasing the number of brands, the number of sizes, etc. (e.g., the number of sizes of shoes, etc.)
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The adaptation of all modern marketing techniques will be an obvious benefit to the island in general, even though it will take a great deal of time for their establishment and understanding.

Cooperative Marketing and Conditions

Cooperative marketing, as conditions are organized, is a type of arrangement to perform some of the different necessary marketing functions, for realizing a common purpose. The main reason for the establishment of these associations is the need for the cooperation of the different producers, particularly in case of market irregularities. Low farm prices and wide marketing margins have been important reasons for establishing this kind of associations in Puerto Rico.

Some progress has been accomplished by the island farmers in the cooperative marketing of three important crops - cotton, sugarcane, and coffee. It will not take long to obtain an organized, efficient marketing system for the other crops. The success of these associations will depend on the usefulness of these organizations. They will be successful if they are able to provide the necessary marketing services to the farmers.

the fact that it were not for these organizations the survival of these islands as we know them would be impossible. That is the attitude among many of the coffee growers that are members of the coffee marketing cooperative. However, one must remember that more than an economic need is necessary for the establishment of cooperative systems or organizations. A great deal of education in the organization and operation of cooperative systems has to be attained if actual development is to be accomplished. Any efforts made will more than pay for themselves, as many of the marketing problems can be successfully approached by a cooperative system.

The island marketing structure is greatly hindered by a lack of knowledge, lack of capital, lack of adequate information and credit. Monopolistic practices are also used to a certain extent by the intermediaries of agricultural products. Progress in the marketing field will never be attained if it continues to be plagued with these hazards. Good cooperative marketing organizations will very well help, in the extermination of factors retarding progress and preventing the improvement of the system. Success has been accomplished with the crops already mentioned and extension to other crops will be desirable. The farmers, by pooling their scant resources, can establish efficient organizations which will greatly contribute to the expansion of the overall marketing structure. This will undoubtedly result in an increase of the economic incentives which will certainly bring sound land utilization.

4. The Development of the Coffee Industry in the Mountainous Region

The mountainous part of Puerto Rico is the section that grows the coffee of the island. It has been for the most part, due to an adaptation to the soils and climate conditions of the region. However, lack of improved transportation facilities has had a great deal to do with the development of this industry in this region, particularly in its early development. The nature and durability of coffee beans made possible its transportation for long distances on pack animals, which was the only transportation means available when the farms were far from the roads. Therefore, the farm owner of the mountains was forced to keep mules and horses for the transportation of its dear product.

As the years went by and as the road system of the interior of the Island was extended their number started to decrease as their usefulness went down. At present the number of pack animals has been reduced, but as yet there are more than half of the amount that was reported in 1910.

Thus, land which could have been devoted to some other use has to be kept for providing the feed (pasture and forage) for these animals. Therefore, as the road system expands more of these animals are displaced and the lands released for other uses. In the light of these facts it can be seen how the transportation system may modify the use which is made of land. Further extension of this system may permit the keeping of more dairy livestock in place of pack animals. This substitution in uses will undoubtedly be of great benefit to the entrepreneur, as well as to society in general.

CHAPTER IV

Land Development Now in Operation

This chapter deals with the land development and utilization programs now in operation in Puerto Rico. It is recognized that the coverage is incomplete as there are many other relevant programs that have direct or indirect effects on land development and utilization. The objective is that this chapter presents an idea of how some of the problems of land use and development are being approached in Puerto Rico.

Since 1940 great progress has been attained on the Island, in connection with the organization and edification of plans and programs, for the economic reconstruction and development of the country. The greatest progress has been in the delineation of a system to ascertain the conditions and the degree of social and economic advancement which is brought about by a more efficient organization. Progress as measured by physical output has not been as great, but it can not be considered small by any means.

During World War II the assets of the Insular Government greatly increased. To make a more efficient allocation of the revenue collected, the Puerto Rico Planning Board was created. The principal function of this Board is to establish and maintain, in cooperation with the Bureau of the Budget, a plan for the expenditure of the Insular Government income. The Board reviews all proposed public improvements projects and in addition, exercises control of the subdivision and zoning of urban areas.

The Economic Council at this time, in cooperation with the Planning Board, deals with the economic planning for the island. They thus determine policies and programs to be followed for the betterment and augmentation of the economic capacity of Puerto Rico.

In a place like Puerto Rico, which is extremely overpopulated, and not endowed with raw materials that make manufacturing and industrialization possible, planning is essential. Some other services should be administered by the government in order to see that there is an equitable distribution of economic goods and services.

Planning in the Island is conducted by the above mentioned planning board. Services and development schemes are administered by the following public corporations:¹

1. Land Authority, to carry out a program of land reform, based upon the "500-Acre" law, which limits corporate land ownership or control to 500 acres;
2. Puerto Rico Agricultural Company, to stimulate the commercial development of the Island agricultural resources;
3. Economic Development Administration, to assist private enterprises in establishing or expanding business and industry in Puerto Rico;
4. Government Development Bank for Puerto Rico, to make government funds available for the encouragement of industry, and to act as a central financial agency for the Insular Government, the public corporations and the municipalities;

¹ Only those agencies that deal most closely with the problems of land development and utilization are mentioned.

1. Water Resources Authority, to promote greater use of the island's water supply for power and irrigation.

Except for the Land Authority, Water Resources Authority, and the Puerto Rico Agricultural Company the effect of these programs on land development and utilization is indirect. To the extent that these indirect actions affect the purchasing power of the consumers and the marketing structure, they affect land utilization and development.

The Rural Land Utilization Program

No sound land development can be accomplished when the land is not used in an adequate manner, and when man-resource maladjustments exist. The local students of economic and social problems, being aware of this fact, decided to start a program which will lead to more efficient land utilization. So the rural land utilization program as any other program of the same kind, has the objective of classifying systematically land resources in such a way that man can easily understand its fundamental characteristics and utilize them most intelligently and effectively in satisfying his wants.² Therefore, the first step in a study of the kind should be a survey of both geographical and economic nature, in order to obtain an inventory of the land capabilities and resources.

"Geographic surveying includes the observing and recording of facts on the character and distribution of the uses man is making of

² Renne, Op. Cit., p 35.

the present situation." As no land utilization study is comparable with out investigation of economic character, the proper schedules were made to gather such information. They were to complement the information obtained on physical and use characteristics gathered by the geographic surveyors.

The land use and the physical characteristics of the land were surveyed, on the basis of the unit-area method, using a fractional code system of notation of the field data. It includes the mapping of the land use, degree of slope, soil classes, condition of drainage, amount of erosion, degree of stoniness, and amount of rock exposure. In Puerto Rico the size of the unit area (utilized in the surveying procedure) ranges from many acres on level land along the coast, to areas of one acre in the central part of the Island. Buildings, structures and other relevant features were mapped with symbols.⁴

This fractional notation system has the advantage that a great deal of information can be obtained without slowing down the surveying procedures. The numerator of the fractional notation represents the use of land and the denominator signifies the characteristics of the land. The land characteristics included in the data recorded on field

³ Dyer, Donald R., The Development of Geographic Survey Techniques for the Rural Land Classification Program of Puerto Rico, Unpublished Ph.D. Thesis, Northwestern University, Evanston, Illinois, 1950, p 2.

⁴ Pico, Rafael, Surveying Land Use in Puerto Rico, Speech delivered by the Chairman of Puerto Rico Planning Board to the Association of National Geographers, Gainesville, Florida, 1951.

maps in the Rural Land Classification Program are those that are readily recognized when observed and that are significant for consideration of the uses which man makes of the land. The categories and classes of present land uses employed in the classification, are sufficiently detailed to portray accurately the use of all the rural land of the Island, and to focus attention on the distribution of commercial crops and commercial dairying in the overall land use pattern.⁵

Land use in Puerto Rico is classified into the following eight major categories:⁶

1. Cropped Land - Land in which produce is harvested for human consumption and is broken down into 43 crops or combinations of crops.
2. Pasture and Harvested Forage Grass - Land devoted to the growth of grasses for animal consumption. This includes natural pasture, improved pasture, harvested forage grass, and others.
3. Forest and Brush Land - All areas in trees whether planted or part of the natural vegetation. It also includes brush, which consists of trees below 10 feet in height. Land considered as woodland pasture was mapped within class 3 under the category of pasture and harvested forage grass.
4. Non-Productive Land - Land without any agricultural production value. This land may or may not be suitable for

⁵Dyer, Op. Cit., p 87-111.

⁶Pico', Op. Cit., Speech Delivered to the National Association of Geographers.

some productive use, but at present it has no productive value.

5. Rural Public and Community Service Land - This category, as it implies, indicates plots used for public and community services. Usually it comprises small tracts or plots that fall into seven classes.
6. Quarrying and Mining Land - The sixth category of land use includes rock and mineral resources which are being removed from the land. Abandoned mines and quarries are included in non-productive land.
7. Urban and Manufacturing Land - Land in which cities and towns are located. It also includes tracts outside the urban area devoted to any manufacturing activities. This category is divided into seven classes.
8. Miscellaneous Land - Features of land use which do not fall into any of the above mentioned categories, are recorded in the map by means of letters, and in some cases by numbers in addition to letters.

When the physical and the economic data are added to the land use information a very detailed and complete information regarding land utilization, as well as its potentialities, will undoubtedly be obtained. Without any doubt this information will serve as a milestone in agricultural planning. Specifically the objectives of classifying land may be grouped into eight major categories.⁷

⁷ Kerne, Op. Cit., p 36.

1. Land utilization and economically sound land settlement policies both public and private;
2. Guidance in public land purchase and development;
3. Planning the organization and distribution of local governmental services;
4. Guidance in the distribution of public aid, particularly federal and state subventions and public relief to local areas;
5. Guidance in determining sound real estate lending and borrowing policies;
6. Equalization of land assessment for taxation purposes;
7. Guidance in developing and administering programs for improved land utilization practices, soil conservation and erosion control measures, and similar practices;
8. Guidance in developing sound farm management policies and organizing the most effective type and size of operating unit.

As it can be observed land classifications have multiple and highly beneficial uses. However, there will be little accomplished if there is not an adequate interpretation of the economic factor. Once this is interpreted and translated into simple terminology, understandable by the farmers and in terms of the needs of the country, greater land development and utilization can be expected.

At present ~~this~~ program is being carried on by the Rural Land Utilization Division of the Department of Agriculture and Commerce. The entire island has been surveyed and most of the data is undergoing a process of analysis and interpretation.

Some of the things that have been done in the past few years have been to try to get the farmer to produce more of the things that he needs for his own family and to get him to produce more of the things that he needs for his family. It's a little bit of a problem to get the farmer to produce more of the things that he needs for his family, but it will be a little bit of a problem to get the farmer to produce more of the things that he needs for his family.

Marketing and Unemployment Service

The marketing and unemployment service is a service that is provided to the farmer. It is administered by the Division of Marketing and Unemployment Service, which is a part of the Bureau of Agricultural Services of the Department of Agriculture and Commerce. It has been in existence since 1913. They have been established to take care of an aspect of agricultural production, which the average farmer can do very little.

The marketing Division has as a final goal, the establishment of a complete marketing structure throughout the island. However, marketing will never be efficiently accomplished if there is not adequate information on future and present supplies. The extension on crop and livestock production help to provide this information and thus give the farmer an idea of how the market is at the present time or when production is realized. A market news service is also provided by this division. There are hopes that with a better knowledge of supply and demand conditions, better and direct recommendations can be given to the farmer in regard to the way that he will want to utilize his land.

equipment and opportunities to the island communities.

Industrial expansion has been great and up until the present, more than 150 new plants have been established. This program will undoubtedly result in an increased purchasing power and better utilization of many of the agricultural products through industrial processes.

CHAPTER V

Conclusions and Recommendations

In view of the great problem of population pressure facing Puerto Rico it must be concluded that the per capita economic supply of land should be increased. This end can best be secured on the island by making a readjustment of the insular agriculture so that every region contributes according to its productive capabilities and potentialities. The presence of this condition has been helped by the same factors that have favored the establishment of a monoculture economy based on sugar cane. If security, stability and increased agricultural productivity is to be attained, all steps should be oriented toward a higher degree of diversification, without endangering the welfare and productiveness of the sugar cane industry which is the backbone of the Island economy.

Under these conditions land has to be developed and utilized properly and effectively, particularly when it is considered that the insular population continues to increase at a very fast rate. Therefore, it is essential that land be utilized more intensively and that better production and conservation practices be utilized for the attainment of this end. In order to obtain the best production practices, input-output studies should be conducted as they are the best guide in indicating the proper combination and the right amount of resources utilized in producing. Thus, the capabilities of resources will be used to the extent of their potentialities without being unefficient.

It is necessary to determine the efficiency of soils under the different cropping systems not only in terms of physical outputs, but in economic quantities as well. Therefore, the variable inputs can be handled and managed according to price fluctuations, future expectations and other factors that influence and justify the given practice or system of cultivation.

If land use problems are going to be studied under conditions of extreme population pressure and lack of adequate resources, land has to be described in terms of its productive potential characteristics. This will facilitate the treatment of the different agricultural regions as far as application of methodology is concerned, so that every area, region or farm is used for what is most capable and best suited for. By answering the following question in the specific situation, a basis will be obtained for judging the patterns of land utilization. Are those patterns of land utilization the best from the standpoint of efficient resource utilization and social returns?

Generalizations can thus be made according to the area or region. Individual farmer problems and specific problem areas could be covered by some other study with the possibility of getting adaptable and flexible farm management and planning schemes according to the needs of the areas and systems of farming.

In promoting sound and efficient land utilization as determined by research and present land use analysis, the educational aspect should be emphasized. It should be the duty of all agricultural workers to orient the farmer as to the proper things to be done, as well as facilitating the procedures and help the farmer in the land utilization of his land.

for the proper development of land and its productive utilization, it is not only necessary to have plans and policies regarding the best and more efficient utilization. Due consideration should be given and proper measures should be taken in order to prevent land abuses. This is even more important when such abuses will bring an almost complete deterioration of the soil productive capacity. The best land utilization is that attained over a longer period of time. Therefore, in selecting cultural practices, due consideration should be given to the conservation aspect.

Agricultural production is not complete until an income is realized. This income depends to a great extent upon the efficiency and availability of the marketing procedures necessary to conduct the product from the farmer to the consumer. In Puerto Rico the marketing structure is not adequate for the adequate distribution of the agricultural production. This brings the narrowing down of the pattern of utilization, besides lowering the economic incentives necessary for higher development and efficient land utilization. Measures have been taken by the government, but there is a great deal to be improved.

Under the Island conditions of high relative scarcity, nothing will be better than an intensive program in agricultural planning as a part of a greater over-all economic planning scheme. It should be the responsibility of the planners to provide for greater and more efficient utilization of resources taking in consideration social as well as economic returns. However, it should be recognized that planning success depends to no small extent upon the receptivity of the

the people of the island of Hawaii. The people of Hawaii are not yet fully aware of their potentialities and their capabilities. They are not yet fully aware of their duties and responsibilities. They are not yet fully aware of their opportunities. They are not yet fully aware of their potentialities. There is an urgent need for development, both individual and national. If there is not an adequate development of individuals going on at the same time with this movement, individuals conscious of their duties and privileges, aware of their opportunities, and equipped with the proper attitudes are needed who will stop thinking in terms of the problems and accept them as a challenge.

The progress attained in the development of land potentialities and national utilization is going to be a slow one in Hawaii. Until a younger generation, equipped with the essential indoctrination starts to come up, there will be many limitations for the introduction of scientific know-how and techniques for further development.

There are many factors to be considered and many recommendations, which will be necessary to bring national land development and utilization. The following are thought to be of direct or indirect relevance to this matter:

1. There should be a readjustment of the island agriculture in order to attain a more balanced agriculture with every region providing its share according to its potentialities.
2. Toward the attainment of this end there should be a development of the coffee growing region.
3. Consideration must be given to the development of the livestock industry in the mountainous region. To provide for better utilization, conservation

purposes, and an additional source of income to the mountain farmers who are in very poor financial condition.

4. Develop research and studies of input-output nature, essential to a higher and more efficient utilization of resources.
5. An economic analysis of common and accepted cultural practices.
6. Determination of the different land misuses and draft a plan of available alternatives for their prevention.
7. Study the possibilities of fiscal and legal possibilities for the elimination of land misuses.
8. Develop a program of agricultural intensification oriented toward highly specialized and high value crops, maintaining diversification at the same time.
9. A soil testing division to guide and orient in the intensification of crop production.
10. Establishment of marketing facilities, market outlets, and all necessary steps to market the agricultural production more efficiently and provide for a more flexible pattern of land utilization.
11. Conduct a consumer education program on agricultural products.
12. Establish greater cooperation and coordination between agencies and centralize wherever possible.
13. Start an educational program at all levels in terms of the problems and economic organization of the island.

1. to make closer relationship between the agricultural
workers and those working in education.

Some work has been conducted on many of the problems and
recommendations presented. The extent to which this work will provide
solutions to the existing problems will depend upon the degree of coop-
eration received at all levels. However, it is hoped that this work
will throw some light on the struggle for the improvement of the
living standards of all Puerto Ricans.

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