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Sonia De Leao

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THE EVOLUTION OF AGRICULTURAL LAND USE PATTERNS
IN THE STATE OF BAHIA, BRAZIL

by

Sonia de Oliveira Leão

Department of Geography

Submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
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TO

My parents, to whom I owe the privilege of being born in Bahia
and being who I am.

ABSTRACT

An increasing number of geographers have called attention to the necessity of incorporating the time dimension in studies of geographical distribution. Time seems to be especially important in the study of the spatial organization of agriculture because it is one of the most complex of economic activities and depends on multiple processes which act inside and outside its operating units, and because the manner in which agriculture responds to these processes varies through time and space; patterns evolve, are superseded, or have residual features which are difficult to explain in the light of present conditions. This is particularly important in those underdeveloped areas in which economic development has been based not only on agriculture but has also been dependent on the external political and economic control of powerful nations. Indeed, their status of underdevelopment may be partly the result of lags not readily explained in the light of present conditions.

This dissertation deals with the historical spatial analysis of agriculture for the State of Bahia, the earliest economic core of Brazil. Emphasis is placed on the economic processes which have been responsible for the expansion and location of agriculture from the beginning of Bahia's colonization in 1549 until 1970. To guide this dissertation reference and direct comparison is made with von Thünen's classic model of agricultural location. This model was chosen because it contains predictions (under

equilibrium and dynamic conditions) related to both the evolution and location of agriculture, and in particular because von Thünen's "Isolated State" was constructed on the basis of several assumptions, most of which were met, in Bahia during its earlier stages of agricultural development.

Comparison between Bahia's agricultural reality and the theoretical conditions of "The Isolated State" is carried out using the method of comparative statics, whereby the time-path is divided into stages, each one in succession being treated as an equilibrium solution for its respective time period. Division of the time span involved the following criteria; (a) von Thünen's assumptions and subsequent predictions; (b) the major historical processes affecting agriculture in Bahia; and (c) the availability of historical evidence and quantitative records. Based on these criteria, four broad stages of agricultural evolution were identified, as follows:

(1) Origins (1500-1570). This stage begins with the discovery of Brazil and the application by Portugal of mercantilistic policies which resulted in Bahia's colonization. It ends with the first results of the colonial agricultural enterprise developed within a market situation. Von Thünen's prediction that intensity of agriculture is inversely related to distance from a market is observed in Bahia from this earlier stage, albeit in a narrow zone of colonization close to the major local market of Salvador.

(2) Gradual Expansion (1571-1822). This long period includes the remainder of colonial times and ends with the political independence of Brazil. The development of export crop production, notably sugar cane plantations, is discussed. Continued expansion of sugar plantations

throughout the period fails to confirm von Thünen's prediction that a fall in prices of agricultural products leads to a spatial contraction of agricultural land use regions. Rather, historical evidence shows that the two agricultural zones which had already emerged in the earliest period of Bahia's colonization continued to expand despite external competition which lowered sugar prices. The relationship between the intensity of agriculture and distance from the major local market of Salvador, however, remains consistent.

(3) Rapid Expansion (1823-1930). This stage includes the post-colonial period up to the beginning of the Great Depression. Von Thünen's predictions that an increase in demand and transportation improvements cause expansion of agriculture are both empirically observed in Bahia. This results in the evolution of the two earlier agricultural zones into three based on the overall impact of the industrial revolution on Bahia's economy. In addition, the inverse relationship between intensity of agriculture and distance from a major market is still observed.

(4) Spatial Adjustment (1931-1970). This stage begins with the watershed of the Great Depression which led to major changes in Brazil, including government policies to promote sectorial industrialization, and culminates in 1970, the date of the last available agricultural census. Von Thünen's prediction that lower demand for agricultural products causes contraction of agricultural space and to an increase in extensive types of agriculture is partially verified in Bahia. A clear trend for agricultural land uses to be located according to their respective markets is also observed through the evolution of the previous zoning. Statistical testing of the inverse relationship between intensity of agriculture and distance from the major local market shows that the latter variable is not

the best predictor to explain spatial differentiation in the intensity of agriculture in Bahia in this modern period.

The historical evidence and statistical measurements together contribute to two basic findings in relation to the comparison between Bahia's reality and "The Isolated State".

(1) Under the true assumption of trade isolation in which Bahia remained until 1930, a strong and persistent resemblance was observed between the spatial organization of Bahia's agriculture and "The Isolated State".

(2) The breakdown of trade isolation within Brazil after 1930 led Bahia's agriculture to undergo changes which resulted in some deviations between the von Thünen model and actual conditions in Bahia. Empirical verification of the model between 1930 and 1970 seems to indicate that Bahia has become more integrated within a national (Brazilian) context, and that the state occupies a somewhat peripheral position in both the national economy and an enlarged Thünian landscape.

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CHAPTER 1

INTRODUCTION

1.1 The Temporal Framework for Agricultural Geography

Agricultural geography is represented in the twentieth century by a rich literature which includes topical, typological, regional and location studies carried out at a variety of scales and levels of intensity. However, relatively few attempts have been made to study the evolution of agricultural patterns even though this type of investigation does present an important potential for shedding more light on location studies and agricultural planning. At the present time some geographers are making efforts along this line but many of these contributors, however, have not taken into consideration the time dimension, an important component in the analysis of geographic distribution and especially in the study of agricultural space.

Time is even more important because of the complex nature of agriculture itself. Agriculture differs from other economic activities in several ways: it occupies a large part of the earth surface and is, therefore, affected by widely differing natural conditions; it employs large amounts of labour, the quantity and quality of which also varies from place to place; it provides both the basic food energy for human survival and key industrial raw material; it is a way of living as well

as a way of making a living; it does not respond rapidly to changes in prices because of the multiplicity of individual production units and the practical problems of change in enterprise. Finally, agriculture combines physical, biological, nutritional, social, technological, economic and political processes. These have, moreover, evolved through space and time in different combinations to produce extremely complex patterns. Indeed, one may find in any one area relic agricultural systems and patterns which are reminders of previously dominant types or areas in which only one part of the agricultural system progressed whereas another stagnated or pockets in which a new method or type of agriculture is just appearing and may in future replace the currently prevailing type. The occurrence of such spatial complexity leads the author to suggest that the temporal dimension must be incorporated into both theoretic locational analysis and research preliminary to planning.

So far geographers have largely tried to explain agricultural patterns by the study of present conditions. If past conditions were taken into consideration, the approach usually lacked a theoretical framework. The former approach has dominated particularly in recent decades with the emphasis placed on location theory. While there is no doubt that this new step has led to further improvements, location theory assumes equilibrium conditions and thus explains only part(s) of reality at a specific moment in time, and when accurate data are available. In addition, the temporal framework in which most investigations are carried out may not be sufficient to explain the spatial structure within a given study area. This fact may often occur because at any one time the areal distribution of population, agriculture, industry, and the like, represent merely interim stages in long complex processes. This viewpoint

has been reinforced by Ackerman¹ and Blaut². The latter explicitly pointed out that "structures of the real world are simply slow processes of long duration". Later, Spencer and Horvath³ and Grigg⁴ followed the same line of thought. Harvey concluded, after a critical review of the literature, that "the lack of study focused directly on the processes of locational change stems, largely, from methodological problems of dealing with space and time in the same context".⁵ Brown criticized geographers for their attachment to location studies based on general equilibrium theory and proposed,

... that we attempt to extricate ourselves from our ties to classical theory, which beyond question, has prejudiced our thinking for the last 150 years, so that we may begin to formulate better and more meaningful hypotheses. That we not be willing to settle for the easy-to-measure distance function proxies, but try to get at the underlying phenomena which we know to be more important, but do not know how to measure. And in the meantime while we are using distance variables, that we recognize their explanatory weaknesses and avoid misrepresenting them as being something they are not.⁶

Found's criticism went even further when he concluded that, "most land-use theories have been incapable of providing ... models to predict genetic or evolutionary changes through time".⁷ He concluded, moreover, that such models have exceptional importance, particularly in regional or national planning situations.

The problem of understanding the present spatial organization of agriculture becomes even more complex when less developed areas are under consideration. Indeed, their status of underdevelopment may partly be the result of lags not readily explained in the light of present conditions. However useful the measurement of distance-related variables in such areas, their explanatory power may be weakened by physical and/or historical factors not yet overcome. Especially in such circumstances the past

conditions affecting the present agricultural systems and their spatial structure and location must, therefore, be reconstructed and analyzed through time. The research here detailed is to be this type of investigation.

1.2 Application of the Temporal Framework to Bahia

To accomplish the aforementioned objective the State of Bahia (Figure 1) was selected as the study area. Located in Northeastern Brazil which is one of the most cited underdeveloped regions of the world, Bahia's settlement and economy have remained over four hundred years dominantly based upon traditional agriculture. Although Bahia's underdevelopment has been accentuated in the present century, its roots have to be sought in the past. For that reason a brief, introductory overview of the evolution of agriculture is considered useful at this point. This overall development may for convenience sake, be presented as a sequence of three major situations: a long colonial period of 322 years from the year of discovery by the Portuguese in 1500 to 1822, the year of political independence; a shorter intermediate phase from 1823 to 1930, of continued economic isolation from the rest of Brazil and associated economic dependence on external markets; and, finally, a last phase of gradual integration in the emerging national economy of Brazil from 1931 to 1970, the year of the last available census.

During the colonial period it was Bahia and especially the region around Salvador which developed into the first economic core of the Portuguese possessions along the Atlantic shore of present day Brazil. Although this geographical location relative to the Atlantic and Portugal and the natural conditions were partial causes of Bahia's rise to importance,



Figure 1 Location of Bahia

this development was promoted above all by the growing economic and political interest of the Portuguese Crown in holding Brazilian land in direct control. In order to initiate settlement the Crown divided the claimed territories into fifteen large allotments, called captaincies, and granted each to a landlord. Recognition by the Crown of Bahia's potential as sugar producer and the death of the landlord, prompted the King to take in 1549 direct control of the Royal Captaincy of Bahia. He founded the City of Salvador on its large sheltered embayment as the administrative center for all the captaincies and introduced as well the institution of the sugar cane plantation. From the beginning, therefore, the landholding system of Bahia was characterized by large estates, most of which produced sugar for the metropolitan market (Portugal). Salvador, the colonial capital, became the entrepôt and the largest Bahian market. In spite of trade isolation from all other captaincies, it remained the largest city in the Portuguese, American territories until a new staple crop, coffee, was later introduced in southeast Brazil.

During the colonial period the sugar cane plantations were established on the best lands surrounding Salvador whereas the secondary cash crops (cotton and tobacco) and the food crops (manioc, beans, rice, and corn) were grown on the marginal lands not suitable for sugar cane. This dual cropping pattern expanded along the coast where the transportation facilities were best. An exception was the perishable foodstuff (vegetables and fruits) which continued to be grown near Salvador. In the hinterland cattle and subsistence agriculture expanded together.

Thus, there developed very early a dual marketing system and spatial specialization with sugar produced on the coastal plantations and shipped via the entrepôt (Salvador) to the metropolitan market

(Portugal) and all other foodstuffs produced on marginal lands or in the hinterland to supply the plantations and Salvador. From these beginnings there dates as well the continuing problem of an inefficient food supply for the city, because the food crops have ever since been relegated to the marginal lands and the small holdings.

During the intermediate phase from 1823 to 1930 the dual marketing system remained relatively unchanged despite the political independence of Brazil and displacement of the country's economic core to the Southeast. These changes did not lead to any significant reorientation of the trading pattern, because Bahia remained economically isolated from the other states of Brazil and dependent upon the external market, which, however, expanded with independence and the spread of industrial urbanization to include more of Western Europe and the United States. It was rather external changes which brought benefits to Bahia's agriculture; the lowering of transoceanic freight charges, the increase of external demand for tropical products and raw materials and the mid-nineteenth century trend towards free trade, all increased demand for products of Bahian agriculture. Internally these factors were complemented by the introduction of some technological innovations such as railroads and processing plants, and by an increase in population. As a result the crop pattern changed in two ways. On the one hand the traditional crops and agricultural land uses expanded into the interior. In the hinterland cattle ranchers, for example, opened more lands in the western and southeastern frontier. On the other hand two new secondary cash crops became important staples. Coffee expanded from the central coast, westward into the interior uplands, and cocoa plantations were developed throughout the coastal lowland to the south of Salvador. In the process cocoa became the leading

export staple, followed by tobacco.

The last phase of gradual integration into the emerging national economy of Brazil started rather suddenly due to the onset of the Great Depression in 1929/30. The drastic slackening in overseas demand and draconian policies instituted by the trading partners combined to push down the prices of Bahia's agricultural commodities. As a result the Brazilian government was led to adopt a sectorial development policy aimed at greater industrial self-sufficiency. This emphasis on import substitution brought, however, the greatest benefits to the Southeast, the new core area centered on Sao Paulo. Another thrust of the new national policy was aimed at a reduction of regional isolation through abrogation of internal, state protective duties and improvements in transportation. These measures, however, did not have the desired spread effect and rather led to increased outmigration of both capital and population from the old Bahian national core area as part of the growth in the new southeastern core. As a result of these changes in the political and economic environment of Bahia the traditional dual marketing system with its emphasis on export staples was disrupted. In its place there has developed a multiple marketing system in response to the new supply and demand relationships with several areas. On the global scale Bahia has continued to be linked to the external market with Salvador serving as entrepôt mainly for the two remaining export products, cocoa and tobacco. On the national scale Bahia is gradually becoming more integrated with the developing economy of the entire country but especially as a hinterland region of the new national core area. On the regional scale Salvador's traditional rank as leading city and market is reinforced through continued focalization of Bahian trade and transport

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on this rapidly growing center.

In response to these new conditions and unabated, rapid population growth Bahia's agricultural space has continued to expand while the distribution pattern entered on a process of spatial adjustment. Two major processes will be singled out in this overview: a rearrangement in the locational pattern of the traditional agricultural land uses and the introduction and diffusion of some new cash crops and some improved methods. As to the distribution of the traditional export crops a major adjustment was made by the almost complete replacement of coffee areas by cattle pastures and by the relative spatial contraction of the area devoted to sugar cane, tobacco and cacao. But this areal contraction of the cropped areas was not accompanied by an increase in productivity on the remaining lands, as might be expected. Widespread adherence to traditional practices and the depressed economic conditions precluded such improvement. As already indicated this concentration of the area under export crops led to a rapid and substantial expansion of pasture land. It spread in two directions, coastward into areas formerly used for export crops and further inland into peripheral frontier areas. Within thirty years from 1940 to 1970 the proportion of agricultural land under crops was reduced from about 30% to 21% and the proportion under extensive pasture increased from about 70% to 79%. This shift represents in the author's judgement a substantial adaptive change not progressive but regressive in nature.

New marketing opportunities opening after World War II on the global and national scales led, however, to some improvements. The possibility to ship cattle to other states induced the spread of livestock breeding and management techniques.

Increased demand for staple foods in Salvador and Bahia generally stimulated the further development of the primitive subsistence agriculture in the interior which forced the construction of the "beans highway" to the northwest of Salvador. Another recent beneficial spatial adjustment in the agricultural pattern originated with the introduction and initial diffusion of several cash crops (rubber, oil palm, agave, etc.). In consequence of the increase in internal demand the agricultural pattern has thus been adjusted spatially through the intensification of traditional livestock and crop agriculture and the greater diversification provided by the new crops.

But the latter improvements by 1970 had not yet evolved and spread sufficiently widely to offset the great expansion of extensive pasture land and the associated contraction or replacement of cropped land. Indeed, the expectation that the national policy would open a market for Bahia's agriculture in the southeastern core of Brazil to replace the reduced overseas market did not materialize to the degree necessary. Instead, the Southeast not only supplied itself, but, partly on account of the national transport improvements, was enabled to supply the Salvador market with most of the needed perishable foodstuffs and poultry products. On account of these well organized, long-distance shipments from Sao Paulo, Salvador experienced great increases in the cost of living, while, at the same time, its immediate hinterland with a radius of about forty kilometers became covered by secondary forest held by large landowners. This brought about the reduction of the scattered, noncompetitive small vegetable farms. As a result, even milk came to be in short supply and very expensive in the urban area. An even more paradoxical effect was the importation of significant amounts of sugar and coffee from other states, even though they

had in the earlier phases been the staple of Bahia's export trade. Thus it can be seen that the persistence of traditional agricultural land uses and methods and especially of the original landholding structure in the form of dominant latifundia continues to reduce greatly the opportunity to adapt the spatial pattern of agriculture during this phase to new conditions.

This preliminary overview of the evolution of agricultural location patterns in Bahia seems to confirm the proposition that any analysis of the current spatial organization of agriculture needs to be carried out in a conceptual framework which facilitates the investigation of the processes that have influenced the evolution of Bahia's agricultural space during successive time periods. This emphasis on process, it is felt, ought to be complemented by the appropriate reconstruction of past spatial structures to the extent permitted by the often meagre data. Such an approach has been attempted here, because it is felt to be the key for a better understanding of the evolving pattern and its current complexity. For the purpose of this dissertation the term "process" is used to mean a functional association of events that may affect agriculture in the long run. The term "evolution" rather refers to the temporal framework in which the effects of the processes appear in geographic space, leading to either the origin or change in spatial patterns and their location.

Despite the significance of Bahia in the history of the development of the Americas; no thorough study of Bahia's agriculture has so far been carried out. This historical spatial analysis is therefore an attempt to fill that gap. From the conceptual standpoint, the choice of this study area is attractive, because Bahia is representative of a relatively self-contained agrarian economy which has from its inception been market

oriented. The opportunity, therefore, exists to study that orientation and the patterns it engendered over a longer time span than is otherwise available. This offers a somewhat unique opportunity in the study of agricultural geography and one which, it is hoped, may have both a theoretical significance and application to other neo-colonial situations.

1.3 The Theoretical Framework

There are currently several models available for the study of underdevelopment, including the dual model⁸, the metropolis-satellite⁹, the growth centre¹⁰, the stages of growth and center-periphery¹¹, each of which has been applied to Brazil. Although these models have validity with respect to the overall economic and/or spatial situation they do not provide a framework to study specifically the evolution of agriculture nor its location.

An evolutionary approach was employed by Spencer and Horvath in order to clear up conceptual problems encountered in the attempt to make a geographical interpretation of the processes by which a particular region of the earth becomes an agricultural region.¹² By comparing three different regions of the world, the American corn belt, the Philippine coconut landscape, and the Malayan rubber landscape, they identified the processes which gave rise to each particular system and then described the stages of evolution which each had gone through. Elsewhere in the article they concluded:

The point that is clear in all three regions examined is that crop growing traits, in the assemblages we call agricultural regions, originate, take shape, evolve, mature, change, and decline as part of the whole culture of man operating in groups.¹³

They were not providing a theoretical framework to identify the aforementioned stages but they merely alluded to them by way of analogy to the biological life cycle and by the use of the analogous terms cited above. While such an approach was widely employed in past decades, it does not seem appropriate for the study of an economic activity like agriculture. It is certainly doubtful whether such agricultural region in the world has experienced some or all of those stages and specifically whether in that sequence. In addition to the conceptual weaknesses of the work, the authors did not take into consideration the problem of location.

In the search for a theoretical framework to guide the present empirical study the von Thünen model was deemed most appropriate to the purpose. "The Isolated State"¹⁴, although it represents an ideal stage of agricultural development which was, moreover, perceived in terms of the scientific, technological, economic, social and political conditions prevalent in early nineteenth century Europe, does provide theoretical support for studying both evolution and location of agriculture.

Von Thünen's classical model is stated in terms of economic equilibrium theory, so that it assumes that several variables are in equilibrium, among others the demand and supply of a given commodity. Only transport cost was allowed to vary with the distance from the market. For that reason his classical model has merely a spatial and not a temporal dimension, and therefore, can only explain the location of agricultural land uses at one moment in time but not their evolution over time. But it has been overlooked by most previous researchers that von Thünen himself explicitly included in the last part of his work three proposals detailing how to make the models more realistic by relaxing three of the assumptions.¹⁵ One of these is a change in demand

which results in a fall or rise in price and as a consequence in a contraction or expansion of the area of agricultural land. This argument of von Thunen clearly implies change in these variables over time and thus it can be used as a theoretical framework to guide research into the evolution of agriculture and its changing location.

The model and its use as a theoretical framework is discussed in detail in Chapter Two. At this point it may suffice to summarize some of the most relevant of von Thunen's predictions which provide the theoretical framework guiding the historical/locational analysis.

- 1) That the intensity of agriculture is inversely proportional to distance from the market.
- 2) That transportation improvements cause a selective expansion of agriculture.
- 3) That in a multiple market system the spatial organization of agriculture is determined by the market magnitude.
- 4) That a change in prices determined by a change in demand forces the agricultural space to undergo contraction and/or expansion.
- 5) That under conditions 2, 3 and 4 distance will remain as the major variable in causing the areal differentiation in the intensity of agriculture.

The central objective of this dissertation is, therefore, to verify to what extent those predictions are applicable in Bahia over time and space. On account of the lack of statistical records for the first two historical phases, this verification for that period is based on historical evidence. The existence of census data for the decades after 1930 permits the use of statistical methods for the last period.

The previously mentioned phases of agricultural evolution in Bahia may be briefly characterized on the basis of von Thunen's principles as follows: 1. A colonial period subdivided into two subphases --

(a) origin (1500-1570) and (b) gradual expansion (1571-1822). 2. An intermediate period of continued economic isolation from the rest of Brazil and associated dependence on external markets (1823-1930). 3. A final period of gradual integration into the emerging national economy, found to be a phase of spatial adjustment (1931-1970). For each of these phases a sectorial examination of agriculture and its location was undertaken from which the following findings are expected.

1) That during the colonial period (1549-1822) von Thunen's prediction that a lower demand for agricultural products causes contraction of agricultural space and to an increase in extensive types of agriculture would not be observed in Bahia. However, on the contrary, the persistence of the downward trend of sugar prices after 1650, was followed by a relatively rapid increase in the number of sugar mills and consequently by expansion of the sugar cane area. This deviation from the expected pattern may, however, be explained by a lowering of the cost of production. Indeed, there are indications that the process of vertical integration backwards experienced by mills, sugar cane production, cattle and tobacco was the anomalous factor which annulled the inverse effect, that is, the contraction of the sugar cane area.

There is also evidence that the relationship between the intensity of agriculture and the distance from Salvador was strong during this long colonial phase.

2) That from 1823-1930, the lowering of transoceanic transport costs, the expansion of railways and the increase of demand for tropical goods and foodstuffs would push crop production outward into the hinterland, and this would, therefore, confirm von Thunen's expectation that both increase in demand and technological progress of transportation cause

the expansion of agricultural space, particularly the cropped area.

The relationship between the intensity of agriculture and distance from Salvador still prevails.

3) That from 1931 to 1970, the multiplicity of markets, a further improvement of the transportation network, the low prices for the export staples and the rise in beef and staple foodstuff prices on the internal market would cause a spatial adjustment in the agricultural patterns.

During this process a relative contraction of the cropped area, particularly that devoted to grow crops oriented toward the external market and followed by an expansion of pasture lands would be expected to occur. This would partially agree with von Thunen's prediction that a lower demand for a major agricultural staple causes the increased dominance of extensive types of agriculture. In addition, it would be expected that during such a spatial adjustment, the location of agriculture would tend to be oriented according to the market size. This would also confirm somewhat von Thunen's prediction that in a multiple market system the spatial organization of agriculture is determined by the market magnitude.

Finally, that the location of the agricultural land use classes in a further stage of evolution, cannot be explained by a deterministic causation (intensity against distance). Instead, one has to introduce modifications into the model in order to make it more realistic. And to do so, a probabilistic multicausation model based on the strategic variables accounting for the highest variation in the location of agriculture would seem to be most appropriate. In Bahia it is expected that farm size, average rainfall and distance together account for the highest variation

in the location of agricultural land use. This type of relationship is statistically tested.

1.4 Outline of Chapters

The rest of this dissertation is divided into nine chapters. The full presentation of the von Thunen model, the associated literature and the model's relevance as framework to study the evolution of the agricultural land uses in Bahia are taken up in Chapter 2. In Chapter 3 the physical and social structure relevant to the evolution of agriculture in Bahia will be briefly outlined. The whole methodological procedures and the sources of information are detailed in Chapter 4. The processes and the conditions accounting for the origin of agriculture in Bahia are analyzed in Chapter 5. Chapters 6 and 7 contain a reinterpretation of the role and function of the sugar cane plantation, and its influence on the expansion and the location of the agricultural land uses during the colonial period, respectively. Chapter 8 deals with the impact of technological innovations on the expansion of agriculture, the structural changes of the plantation system, and the location patterns during the phase of rapid expansion between 1822-1930. In Chapter 9 the spatial adjustment of agriculture and its location in the post 1930 period are statistically analyzed and finally, in Chapter 10 the conclusions relating to the overall fit between model and reality are presented.

REFERENCES AND FOOTNOTES, CHAPTER 1

1. Edward A. Ackerman, Geography as a Fundamental Research Discipline, Department of Geography, 1958), pp. 18-26.
2. J.M. Blaut, "Space and Process", Professional Geographer 13 (1961): 1-7.
3. J.E. Spencer and H.J. Horvath, "How does an Agricultural Region Originate?" AAAG 53 (1963): 73-92 (hereafter cited as Spencer & Horvath).
4. D.B. Grigg, The Agricultural Systems of the World: An Evolutionary Approach (Cambridge: Cambridge University Press, 1974), p. 1 (hereafter cited as Grigg).
5. D.W. Harvey, "Locational Change in the Kentish Hop Industry and the Analysis of Land Use Patterns", Transactions and Papers 33 (1963): 123.
6. Robert C. Brown, "The Use and Mis-use of Distance Variables in Land-Use Analysis", Professional Geographer 20 (1968): 340.
7. William C. Found, A Theoretical Approach to Rural Land-Use Patterns (London: Edward Arnold, 1971), p. 98.
8. Jacques Lambert, Os Dois Brasis, 10a. ed. (Sao Paulo: Ed. Nacional, 1978), pp. 101-126.
9. Andre Gunder Frank, Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil, rev. and enl. (New York: Monthly Review Press, 1969), pp. 145-277 (hereafter cited as G. Frank).
10. Manuel Correia de Andrade, Nordeste: Polos de Desenvolvimento, 2a. ed. (Sao Paulo: Ed. Brasiliense, 1970), pp. 59-105 (hereafter cited as MCA, Polos de Desenvolvimento).
11. Bertha K. Becker, "Crescimento Economico e Estrutura Espacial do Brasil", Revista Brasileira de Geografia 34 (1972): 101-115 (hereafter cited as B. Becker).
12. Spencer & Horvath, p. 74.
13. Ibid., p. 90.

14. Johann Heinrich von Thünen , Von Thünen's Isolated State [Der Isolierte Staat] ed. with an Introduction by Peter Hall, trans. Carla M. Wartenberg (Oxford: Pergamon Press, 1966), pp. 7-222 (hereafter cited as VTIS).
15. Ibid., pp. 215-222.

CHAPTER 2

THE VON THÜNEN MODEL AND LITERATURE REVIEW

2.1 Introduction

The research problem presented in Chapter One advanced the premise that to investigate the evolution of agricultural land use patterns in Bahia, it was necessary to establish a theoretical framework in which space and time were taken into consideration. In the search for such a framework meeting these requirements von Thünen's model appeared to be the most appropriate because it included predictions with respect to changes through space and time. To support this assertion a thorough review of The Isolated State and associated literature will be presented in this chapter. Also its relevance as a conceptual framework to guide the investigation of changing agricultural land use patterns in Bahia will be discussed.

2.2 Review of von Thünen's Model

2.2.1 Historical Setting

J.H. von Thünen wrote Der Isolierte Staat (The Isolated State, 1826 and 1842)¹ under the influence of four factors which must be taken into account when one examines or criticizes the work: The first factor is the contemporary scientific development in physics and its influence

on the study of social sciences. The concepts introduced and methodology applied in this work strongly reflect the influence of physics. The concepts include deterministic causality and the theory of general equilibrium. The methodology illustrates the scientific method of investigation. A second factor was the influence of technological development in von Thünen's lifetime. While population pressure in Europe had already stimulated some improvement in agriculture (e.g. crop rotation, the so-called Belgium or Flemish system), it had not reached the Mecklenburg region by the early 1800's. The region was also backward in terms of changes due to the industrial revolution going on elsewhere in Europe. A third factor was the trade embargo enacted by England, specifically the Corn Law² of 1815, whereby the major food importing country of the world was partly closed to European agricultural imports, except wool. This situation affected trade relationships throughout the continent as von Thünen pointed out:

Embargos have torn asunder the bonds that once connected nations; none of the laws that govern the grain price in conditions of free trade can come into operation; every country tries to be an Isolated State.³

England's embargos lasted until 1846, and thereafter, von Thünen's model was constructed in relation to a prevailing condition of external isolation. Finally, the fourth factor was that the model was based on the operation of capitalistic premise of free competition, private property, rationality and profit maximization within an isolated state.

The lack of an explicit temporal perspective in which The Isolated State was written has led to some misinterpretation. It has been common among commentators or researchers, attempting to apply von Thünen's principles, to focus on one aspect of the work, such as the method, crop

theory, intensity theory or rent theory. These different emphases, instead of throwing more light on improving the model, have created confusion among authors. After all, how many theories did von Thünen try to develop? It seems that he constructed a solid model of agricultural location. However, some insights from it have not been fully utilized. There is a need to apply it in an integrated fashion making allowances for the particular temporal framework and prevailing conditions.

This review of von Thünen's The Isolated State has tried to identify how conditions prevailing at the time of its construction should be considered carefully in terms of any present-day application of the model.

2.2.2 "The Isolated State"

The Isolated State is divided into three parts, but in this commentary, just Part One and some aspects of Part Two are taken into consideration.

Von Thünen's aim was to investigate the effect of differential grain prices, of differences in soil fertility⁴ and of different taxation levels on the spatial organization of agriculture. In the following chart (Figure 2), this author has outlined the major topics created by von Thünen, here summarized as follows:

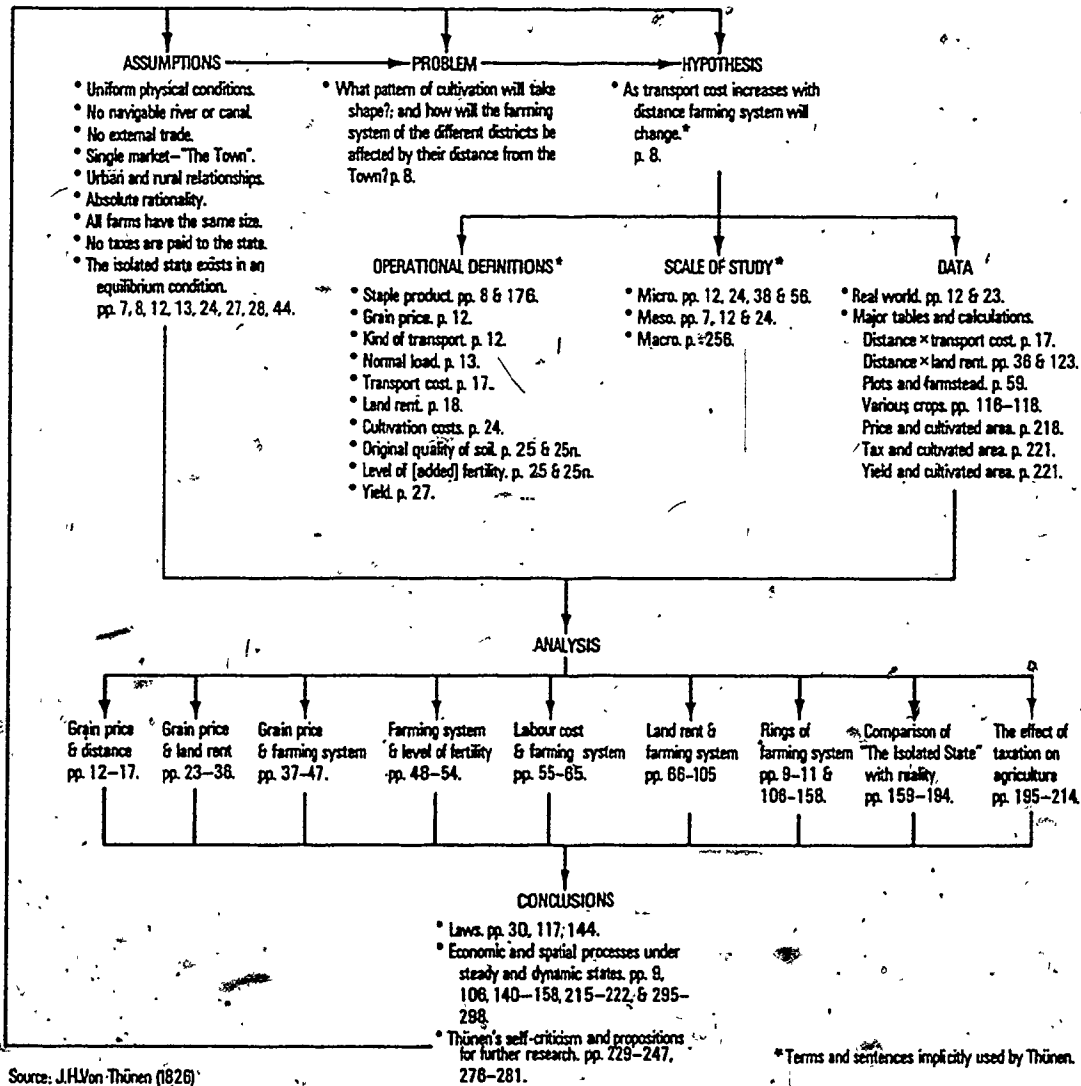
2.2.2.1 The Method. The steps followed by von Thünen make it clear that he attempted to apply to agricultural economics the scientific method of research, according to the recently developed methods of physics.

He expressed this intention in the following statement:

This intellectual operation is akin to the experimental method used in physics, as well as agriculture: only the factor to be determined is raised quantitatively, while all the others are held constant.⁵

Figure 2

OUTLINE OF THÜNEN'S METHOD OF ANALYSIS: "THE ISOLATED STATE"



To achieve the objective of inquiry, von Thünen used sample data derived from records assembled for his estate (Tellow)⁶. In the process he raised two questions and then stated each in the form of an hypothesis (Figure 2). The next step was to postulate independently the farming system which should be closest to the market i.e. free cash cropping. He also defined several concepts used throughout his analysis as well as stating explicitly that "The Isolated State" was a model constructed from the data gathered for Tellow. It is valid here to emphasize this point, not well understood by some von Thünen analysts who have tried to find a true Isolated State in the real world.

The recognition that the small data sample (Tellow) based on a very short period of time (five years) was not sufficient; led von Thünen to ask:

... How will the land rent and farming system change at Tellow if we assume a gradual fall in the grain price?

In the discussion of this problem ..., the Isolated State is only a graphic representation, a model to help us see the problem as a whole; but it is a model which we cannot abandon, because it is, as we shall see, so rich in consequences.

... We may, then, imagine Tellow in the Isolated State, obtaining by this means a graphic illustration, a diagram of the adjustment this estate would have to undergo in answer to reductions in the grain price.⁷

Hence von Thünen, without performing any statistical test, inferred from the micro-scale farm sample to the meso-scale of an imaginary population of farms within a so-called Isolated State

⁶Tellow was a large estate measuring 1146 acres (463 hectares).
P. Hall, p. xv.

(Mecklenburg region) and hence generalized his "findings" to the European macro-scale. Finally, he compared the model with the real world, criticized himself and suggested further researches. By taking into account scientific developments within von Thünen's lifetime, one has to agree that no social scientist had previously made a better methodological contribution to a research problem than he did.

2.2.2.2 The Analysis of the Relationships Between Farming System and Distance from the Market. Von Thünen's major concern was to find in the hypothetical "Isolated State" the proper location for the crop rotation system, i.e. the most intensive farming system for growing grain and other crops. He did not have any prior experience, nor data to work with. Moreover, he had learned from his teacher, Thaer, "that the farmer should aim constantly to intensify his system of cultivation, above all through improved crop ratios. Higher levels of investments would as a rule bring higher returns".⁸ To verify the truth of these statements, von Thünen carried out the analysis between different farming systems and the new rotation system. To simplify his task, he used the criteria of staple products instead of actual land uses.⁹ As a second step he considered the high costs of transporting, by wagon, each staple to the market where the prices were established. From these considerations he stated that on the farm itself the value of grain fell with increasing distance from "the Town" (Rostock).¹⁰ This reasoning led von Thünen to calculate the land rent (farmer's net income) based on the costs of production after subtracting the transport costs. Other economic concepts that he identified included marginal land, the relationships between supply and demand, and marginal productivity.¹¹ These concepts are all part of his well known model of spatial analysis.

An important achievement of von Thünen's work was to provide evidence that, on the basis of the land rent, the farming system changed with changes in distance from the market. In terms of the staple products he also showed that cost was related to bulk and/or perishability. Bulky and/or perishable items should be grown closer to the market than items with a higher price/weight ratio. Von Thünen also showed that one could calculate the margins of production for each of the staple items. The margin of production for any item was the location where the land rent for that item fell to zero as the result of increasing transportation costs. It is worthwhile to observe that according to the data the new crop rotation system yielded a higher land rent than the prevalent farming system for producing grain. If it were to be introduced into "The Isolated State" it should be located closer to the market than the traditional systems. Von Thünen extended the principle of distance decay, as identified by land use around a market in an "Isolated State", to apply also to individual farms. That is, as distance from the farmstead increased so intensity of production decreased.

Since Hall's english translation edition of The Isolated State was published in 1966, geographers have been discussing the necessity of identifying which of von Thünen's theories one is trying to apply. That is, whether concern is with the crop theory or with the intensity theory. However, neither Hall nor any other geographer has clarified the distinction between these two theories. Is there in fact a distinction? This particular discussion emerged from Hall's report of Petersen's interpretation of The Isolated State. According to Petersen the book has two main objects of inquiry. Petersen states:

... The first inquiry can be summarized thus: A given crop, say a grain crop, may be cultivated under different systems, some more intensive than others, ... How Thünen asks, is this variation related to distance from the sole consuming market?

The second subject of inquiry is the one Thünen stresses in this opening quotation. As well as the same crop being grown in different places under different systems of intensity, the crop itself may vary. How is this phenomenon related to distance from the market?

These two subjects must not be confused. There is an intensity theory and a crop theory. But the crop theory is not a theory of intensity. It has indeed something to do with intensity; but the main factor is something other.¹²

Petersen does not make this point clearly. Von Thünen did not distinguish two subjects of inquiry. His problem was clearly stated in Figure 2 as "what pattern of cultivation will take shape? and how will the farming system of the different districts be affected by their distance from the Town?"

One aspect of von Thünen's analysis, however, which has caused considerable confusion is the fact that he placed forestry closer to the market than grain production. This, explained in terms of land rent does not fit in with the general principle of decreasing intensity from the market unless it is viewed in its proper historical context when wood, for domestic fuel purposes was a daily requirement. However, if silviculture is smoothed out from the model, both land rent and intensity do overlap in both type and intensity terms. Hence, von Thünen in fact, constructed just one model to explain the location of agriculture under the conditions prevailing in his lifetime. To verify the model it is appropriate to use agricultural land use, intensity or land rent. These variables are interchangeable. What seems relevant in testing the model is the

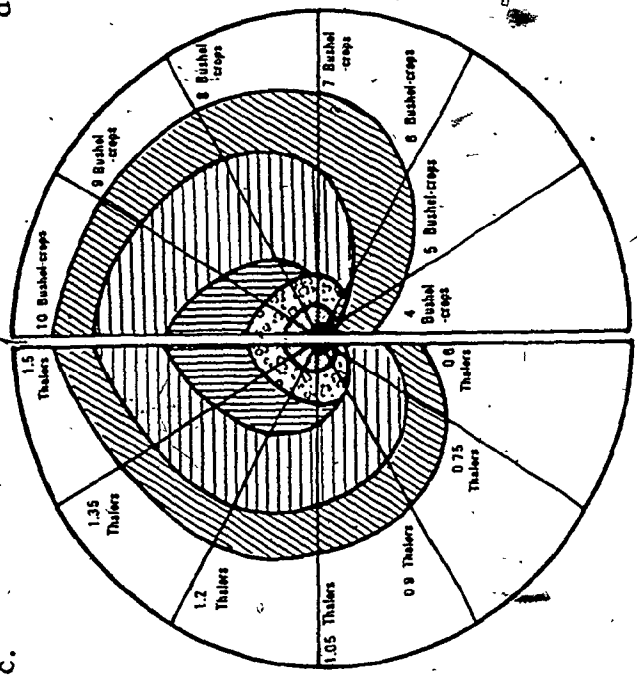
relationship between any of these variables and distance from a market (absolute or relative). The model is rendered much more powerful by linking together the concepts rather than by isolating them.

2.2.2.3 The Economic and Spatial Process Considered Under Study and Dynamic Conditions. Figure 3 represents the diagrammatization of the model as von Thünen himself presented it. It shows "The Isolated State" under both steady and dynamic conditions.

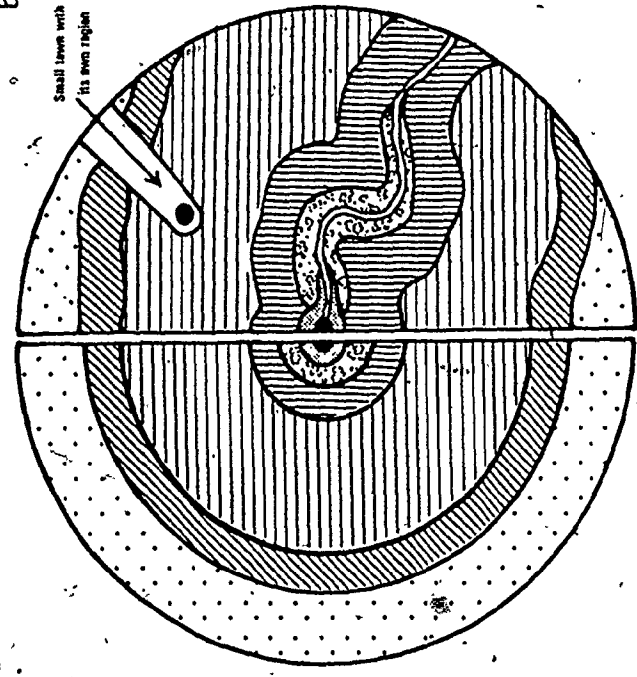
The steady state or equilibrium condition implies that the market price for grain (1.50 thalers per bushel of rye)¹³ is stable; i.e. demand is equal to supply. The prices of the other staples are also to be governed by that for grain, according to the price-relation calculated by von Thünen using contemporary data. Soil fertility, and other variables i.e. taxation levels and prices, which could in reality fluctuate are also held constant. Figure 3a shows von Thünen's classical concentric model of farming systems, surrounding a single market. Free cash cropping (vegetable, fruits and milk) lies closest to the market (1-4 miles). Beyond this inner ring the spatial organization follows according to that postulated in terms of land rent: forestry (4-7.3 miles), crop rotation (7.3-9.4 miles), improved Mecklenburg system (9.4-24.7 miles), the traditional three-field system (24.7-31.5 miles) and stock farming (31.5-50 miles).¹⁴ After 50 miles¹⁵ or 371 km the land remained uncultivated (marginal land) because operational costs for the most extensive farming system exceeded the returns (land rent equal to zero). This distance corresponds, therefore, to the margin of production in relation to "the Town's" demand. Figure 3b shows land uses of "The Isolated State"

¹⁵The old German mile measured 7.42 km. P. Hall, p. 12 n.

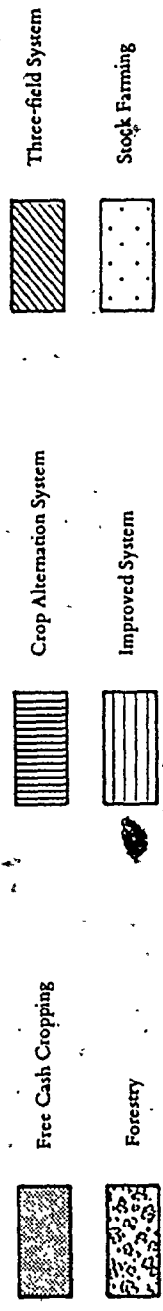
d.



c.



a.



Source After J.H. Von Thunen (1820)

Figure 3 Von Thunen's Isolated State under Steady and Dynamic Conditions

under the modification of two of the assumptions: the absence of alternative transportation routes and the presence of a single market town.

Von Thünen introduced a navigable waterway and suggested that if water freight costs were one-tenth of land freight costs under this new condition the shape of the land use zones changes. It can be noted that cheaper transportation costs lead to expansion away from the market of the intensive system (crop rotation) where the zone of most extensive activity tends to contract (stock farming) and near the waterway it entirely disappears. Von Thünen does not make clear, however, under this condition, how the margin of production is reached. This omission leads one to infer that all things being equal, the margin of production remains the same, admitting, however, the intensification of stock farming in the zones inwards (improved and three-field systems). Von Thünen later added that the effect of constructing highways and/or railways is similar, if less marked.¹⁶ Moreover, he explains that if the highways were to extend to all districts of the state (the cultivated plain) the more intensively farmed rings would expand, retaining, however, their regular shape (Figure 3a). In this hypothetical situation, which implies a further development, the expansion of rings will be of course conditional on demand. Regarding the second assumption, he allowed the emergence of a small town inserted in the third ring with its local production zone supplying its food. Moreover, the production is sold locally so that no shipment is sent to the larger market. Finally, von Thünen compared "The Isolated State's" small town with the small states of Europe where the grain price was wholly governed by the price obtained in the central town (London).¹⁷ This is analogous, therefore, to a metropolitan situation.

The equilibrium condition of von Thünen's model has been widely applied in different ways. Nevertheless, there is another aspect of the model which has rarely been considered as shall be shown, i.e. the disequilibrium condition.

The disequilibrium condition results from the relaxation of some assumptions, and which lend to "The Isolated State" a temporal dimension (dynamic model). As such, the model offers another possibility for studying agricultural space and its component patterns. All things being equal, an increase in tax levied on the grain brought to "the Town" would cause the intensive system of farming to be replaced by extensive systems. A negative relationship would exist between the tax level and the farming intensity. The spatial consequence would be a contraction of cropped area so that the land rent becomes zero closer to the market.¹⁸ Figure 3c illustrates how "The Isolated State" would look under the new condition of increased tax levels. The stock farming system does not appear in the diagram but it may be inferred that it would move closer to the market or become integrated into the three-field system.

Figure 3d shows a physical disequilibrium in "The Isolated State" created by holding all things equal except the soil fertility.¹⁹ Now the relationship between the natural fertility of the soil and intensity is positive. That is, the lower the soil fertility, the lower the farming intensity. Consequently the effect on the cropped area would be the contraction of agricultural space. Again the land rent would become zero closer to the market if demand remained constant.

Finally, von Thünen relaxed the assumption of a stable price for grain in the market and allowed it to fluctuate.²⁰ In so doing he tried to apply the law of supply and demand to "The Isolated State".

Assuming all things equal and an average yield of 10 bushel-crops, the market prices per bushel vary from 1.50 thalers (the highest price) to 0.60 thalers (the lowest price). Figure 3c represents the impact of a change in demand (increase or decrease) on the cultivated area. The relationship between prices and the farming intensity is also positive. That is, when the price rises the cropped area expands. Hence under this condition, the land rent for grain becomes zero at 31.5 miles from the market whereas at the lowest price, the cropped area not only contracts but there is also a simultaneous decline in intensive farming. Consequently the land rent for grain becomes zero at 10.4 miles from the market. In reality, according to von Thünen, the inferior land is abandoned. Under the reverse conditions there would be an expansion of the agricultural frontier.

Although von Thünen did not further develop his dynamic model, he specifically relaxed the equilibrium condition, an aspect which has not been considered by most geographers. He allowed the introduction of technological innovations into his model through the acceptance of a new farming system (crop rotation) and transportation improvements (the waterway, highway and railway). All these aspects of the model lend to it dynamism, and therefore, an evolutionary dimension.

2.2.2.4 Selfcriticism and Suggestions for Further Research

Von Thünen's comments and propositions relating to his methodology and theoretical framework were only treated by him in the Introduction to Part Two. Section One (1850) and Part Two, Section Two (1863). Regarding his method, von Thünen continued to be certain that he applied the best one, because his results were based on empirical data and mathematical procedures. Even though he was convinced, on the one hand, of the validity of his

method, he nevertheless cautioned his reader on the other hand that these procedures presented a twofold danger:

- (1) That mentally we separate what in reality is interdependent; and
- (2) That we base our findings on assumptions which, not being fully conscious of them, we fail to make explicit; and that we then regard as generally valid what is valid only under these assumptions.²¹

Yet, convinced that his findings were incomplete, von Thünen presented a series of problems, questions and suggestions for further inquiry. Those problems and questions of particular geographical interest are either summarized or cited below. The numbers used are those in the original text.

Problem 5: Effect on agricultural area of the construction of a new transportation network.

- (a) In which districts and to what point of the Isolated State will highways and railroads be constructed to advantage?
- (b) What effect will their construction have on the size of the cultivated plain, on tillage and on national wealth?²²

Problem 6: Influence of climate upon agriculture.

- (c) Which crops are the more profitable and thus the staple products, in the various climates?²³

Problem 8: Location and distribution of towns, the factors of industrial location and the role of population density.

- (c) What effects does distance between farm and country town have on cultivation and on education of the rural population?²⁴

Problem 10: Soil fertility and human enterprise.

How far must the soil in the different districts of the Isolated State be improved, assuming rational farming?²⁵

Problem 11: Optimum farm size and land rent.

(b) What is the effect of distance from the market on the optimum size of farms?²⁶

Problem 17: Steady state as an ideal stage of development.

With regard to this last problem von Thünen did not raise any question but he considered the phenomena observed in the real world as transitional to an unattainable, theoretic steady state. To justify the method of focusing on the steady state and of making it the basis of his argument he stated:

In the Isolated State, however, we have concentrated on the ultimate condition, the object realised. Once the goal has been attained the steady state sets in and there is no more change; and we shall find regularity and order where in the period of transition so much seemed unintelligible chaos. But in the real world the steady state cannot exist, ...²⁷

Lastly, von Thünen relaxed the assumption of steady state and under the heading "The Dynamics of the Isolated State: Are there obstacles to its expansion?"²⁸ he allowed it theoretically to grow in population and analysed the results. To support this conceptual new approach, von Thünen took as example North America in the process of settlement.

It is this author's belief that most of von Thünen's interpreters have not properly judged his work. In terms of present scientific usage, von Thünen's theoretical rigour of thinking led him to anticipate three kinds of model: an analog model (scale homology between Tellow and "The Isolated State"), a mathematical model (location of farming systems in relation to distance costs) and a conceptual dynamic model (expansion or contraction of land use areas within "The Isolated State" under the

conditions of changing taxation, yields and demand). Moreover, von Thünen's awareness that his work was incomplete led him as a true scientist to draw the following conclusion:

... here we see the supreme importance of the proof we have given: that the result obtained by studying one factor only at a time, holding all others constant, is not a false result, but merely incomplete, and that it will remain so until every other factor has been subjected to a similar inquiry. Thus every research, into any aspect of the problem, however small, contributes to the building of the great edifice.

I think that I need scarcely apologise to readers who accept my approach and understand the vastness of the task if in this work I offer only fragments; ... If he can but inspire others to further study, the author is content.²⁹

From the above some conclusions may be drawn. First, von Thünen's method of analysis was indeed an important contribution to the social sciences. However, at the present time the scientific method has developed and reached a higher level of sophistication than that used by von Thünen. His merit in this regard, however, should not be underestimated. Second, the model provides insights for studying the evolution of agriculture due to key innovations introduced into the model e.g. modernization in the farming system (crop rotation), transportation improvements, and multiple markets. Third, although the model was devised under an equilibrium condition, the relaxation of some assumptions, like change in demand, soil fertility and taxation, brings into the model a spatial disequilibrium which also accounts for changes, and therefore, evolution. Fourth, underlying the model is the general principle of distance decay which is held true for any one of the conditions above. The deterministic approach (cause-effect) is evident no matter if the consequence be land rent, intensity or agricultural land use, and

therefore, von Thünen's final achievement was that of a theoretical model of agricultural location. The best evidence is that his diagrams represent the farming systems underlying agricultural land use. Apart from the forestry ring, an historical exception, the logic of the model presents consistency, at least theoretically. Whether this logic holds true in the real world is a matter for more accurate verification. Finally, most of his suggestions for further research, e.g. climatic influences, holding size, soil fertility, education of the rural population, and the like have not been used for testing the model in geography.

2.3 Selected Literature on von Thünen's "The Isolated State"

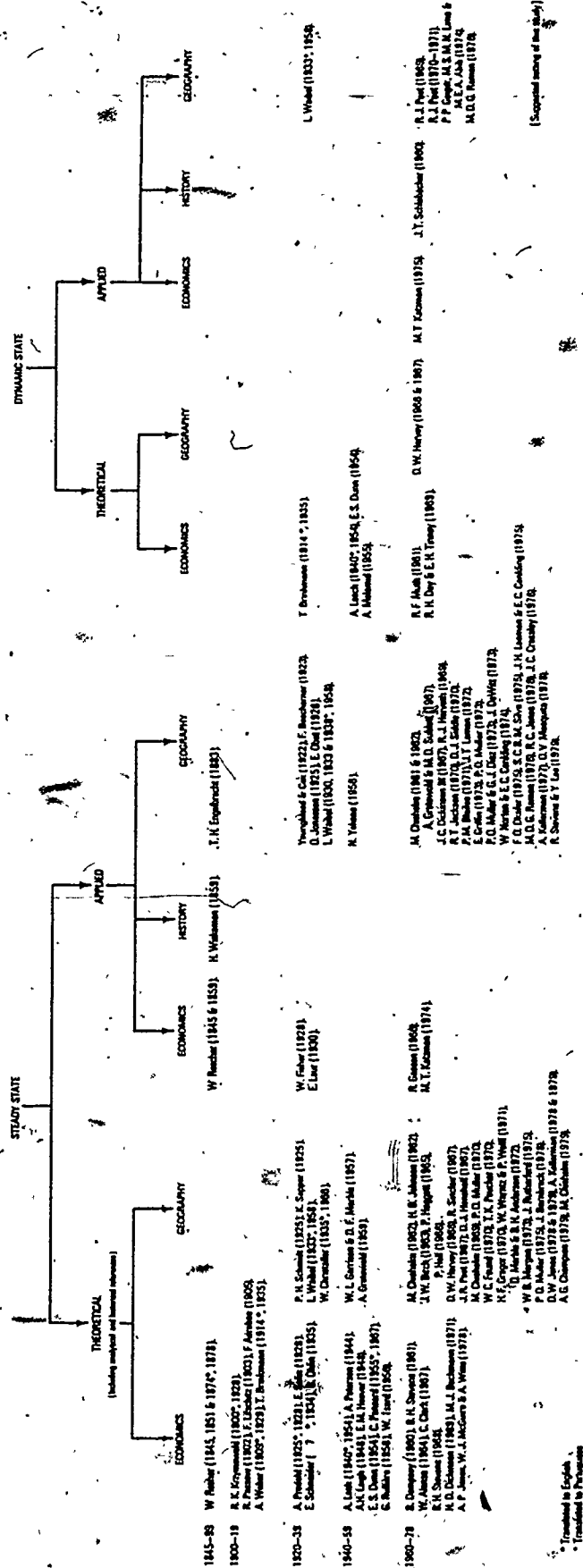
A thorough review of the literature on The Isolated State constitutes by itself an interesting topic for a dissertation due to the range of works written on it. The impossibility of discussing or mentioning all of them in this section led this author to make an initial summary selection according to objective, discipline, and chronology (Figure 4).

In this commentary, the major focus is on contributions related to agricultural geography, particularly those related to the dynamic approach of the model and/or those empirical studies carried out in Brazil, particularly in Bahia.

It is interesting to note that in spite of the early publication of The Isolated State, (see footnote 1) von Thünen's ideas did not spread outside Germany much before the 1950's. This delay is particularly noteworthy in geography. However, in contrast, after 1960 there is an increasing trend in the proliferation of geographic literature based on his work.

SELECTED LITERATURE ON THÜNEN'S "THE ISOLATED STATE"

Figure 4



* Translated to English
• Translated to Portuguese

(Suggested reading of the study)

Roscher,³⁰ during the nineteenth century, was the first German economist to focus on von Thünen's work. He recognized the geographic importance and he attempted to verify statistically the land use rings that were the basis of the model. Later Engelbrecht³¹, in his work on North American agriculture, also used this quantitative approach.

Further development of von Thünen's ideas and principles emerged in Germany in the first decades of this century. Krzymowski³², Weber³³, Brinkmann³⁴, Christaller³⁵, and Lösch³⁶ being a few of the outstanding contributors of this period.

After von Thünen, it was Brinkmann who thoroughly studied the four factors accounting for the levels of intensity in agriculture. According to him, the gross returns and expenses in agriculture are chiefly affected by (a) the economic location of the farm, (b) the natural conditions (physical productivity) of the farm, (c) the stage of development of the social organization, and (d) the personal qualities of the entrepreneur.³⁷ An important point he emphasizes in the economic location of the farm is that distance in space and economic distance do not, without some qualification, correspond to each other.³⁸ In considering the static condition of agriculture, Brinkmann's viewpoint is that the influence of natural locational factors is more significant than those of economic factors. The emphasis put on this point is clear from this statement: "In a particular localized area differences in economic location are slight while soil conditions may show the greatest extremes. For more generalized comparison, however, it is the climatic variations which are of greatest significance."³⁹

This viewpoint indicates that Brinkmann is more in favour of the principle of comparative advantage to explain the location of agriculture

than the principle of distance decay. In this respect he follows more the ideas of Ricardo than of von Thünen.

Lösch's concern was to develop a general theory of location based on the preexistent theories (agriculture, industry, trade, and services). In so doing he found a geometrical solution to explain transportation costs related to agricultural products. In trying to analyse the von Thünen rings he defined all of the variables involved in the establishment of agricultural land uses. He presented mathematical equations, followed by an empirical example of three products (milk, cream, and butter); and the effect of the interregional trade on land use.⁴⁰ In addition, Lösch graphically treated the intensity problem in agriculture showing the effect of competition between two agricultural outputs as well as describing the appearance of the rings when several centers of consumption are considered.⁴¹ According to his explanation, the number of displaced rings decreases with the increasing density of urban places.⁴² A careful review of the literature provides evidence that Lösch was the first scientist to give a more complete and advanced theoretical context to von Thünen's model.

Further contributions were added in the 1950's. Dunn⁴³, working on von Thünen's assumptions and principles as well as on Lösch's variables and ring equations, developed an explicit distance function and a more simplified explanation to account for the formation of a concentric pattern. These formulae are very well known, and therefore, will not be presented here. Dunn's linear model which made von Thünen's land rent function explicit has been described by some authors as "Dunn's theory of rent". He also added more comments on some other aspects of The Isolated State. In so doing, he treated the relationship problem

between intensity, distance, and farm size. According to his explanation, when a single commodity, say grain, is considered the intensity of cultivation increases continuously as one approaches the market. Moreover, when different commodities are considered "it does not follow that the most intensive form, and hence, the most intensive exploitation of the soil, will always be closest to the market. Economic rent is the factor which determines the proximity of a land-use form to the market."⁴⁴

Finally he concludes:

Hence, it is entirely possible for one product to yield a lower rent per acre (and be located farther from the market) at the same time that its final⁴⁵ equilibrium is consistent with higher intensity.

From the rational viewpoint, Dunn's statement does not seem logically consistent on the basis of his assumptions which are the same as those used by von Thünen. By not clarifying his viewpoints Dunn added more confusion to the matter. Yet, without relaxing the assumption of equal size of farm he states that there is no necessary relationship between small farms and proximity to market. His analysis of the effect of a multiple market on the spatial structure of agriculture is essentially the same as those given by Lösch and Hoover (graphical representation of rent gradients and zones of land use tributary to five market centers).⁴⁶

Garrison and Marble⁴⁷, relaxing the assumption of a single market, developed a model based on set theory, axiomatic structures, and differential calculus, to find an optimum solution through which the entrepreneur maximizes his net return. By use of complex formulae and graphical presentation, they presented a model which was held to be (a) more rigorous and (b) directed toward analysis on the level of the individual entrepreneur rather than on the industry level. Also an explicit definition of intensity was developed for a simple linear case.

Other theoretical contributions were added to von Thünen's equilibrium model after 1960. Sinclair⁴⁸ devised a new version of the model which conforms with both situations of development and underdevelopment. In the former case the classic relationships are reversed. That is, intensity of agriculture increases with distance from the market whereas in the latter case the classical model remains valid. Peucker⁴⁹ also used von Thünen's model to provide a solution to the underdevelopment problem. His major theoretical solution requires a substitution of human resources by capital and to do so the industrial countries must renounce a part of their accumulated material capital.

Other contributions to the development of von Thünen's work are as follows: field-farmstead relationship, Found⁵⁰; intersectorial flows, Beckman⁵¹; ideological interpretation, Barnbrock⁵²; comparison between von Thünen and Ricardian land rent concepts, Jones⁵³; a mathematical review of von Thünen's findings, Jones et al.⁵⁴; and the major determinants of rent from agricultural land around metropolitan areas Kellerman.⁵⁵

Several works present general discussion and criticism of the model⁵⁶, while others handle algorithms for operationalising it by means of the computer.⁵⁷ Recently Chisholm, one of the greatest protagonists of von Thünen's concepts, discovered that "the germ of von Thünen's location idea had been published by Adam Smith 50 years previously in The Wealth of Nations [sic]."⁵⁸ Still in this historical line, Wang has established that Chinese writers of some 2300 years ago described an 'ideal universe' consisting of rings around the capital.⁵⁹ It seems that these findings do not detract from von Thünen's work, since he treated the matter in more detail than any other predecessor. Moreover,

what really impresses one is the fact that Chisholm did not discover that the von Thünen land rent concept is a criticism of the same concept, earlier developed by Adam Smith.⁶⁰

Empirical observations and quantitative verifications of the model in its equilibrium formulation have been widely carried out either at different scales (micro, meso and macro)⁶¹ or in different areas of the world, and different types of variables e.g. net farm income, value of farm products, value of land and buildings, inputs of labour and capital, types of land use, agricultural land use, population density, among other variables, have been frequently used to verify the model.⁶²

Few studies have focused on the impact of lowering transportation costs and import restrictions on agricultural land use and/or the economic rent (land rent), without taking into consideration, however, the dynamic aspect of the model.⁶³

2.3.1 Von Thünen's Model (Dynamic)

The literature available provides evidence that following von Thünen, Brinkmann was the first economist to undertake theoretical discussion of the factors accounting for the change of intensity in agriculture. He starts this task by dropping the equilibrium condition, which in his viewpoint does not exist, and then considers only the evolving situation in a given locality. He suggests two general factors as being responsible for changes in the optimum expenditure of labour and capital. One is increasing demand for agricultural products, which may result from population growth and increasing consumption per capita. The other is the general level of technological improvement and in particular that improvement related to agricultural production.⁶⁴ The effects of

these factors on the expansion of agriculture, and therefore, on the locational change is illustrated by Brinkmann either by using an empirical example or diagrammatically.⁶⁵

Lösch also undertook the analysis of spatial disequilibrium caused by technological improvement in agriculture. In so doing he represented geometrically the effect of a new method of farming which may cause an inversion of von Thünen's rings. Since Lösch's major concern was the formation of the rings, his final conclusion was that "in a dynamic economy von Thünen's rings must be formed, whereas in a traditional economy their reversal may hold equally well".⁶⁶

Dunn, after the analysis of the equilibrium condition of von Thünen's model, also considers that in reality the economic structure is in a continuous state of flux; and therefore, the theory of location must take into consideration not only geographic modifications but temporal modifications as well. His cursory comments on the dynamic factors which may affect the agricultural location do not differ much from the previous authors. However, Dunn's major contribution is the methodological suggestion of undertaking the dynamic study through application of comparative statics.⁶⁷ Indeed this approach is the most appropriate for studies of space and time over a long period for which data are not fully available (see Chapter 4).

Harvey has insisted that the equilibrium models are not completely satisfactory to interpret location patterns subject to rapid and often uneven change in technology and demand over time. Nor does he believe that equilibrium may be achieved under modern conditions in which the technological change does not leave relationships stable over a decade or so. Consequently he suggests that von Thünen's model is applicable

for studying the advance and movement of frontiers of agricultural activity in newly developing countries and among them he mentions Brazil.⁶⁸ In a further work the same author considers that von Thünen's model is one of the simplest equilibrium models to be dynamically handled by the procedure of comparative statics.⁶⁹

To the knowledge of this author the most sophisticated treatments of the spatial dynamics of the model were carried out by Muth⁷⁰ and Day and Tinney⁷¹. The former deals with the problem of identifying ways in which the equilibrium location of firms, in the urban fringe, change under the condition of varying demand and supply for the commodities they produce. The latter researchers employed linear programming to simulate "an evolution toward a von Thünen-like spatial equilibrium".⁷² From the theoretical and economic viewpoint both contributions are valid, but for a hierarchical study in which complicated processes result in spatial change, they do not add much insight.

Waibel⁷³ provides significant empirical observations to show the change in Europe's agricultural zoning, under the impact of the railways in the nineteenth century. In addition, he takes also into account the improvements in trans-oceanic transportation, tightening the relationships between supply and demand areas and giving way to what he calls "The World Isolated State". Waibel's belief is that von Thünen's generalizations have temporal and spatial validity as long as the scale of study changes according to historical developments. Yet, he suggested that in tropical regions several actual "Isolated States" have emerged since the sixteenth century. He focuses on Northeastern Brazil where he identifies two rings as having developed as an extension of the European colonial economy. The first ring was occupied by sugar cane plantations surrounding the

coastal entrepôts while the second was occupied by interior ranching.

"The Isolated States" that he recognized were separated by tropical forest in which the natives practiced shifting cultivation.⁷⁴

Waibel's "The World Isolated State" was further redefined by Schlébecker⁷⁵ through what he calls the 'metropolitan hypothesis'. It begins from the point that all men are located within, or are a certain definite distance from a metropolitan unit. Those who live within a certain given zone around the metropolis have at least one common experience: they are all some specific distance from the metropolis. Yet, for any given group of people this one common experience may have shaped many of their ideas and actions. Then Schlebecker defines the metropolis as a conglomerate of cities which forms a fairly unified economic unit. This conglomerate of cities called "The World Metropolis" had its origins centered in the Mediterranean but, by the sixteenth century, a much larger metropolis had started to emerge in Western Europe. In the nineteenth century the American seaboard joined this global metropolis, forming a much larger conglomerate with its axial points in London and New York. The author's hypothesis is based on von Thünen's location theory but his major concern is to discover how, and to what extent, the people of "The World Metropolis" influenced the activities of the American farmers. Finally, he roughly outlines the effect of the metropolis on the expansion of American agriculture from the seventeenth century up to the present century.

Peet⁷⁶ revised this concept of an integrated world system and renamed it "Thunian World City" (Britian, Western Europe and northeastern North America), in studying the expansion of commercial agriculture in the continental hinterlands during the nineteenth century. His argument is

that during the last century the "Thunian World City" was surrounded by a series of large concentric agricultural zones. With increasing demand for food and raw material in the "City" market, the zones were pushed outwards, causing the agricultural frontier to invade the vacant, or little used, continental interiors. Peet explains these frontier movements through an analysis of changes in demand and supply conditions in the system reinforced by the rapid change in transportation costs. This study, therefore, uses von Thünen's model dynamically to explain just one stage in the expansion of agriculture. A further work was carried out by the same author, in which he added more theoretical explanation on the dynamics of agricultural expansion, based on von Thünen, Brinkmann and Dunn.⁷⁷

The first attempt to verify von Thünen's dynamic model in Brazil (Southeastern) was undertaken by Geiger et al.⁷⁸ By taking into account the major land uses in two different years (1950 and 1970) the study identifies six rings around Sao Paulo. These rings depict a complex situation, however. The dominant agricultural land uses appear in the following sequence: vegetable and fruits, sugar cane, cotton, coffee and cereals, and cereals. Yet, there was a displacement of the rings and an internal expansion of the major products, as well. The basic reason for such expansion was the increase of the internal demand due to metropolitan growth.

Geiger's findings seem to be confirmed by Katzman⁷⁹ in a similar study carried out in South-Central Brazil for the period 1940 to 1970. His major argument is that recent industrialization has reduced the importance of foreign market demand and increased that of domestic demand on land use in the study area. To support this argument, Katzman used von

Thünen's model to explain the sequence of agricultural specialization and frontier expansion. Thus he concludes that prior to industrialization, the domestic market for foodstuffs was small and non-commercial, and world demand for coffee was the engine of frontier settlement. Rapid industrialization and population growth in the last thirty years, however, has moved the focus of agricultural consumption to urban areas; has increased the demand for perishable and non-perishable foodstuffs as a result of increasing total and per capita income; and has made frontier lands more accessible through highway construction. The resulting changes in land use are predictable by location theory, where urban demand increases and transport cost decreases. The growth of Parana as a coffee frontier and Goias as a rice frontier, cannot be understood without realizing that these crops have been displaced by the expansion of other land uses in Sao Paulo. Areal expansion, or extensive agricultural growth, occurs in a particular economic environment in which land is abundant and relatively cheap while agro-technology is expensive.

Finally, Ramon's⁸⁰ attempt to apply the same approach in a region of Spain (Baix Camp de Tarragona) resulted in the verification of similar expansion of land uses between 1955 and 1971 also related to the growth of the major regional centers (Tarragona and Reus).

From this evaluation of the literature on dynamic approaches to von Thünen's model, four major observations may be made. First, none of the earliest theorists such as Brinkmann, Lösch and Dunn recognized that von Thünen himself dropped the equilibrium condition of the model, by introducing the factors of changing demand, decreasing the soil fertility and increasing taxation. Each one treated the matter as their own extension of the model despite making direct reference to von Thünen's work.

Second, comparing the number of references to both states of the model, the dynamic approach has been only lightly but effectively used for geographical analyses and improvement of its theoretical base, invites attention. Third, the cross sections used by the empirical investigations provide just a partial view of the spatial situation in the areas that were under consideration. To throw more light on the dynamics of agricultural space, a longer period would seem to offer the opportunity for more insight. Fourth, in the empirical verification no attempt has been made to use any of von Thünen's suggestions in the area of climatic influences, holding size, taxation, etc. nor has a probabilistic approach been carried out in geography.

2.3.2 Applications of von Thünen in Brazil and Bahia

Two studies involving von Thünen's principles were those of Katzman⁸¹ and Mesquita⁸² who applied intensity indicators to different regions of Brazil. The objective of the former was to show the validity of integrating the von Thünen paradigm and the industrial-urban hypothesis for analyzing the spatial structure of agriculture. In so doing he performed an empirical test in the state of Goiás on price gradients, land values, land uses, factor proportions, factor productivities as dependent variables and absolute distance, fertility, and industrial urbanism as independent variables. From this he concluded that the spatial structure of agriculture in the frontier state, conforms well to a von Thünen model in which there is limited land-labour factor substitution. Yet, predictions on the capital intensity of farming are improved when local industrial development is taken into account. So far, this work seems to be the first numerical presentation of the complete system of von Thünen's agri-

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cultural intensity gradients as well as the first to test the model using a probabilistic approach in which soil fertility is taken into consideration. Mesquita performed an empirical test in Sao Paulo tributary areas aiming to verify to what extent intensity and distance from a large urban center are inversely related. From the 1970 census a set of three dependent variables related to inputs of labour and capital (fixed and variable) against absolute distance were used. The results confirmed the model's prediction.

In Bahia two works show complete discordance between empirical observations. DeWitt⁸³ in a dissertation oriented to "describe the importance of food production on regional development [sic] in the State of Bahia", places emphasis "on the production of horticultural produce for Salvador's urban population". The author used Lambert's framework (dual model) and von Thünen's model, this latter offering an ideal situation, to compare with Salvador's reality. He starts the study by showing that the State of Bahia does not have any resemblance to the "Isolated State" and then he selects factors, based on Spencer and Horvath, to explain the land use patterns around Salvador. Among these factors he used Bahia's historical background to emphasize that the best land around Salvador was used in the past to grow commercial crops for export whereas, for centuries, food for Salvador was produced within the city itself or imported from the Recôncavo. Moreover, at the present time road construction has brought different parts of the nation into contact that had previously been isolated from each other, thus enabling the Sao Paulo food producers to compete with the local producers who continue to farm under traditional systems. Without performing any statistical test or showing land use patterns around Salvador, DeWitt's conclusion is that the components of

the von Thünen model do not fit the reality of Salvador. Yet he maintains that the model remains a useful tool for analysis of agricultural systems in developing nations.⁸⁴

It seems that DeWitt lost an excellent opportunity to exemplify von Thünen's model as a useful framework for studying the dynamics of agricultural land use. Yet, he committed a scientific fallacy in trying to verify von Thünen's assumptions instead of von Thünen's hypothesis. In addition the author's generalizations about land use in Bahia, based on horticulture, render his conclusions questionable.

The other dissertation was written by Silva⁸⁵, in which a section entitled in translation "Location of Agricultural Activity" is inserted. It deals with von Thünen's equilibrium model followed by the presentation of a map based on secondary sources, statistic-cartographic data and Silva's own experience as a geographer in Bahia. This map represents Thünen zones around Salvador in the following sequence: (1) horticulture, (2) milk shed, (3) commercial crops, (4) improved livestock, and (5) traditional livestock. Two years after DeWitt's empirical observations, Silva's findings are completely in opposition to the previous author. The two first zones depicted by Silva as actual agricultural land uses appearing in 1975, represent what should have existed before 1960. In fact the horticultural zone in the 1970's was already extremely weakened, while the milk shed zone did not exist in the represented area anymore. Further, he included in the horticultural zone a manioc area, which is not horticulture at all. No quantification was carried out, in spite of his stressed statistic-cartographic method. As the author points out, however, his "explanatory model" represents a preliminary step and invites elaboration and verification by further studies.

The confrontation of the two works on the spatial organization of agriculture in Bahia, does show different perceptions of the same geographical space within the same temporal framework (1973 and 1975). Although both authors had based their findings on qualitative rather than quantitative observations, they do prove useful in focusing on spatial relationships and processes within a specified framework.

2.4 The Relevance of Von Thünen's Model to an Analysis of the Evolution of Agricultural Patterns in Bahia

The foregoing review of the use of von Thünen's model indicates both its spatial and temporal dimensions. Its relevance as a theoretical framework for studying agricultural land uses in both conditions, is, therefore, evident. Its verification in the real world does present some difficulties. These difficulties relate to the assumptions of the model and to the availability of data. A true "Isolated State" cannot be found in the world because it represents an ideal stage of economic, social and spatial development which does not in fact exist. Instead, what a researcher must try to investigate is the extent to which the generalizations underlying the model, in both conditions, hold true in the real world. It is the viewpoint that is at the heart of this author's decision to use the dynamic approach of the model as a framework for studying the evolution of the agricultural land use patterns in Bahia. In so doing the following predictions of the model will be investigated in the study area:

- 1) That the intensity of agriculture is inversely proportional to distance from the market.
- 2) That transportation improvements cause a selective expansion of agriculture.

- 3) That in a multiple market system the spatial organization of agriculture is determined by the market magnitude.
- 4) That a change in prices determined by a change in demand forces the agricultural space to undergo contraction and/or expansion.
- 5) That under conditions 2, 3, and 4 distance will remain a strategic variable in causing the spatial differentiation in the intensity of agriculture.

Von Thünen's suggestions for investigating the influence of climate and holding size on agriculture will be also taken into consideration.

As has already been pointed out, a true "Isolated State" cannot be found in the real world. Any geographical space has experienced continuous change through time. When one looks back through history and attempts to find out the origins of any present situation it is reasonable to suggest that they resembled in their earliest beginnings, "The Isolated State". Such was the case of Bahia. As will be detailed in Chapter Three the first settlers selected the coastal plain, with its uniform climate and soil as a promising agricultural area. Salvador developed as its single market centre, this it remained for about four centuries. Transportation to and trade with other areas of Brazil were limited. The relationships between the colony and the metropolitan country intensified slowly so that Bahia emerged under conditions of almost true isolation. In addition the earliest estates were by and large, almost uniform in size and were granted under the condition that they were to be efficiently operated, and therefore, they had a capitalistic goal, i.e. the maximization of profits. The close approximation of Bahia during its initial stage of development to a classic von Thünen model situation, thus seems to provide the basis for evaluating subsequent development in terms of the model, of comparing the patterns

produced by growth of population, settlement of different landscapes, transportation improvements, etc. with those suggested by von Thünen as he relaxed the constraints in his "Isolated State".

So far von Thünen's model has not been used for investigating the evolution of a state from its formation up to the present day. This type of research provides an important contribution for agricultural geography in general in exemplifying the application of the model through an extended time frame.

REFERENCES AND FOOTNOTES, CHAPTER 2

1. Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie. Part One of The Isolated State was first published in 1826 by Perthes in Hamburg. A second edition, improved and extended, was published in Rostock by Leopold, in 1842. Part Two, Section One was published in 1850. Part Two, Section Two and Part Three were published by Hinstorff, in Rostock, in 1863. The first collected edition and the only complete one, was edited by Schumacher and published by Wiegandt, Hempel and Parey, in Berlin, in 1876. The First and Second Parts of this book were partially translated by Carla M. Wartenberg. Bernard W. Dempsey, S.J., The Frontier Wage: The Economic Organization of Free Agents, with the text of the Second Part of The Isolated State by Johann Heinrich von Thünen, Jesuit Studies (Chicago: Loyola University Press, 1960). Part Two and Sections One and Two in Carla M. Wartenberg's translation, correspond to Volume Two and Parts One and Two in B.W. Dempsey's translation.
2. This law forbade the import of grain unless the price rose above 80 shillings per bushel. See Peter Hall, ed., Von Thünen's Isolated State, trans. Carla M. Wartenberg (Oxford: Pergamon Press, 1966), P. 180n (hereafter cited as P. Hall).
3. VTIS, p. 180.
4. By soil fertility, von Thünen meant the amount of manure added to the soil, according to the farming system.
5. VTIS, p. 228.
6. VTIS, p. 24.
7. P. Hall, p. XIV.
8. VTIS, p. 176.
9. Ibid.; p. 24.
10. Ibid., pp. 30, 81, 144-146, 234-236.
11. P. Hall, pp. XXIII-XXIV.
12. The thaler was the basic unit of Prussian currency when von Thünen wrote his book (1148 of new thaler = 1 shilling) whereas a Berlin bushel was equal to 54.41. P. Hall, p. 13n.

14. The cultivated plain in the Isolated State stretches up to 50 miles. In the diagram it was represented as 40 miles for saving space. VTIS, p. 215.
16. Ibid., pp. 216, 272-276.
17. Ibid., pp. 216-217.
18. Ibid., pp. 220-221.
19. Ibid., pp. 221-222.
20. Ibid., pp. 144-146, 217-220.
21. Ibid., p. 229.
22. Ibid., p. 240.
23. Ibid., p. 241.
24. Ibid., p. 242.
25. Ibid., p. 243.
26. Ibid., p. 243.
27. Ibid., pp. 245-246.
28. Ibid., p. 295.
29. Ibid., p. 247.
30. Wilhelm Roscher, "Ideen zur Politik und Statistik der Ackerbausysteme", cited by Leo Waibel, "A Lei de Thünen e a sua Significacao para a Geografia Agraria", in Capitulos de Geografia Tropical e do Brasil (Rio de Janeiro: IBGE, 1958), pp. 76-79 (hereafter cited as Waibel, A Lei de Thunen).
31. T.H. Engelbrecht, Landwirtschaftliche Jahrbücher (Berlin: n.p., 1883), cited by Waibel, op. cit., pp. 80-81.
32. Richard Krzymowski, "Graphical Presentations of Thünen's Theory of Intensity", Journal of Farm Economics 10 (1928): 461-482.
33. Alfred Weber, Theory of the Location of Industries, trans. C.J. Friedrich (Chicago: University of Chicago, 1929).
34. Elizabeth Benedict et al., Theodor Brinkmann's Economics of the Farm Business (Berkeley: University of California Press, 1935), pp. 7-59 (hereafter cited as Benedict).

35. Walter Christaller, Central Places in Southern Germany, trans. C.W. Baskin (Englewood Cliffs, N.J.: Prentice-Hall, 1966).
36. August Lösch, The Economics of Location, trans. William H. Woglom and Wolfgang F. Stolper (New Haven: Yale University Press, 1954), pp. 36-67 (hereafter cited as Lösch).
37. Benedict, p. 10.
38. Ibid., p. 11.
39. Ibid., pp. 32-33.
40. Lösch, pp. 36-49.
41. Ibid., pp. 50-51.
42. Ibid., pp. 51.
43. Edgar S. Dunn, Jr., The Location of Agricultural Production (Gainesville: University of Florida Press, 1954), pp. 6-70 (hereafter cited as Dunn).
44. Ibid., p. 44.
45. Ibid., p. 45.
46. Edgar M. Hoover, The Location of Economic Activity (New York: McGraw-Hill, 1948), pp. 95-97.
47. William L. Garrison and Duane F. Marble, "The Spatial Structure of Agriculture Activities", AAAG 47 (1957): 137-144.
48. Robert Sinclair, "Von Thünen and Urban Sprawl", AAAG 57 (1967): 812-815.
49. Thomas K. Peucker, "Thünen's Theory and the Problem of Developing Countries", in 21st International Geographical Congress, India 1968 (Calcutta: National Committee for Geography, 1970), pp. 208-211.
50. William C. Found, "Towards a General Theory Relating Distance Between Farm and Home to Agricultural Production", Geographical Analysis 2 (1970): 165-176.
51. Martin J. Beckmann, "An Input-Output Model of a von Thünen Economy", Annals of Regional Science 5 (1971): 6-24.
52. Joern Barnbrock, "Ideology and Location Theory: A Critical Inquiry into the Work of J.H. von Thünen" (Ph.D. dissertation, The Johns Hopkins University, 1977).

53. Donald W. Jones, "Rent in an Equilibrium Model of Land Use", AAAG 68 (1978): 205-213 and "The Price Theory of Thünen's Theory of Rent: Assumption and Implications of a Familiar Model", Canadian Geographer 23 (1979): 322-336.
54. Alan P. Jones et al., "A Reexamination of Some Aspects of von Thünen's Model of Spatial Location", Journal of Regional Science 18 (1978): 1-15.
55. Aharon Kellerman, "Determinants of Rent from Agricultural Land Around Metropolitan Areas", Geographical Analysis 10 (1978): 1-12.
56. See Andreas Grotewold, "Von Thünen in Retrospect", Economic Geography 35 (1959): 346-355; Binder Hildegard Johnson, "A Note on Thünen's Circles", AAAG 52 (1962): 213-220; J.W. Birch, "Rural Land Use and Location Theory: A Review", Economic Geography 39 (1963): 273-276; Peter Hagget, Location Analysis in Human Geography (London: Edward Arnold, 1965), pp. 161-182; P. Hall, pp. XI-XLIII; David W. Harvey, "Theoretical Concepts and the Analysis of Agricultural Land-Use Patterns in Geography" AAAG 56 (1966): 361-374 (hereafter cited as Harvey, Theoretical Concepts); Colin Clark, "Von Thünen's Isolated State", Oxford Economic Papers 19 (1967): 370-377; Janet Henshall, "Models of Agricultural Activity" in Social Economic Models in Geography, ed. Richard J. Chorlley and Peter Hagget (London: Methuen, 1967), pp. 425-458; Michael Chisholm, Rural Settlement and Land Use: An Essay in Location (London: Hutchinson & Co., 1962), pp. 11-42 (hereafter cited as Chisholm, Rural Settlement) and "The Relevance of von Thünen", AAAG 59 (1969): 401; H.D. Dickinson, "Von Thünen's Economics" Economic Journal 79 (1969): 894-902; Howard F. Gregor, Geography of Agriculture: Theme in Research (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970), pp. 57-71; William Warntz and Peter Wolf, Breakthroughs in Geography (New York: New American Library, 1971), pp. 106-131; and W.B. Morgan, "The Doctrine of the Rings", Geography 58 (1973): 301-312.
57. Benjamin H. Stevens, "Linear Programming and Land Rent", Journal of Regional Science 2 (1961): 15-26 and "Location Theory and Programming Models: The von Thünen Case", Papers of the Regional Science Association 21 (1968): 19-34; and D. Marble and B.H. Anderson, "Land Use: A Computer Program for Laboratory Use in Economic Geography" Geography Technical Papers Series 8 (AAAG), 1972.
58. Michael Chisholm, "Von Thünen Anticipated", Area 11 (1979): 37-38.
59. Aharon Kellerman, "Location Theory Anticipated", Area 11 (1979): 347-348, citing L.S. Wang, "A Chinese Model: The Ideal Universe" in Yu-Kung, Yearb. Assoc. Pac. Coast Geogr. 32 (1970): 167-171.
60. VTIS, pp. 18-22.

61. See Chisholm, Rural Settlement, pp. 43-172; P.M. Blaikie, "Spatial Organization of Agriculture in Some North Indian Villages: Part I", Transactions 52 (1971): 1-40 and "Part II", Transactions 53 (1971): 15-30; Richard Stevens and Yuk Lee, "A spatial Analysis of Agricultural Intensity in a Basotho Village of Southern Africa", Professional Geographer 31 (1979): 177-183; Joshua C. Dickinson III, "Variation on the von Thünen Theme in a Semi-Traditional Society", AAAG 57 (1967): 172; Leo Waibel, "A Teoria de von Thünen Sobre a Influência da Distância do Mercado Relativamente a Utilização da Terra" in Capitulos de Geografia Tropical e do Brasil (Rio de Janeiro: IBGE, 1958), pp. 99-129; Olaf Jonasson, "Agricultural Region of Europe", Economic Geography 1 (1925): 277-314; Nobumichi Yokeno, "Thünen's Structure in the Agriculture of Japan", Sophia Economic Review 3 (1956): 12-22; Ernst Griffin, "Testing the von Thünen Theory in Uruguay", Geographical Review 63 (1973): 500-516; Peter O. Muller, "Trend Surfaces of American Agricultural Patterns: A Macro-Thünian Analysis", Economic Geography 49 (1973): 228-242.
62. See Martin T. Katzman, "The von Thünen Paradigm, the Industrial-Urban Hypothesis, and the Spatial Structure of Agriculture", American Journal of Agricultural Economics 56 (1974): 683-696 (hereafter cited as Katzman); Francis Chukwudum Okafor, "Intensity of Agricultural Land Use in Canada: Von Thünen's Model Extended" (M.A. thesis, University of Western Ontario, 1975), pp. 37-42; Ma. D. Garcia Ramon, "Valor Actual del Modelo de von Thünen y dos Comprobaciones Empíricas", Revista de Geografía 10 (1976): 21-29 (hereafter cited as Ramon); Richard C. Jones, "Testing Macro-Thünen Models by Linear Programming", Professional Geographer 28 (1976): 353-361; Aharon Kellerman, "The Pertinence of the Macro-Thünian Analysis", Economic Geography 53 (1977): 255-264; and Olíndina Vianna Mesquita, "O Modelo de von Thünen: Uma Discussão" (Tese de Mestrado, Universidade Federal do Rio de Janeiro, 1978), pp. 93-94 (hereafter cited as Mesquita); William Norton and E.C. Conkling, "Land Use Theory and the Pioneering Economy", Geografiska Annaler 56B (1974): 44-56; and Peter O. Muller and Gregory J. Diaz, "Von Thünen and Population Density", Professional Geographer 25 (1973): 239-241.
63. Michael Chisholm, "Agricultural Production, Location, and Rent", Oxford Economic Paper 13 (1961): 342-359; Ruth Gasson, "The Changing Location of Intensive Crops in England and Wales", Geography 51 (1966): 16-28; and Andreas Grotewold and Michael D. Sublett, "The Effect of Import Restriction on Land Use: The United Kingdom Compared with West Germany", Economic Geography 43 (1967): 64-70; and J. Harold Leaman and E.C. Conkling, "Transport Change and Agricultural Specialization", AAAG 65 (1975): 425-432.
64. Benedict, pp. 33-50.
65. *Ibid.*, pp. 142-163.
66. Lösch, p. 57.
67. Dunn, pp. 71-85.

68. Harvey, Theoretical Concepts, pp. 367-368.
69. David W. Harvey, "Models of the Evolution of Spatial Patterns in Human Geography" in Models in Geography, ed. R.J. Chorley and P. Haggett (London: Methuen, 1967); pp. 563-564 (hereafter cited as Harvey, Models of Evolution).
70. Richard F. Muth, "Economic Change and Rural-Urban Land Conversion", Econometrica 29 (1961): 1-23.
71. Richard H. Day and E. Herbert Tinney, "A Dynamic von Thünen Model" Geographical Analysis 1 (1969): 137-151 (hereafter cited as Day and Tinney).
72. Ibid., p. 144.
73. Leo Waibel, A Lei de Thünen, pp. 85-96.
74. Ibid., pp. 96-98.
75. John T. Schiebecker, "The World Metropolis and the History of American Agriculture", Journal of Economic History 20 (1960): 187-208 (hereafter cited as Schiebecker).
76. J. Richard Peet, "The Spatial Expansion of Commercial Agriculture in the Nineteenth Century: A von Thünen Interpretation", Economic Geography 45 (1969): 282-301 (hereafter cited as Peet).
77. J. Richard Peet, "Von Thünen Theory and the Dynamics of Agricultural Expansion", Explorations in Economic History 8 (1970-1971): 181-201.
78. Pedro Pinchas Geiger et al., "Distribuição de Atividade Agropastoris em torno da Metrópole de São Paulo", Revista Brasileira de Geografia 36 (1974): 3-36.
79. Martin T. Katzman, "Industrialization, Agricultural Specialization, and Frontier Settlement in South-Central Brazil, 1940-1970", Development and Change 6 (1975): 25-49 (hereafter cited as Katzman, IASES).
80. Ramon; pp. 11-33.
81. Katzman, pp. 690-696.
82. Mesquita, pp. 70-115.
83. John Wainwright DeWitt, "Food Production and Regional Development in Bahia, Brazil" (Ph.D. dissertation, University of Florida, 1973), pp. XIV-XVI, 1-26, 63-94 (hereafter cited as DeWitt).
84. Ibid., pp. 209-210.

85. Sylvio Carlos Bandeira de Mello e Silva, "Urbanizaco e Desenvolvimento Regional no Estado da Bahia: Uma Viso Sistmica" (Tese para Professor-Titular, Universidade Federal da Bahia, 1975), pp. 35-54. (hereafter cited as SBM Silva).

CHAPTER 3

SPATIAL AND SOCIAL BACKGROUND TO AGRICULTURAL LAND USE IN BAHIA

3.1 Introduction

Von Thünen's model, as was pointed out in the previous chapter, was constructed strictly along economic lines. Potentially irregular landscape characteristics such as soil, climate, landforms, farm size, and tenure system are not allowed to interfere with economic relationships governing agriculture, and therefore, in effect these variables are held constant. In developed countries some types of agriculture have developed which minimise the variable impacts of physical and social-structural aspects, but this is not generally the case in the large economically-underdeveloped areas of the world. In fact the reverse situation tends to prevail i.e. the strength of physical environment remains largely uncontrolled, and the traditional form of tenure and the backwardness of institutions preclude the efficiency and modernization of agriculture. Particularly in these areas, land has several functions. It is a factor of production, but it is also a factor of social prestige, political power, investment against inflation and/or merely a source of speculation.

The present evidence in Bahia shows that among the physical and social structures prevailing in the state, rainfall and the system of land division have played a particularly important role in shaping agricultural

land use. Although rainfall and farm size in the von Thünen model are held constant, basic alterations to any postulated regular pattern need to be made explicit as the basis for explanation of patterns revealed by empirical investigation.

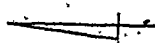
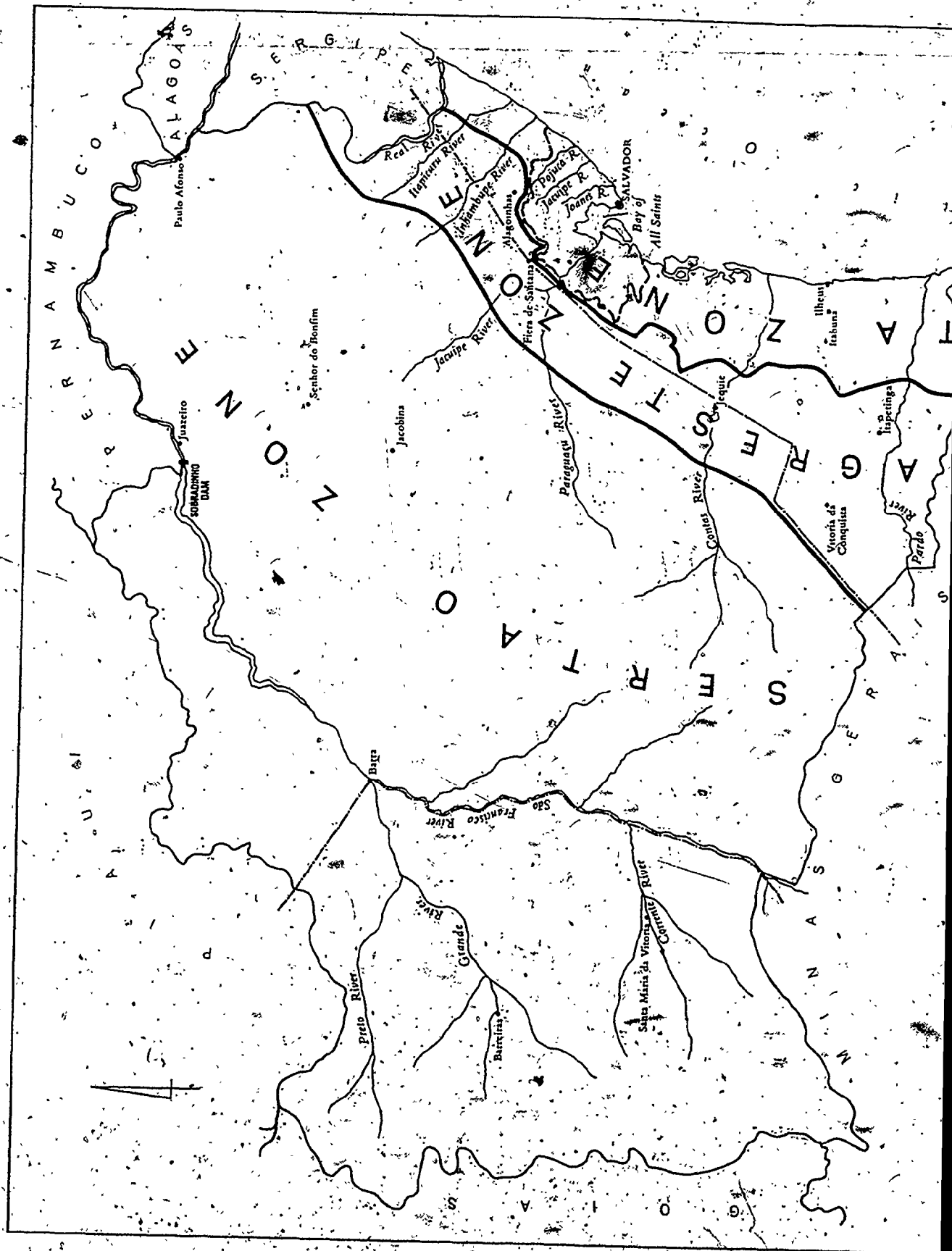
3.2 Physical Structure

The present territory of Bahia originated from the earliest Captaincy of the Bahia de Todos os Santos, one of fifteen parallel east-west strips of land into which Brazil was divided in 1534. Originally it extended from the southern edge of the Bay of All Saints to the mouth of the Sao Francisco River in the north, which meant that the territory that later became the state of Sergipe (Figure 9) was incorporated into Bahia from 1534 to 1824.¹ Furthermore the economic prosperity of the captaincy and the agricultural expansion after 1549 led to the incorporation of significant areas of the Pernambuco, Ilheus, and Porto Seguro captaincies into Bahia's territory. From this process of areal fusions and partitions, the state emerged as the sixth largest in Brazil; currently comprising 7% of the national territory and 36% of the Northeast.

The size of Bahia and its geographic location mean that the physical conditions of its territory are not homogeneous. The major dissimilarities, however, which determine the agricultural possibilities in the state reflect a natural zoning basically oriented by the rainfall and vegetation patterns. The agricultural occupance of these zones, through time, suggest a decrease in intensity from the coastal zone to the interior, very close to a Thünian landscape. Yet, from an historical viewpoint, these geographical zones were not occupied at once but rather sequentially. Actually, it took almost half a century for agriculture which began on the coast to expand into the Bahian

hinterland. This meant that the colonization of the state began within a quasi-homogeneous region, and therefore, under the historical standpoint, the von Thünen assumption of physical uniformity is met in Bahia in the earliest stage of agricultural development, but that later as it expanded it cut across several different regions of physical environment.

The physical and human features of Bahia permit the regionalization of its territory in different ways dependent on the researcher and/or institutional interest. For the purpose of this dissertation the aforementioned zoning of the natural ecosystem which has been widely accepted by the Brazilian and foreign geographers as the basis of the study of the Northeast will be taken into consideration.² Such acceptance lies in the fact that the zoning is based on the climate, a peculiar factor which not only differentiates the Northeast from the other Brazilian macro regions, but also is a factor of internal differentiation of the region. The climatic peculiarity expressed in the regional dualism, humid Northeast and dry Northeast was identified by the earliest colonists who, not only took advantage of their natural potentiality for growing sugar cane and raising cattle, but also labeled them. It is worthwhile to emphasize that in spite of this climatic connotation, each zone (Figure 5) presents internal dissimilarities which can be physically sub-divided. In the search for generalization, this zonal classification already established, seemed more convenient to the author. Thus it will often be referred to throughout this dissertation particularly during the historical analysis. The major features of the zones and the degree of their integration to Salvador through the period of agricultural occupation will be described below.



PERNAMBUCO

ALAGOAS

Paulo Afonso

Juazeiro

SUBMARINO DAM

Senhor do Bonfim

Recife

São Francisco River

Capibaribe River

Araripe River

Santa Maria da Vitória River

Contato River

Paraguari River

Jaçobe River

Alcobaça

Fiera de Salinas

Itambé River

Itapicuru River

Real River

Salvador

Bay of All Saints

Ilheus

Ilheus

Vitoria de Conquista

Jupetinga

Parado River

PERNAMBUCO

PIAUI

PARAIBA

CEARA

ALAGOAS

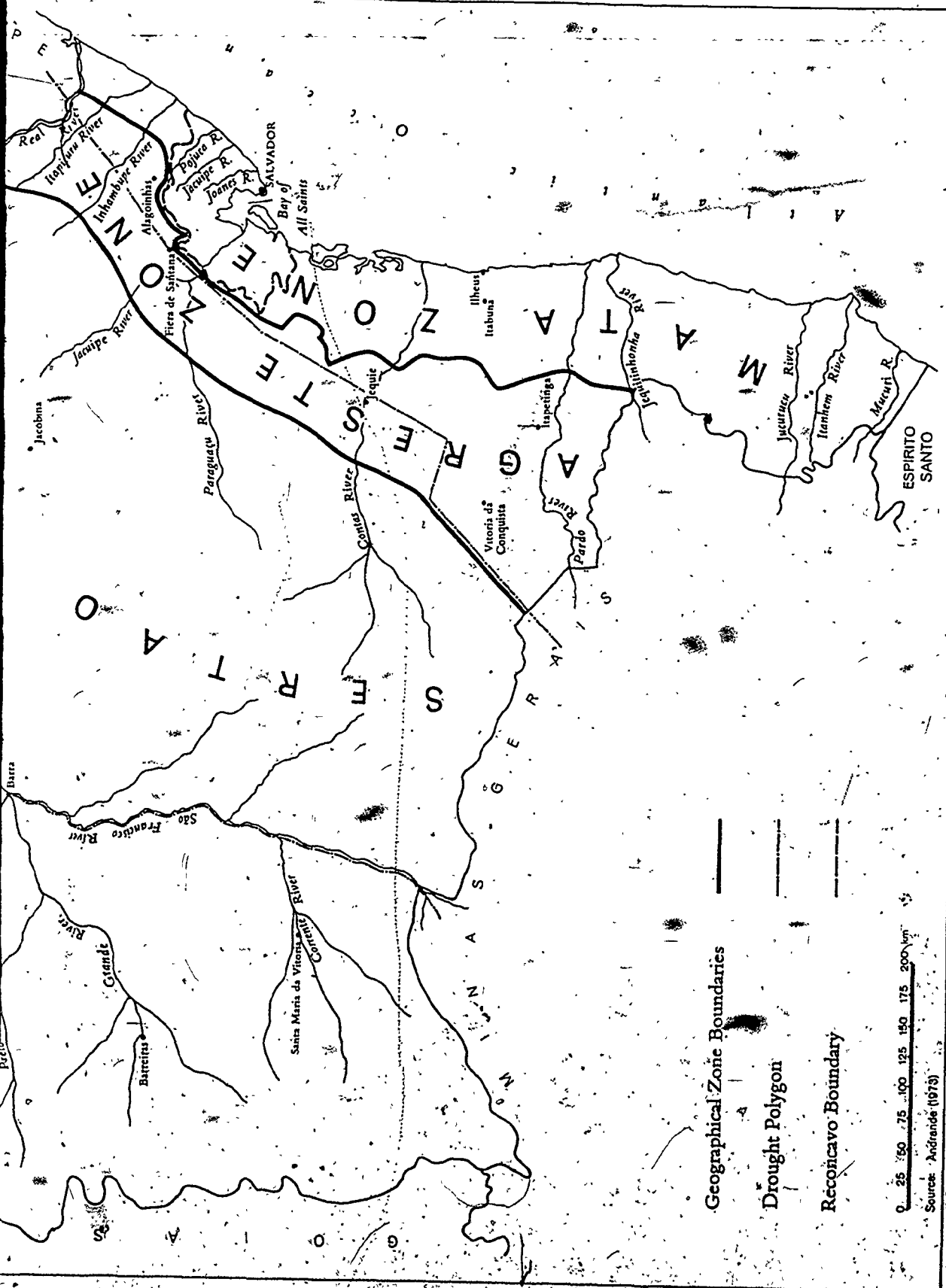


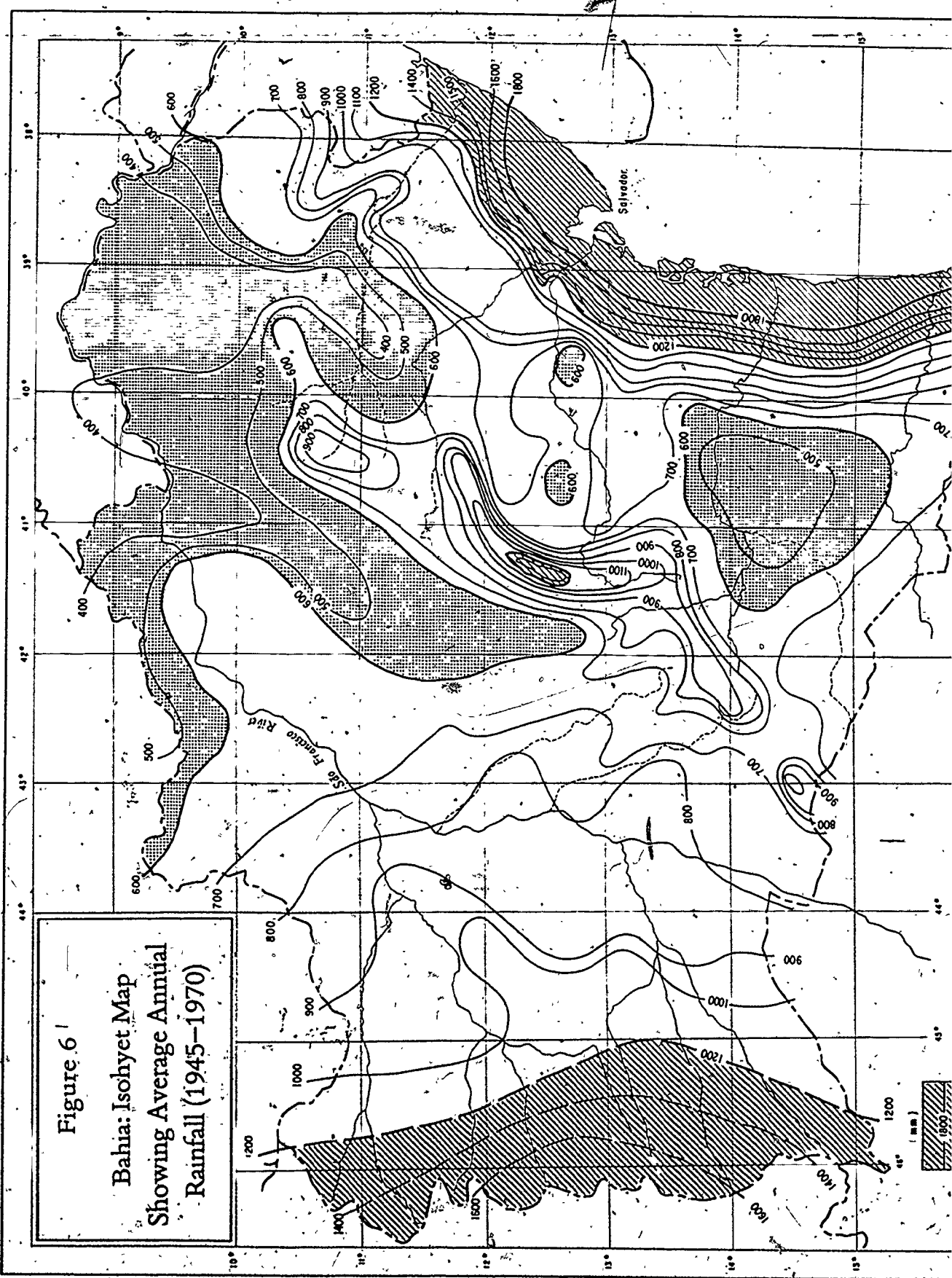
Figure 5 Geographical Zones of Bahia

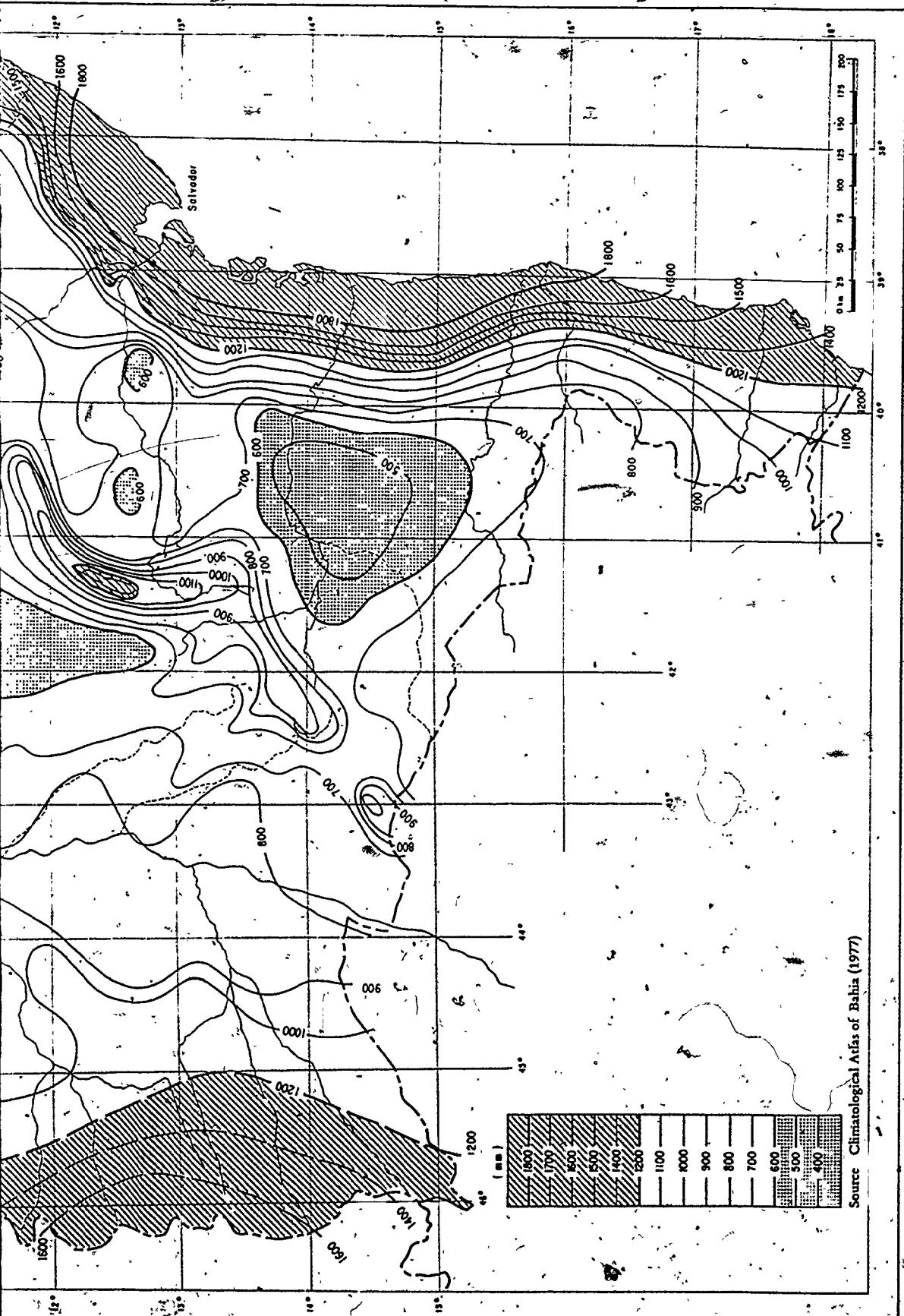
3.2.1 Mata Zone.

This zone runs parallel to the coastline comprising 15% of Bahia's territory. The average annual rainfall, as indicated by the isohyets in Figure 6, is above 800 millimeters with the highest concentration around Salvador and from the Bay of All Saints southward. The majority of the zone has a pluviometric regime classified as mediterranean with a maximum precipitation concentrated from March to September (fall-winter).³ The area comprising the isohyets above 1400 millimeters does not present dry periods whereas in the interior of the zone the driest period (spring) is less than three months. This high amount of annual precipitation, over the zone, results in forest as the dominant natural vegetation. This feature, early identified by the colonists, resulted in the name mata (i.e. forest). Figure 7 showing the major types of vegetation associated with the climatic conditions, indicates that in this zone two kinds of forest prevail. One is the perennial (evergreen) forest, very rich in species, among which cedar (Cedrela odorata), jacaranda (Swartzia pickelii), sucupira-mirim (Bowdichia virgilioides), and brazilwood (Caesalpinia echinata) are of high commercial value.⁴ The other type is the semi-deciduous forest which differs from the previous type in that some species components of the highest stratum lose their leaves during the dry season (spring).⁵ At the present time, both types have almost disappeared either because of agricultural occupation or because of exploitation for firewood and timber.

This area is low lying, in general below 300 meters. From this narrow coastal plain to the interior the surface gently rises, forming low plateaux or flat-topped mesas, so-called tabuleiros (Figure 8). So far the soil capability of Bahia is scientifically unknown so that the agricultural activities have been practiced on the basis of empirical experiences.

Figure 6
Bahia: Isohyet Map
Showing Average Annual
Rainfall (1945-1970)





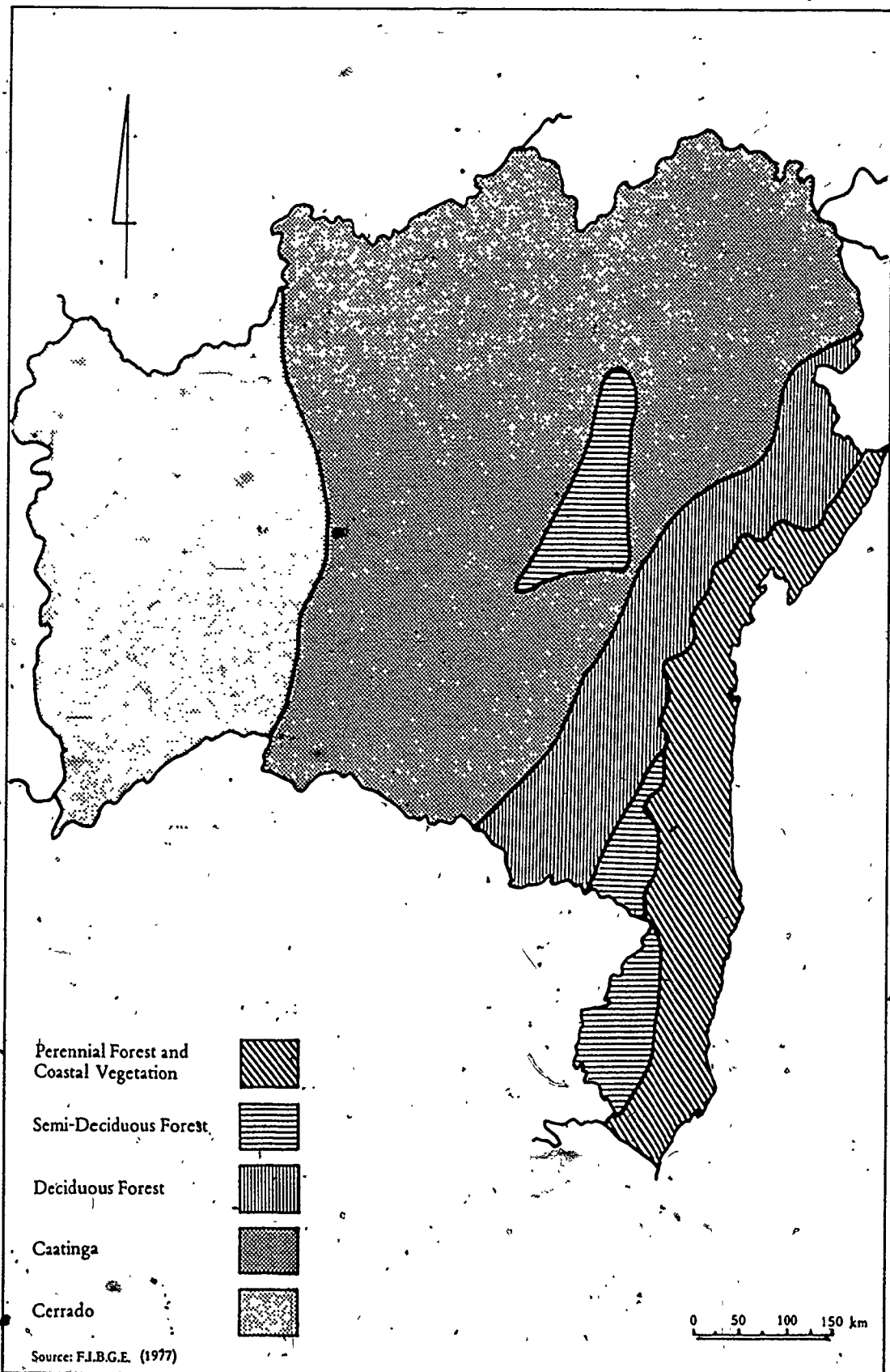


Figure 7 Vegetation Zones of Bahia

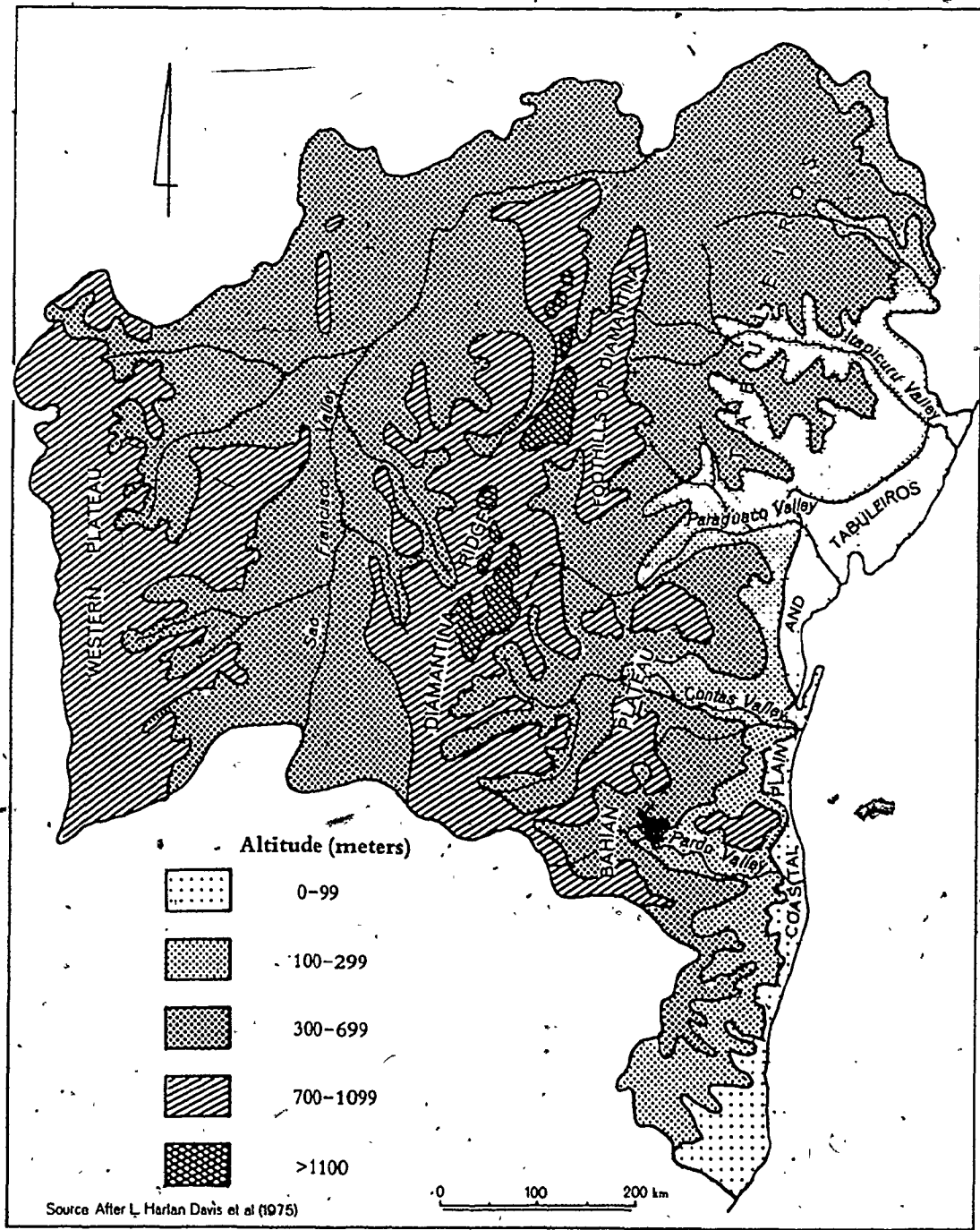


Figure 8 Hypsometric Map of Bahia

Through sustained activity however, the fertility of massape soil is well known. This is a heavy dark clay soil of Cretaceous origin which has been supporting sugar cane plantations for more than four centuries without the use of fertilizers. Other soils like salao (light reddish soil) and tabuleiros (sandy soil) appear within this zone. The former was also occupied by sugar cane during the plantation expansion but its fertility is considered lower than the massape. The tabuleiros are particularly important for growing tobacco, manioc, and cereals, and is the dominant soil over the widest area of the zone.

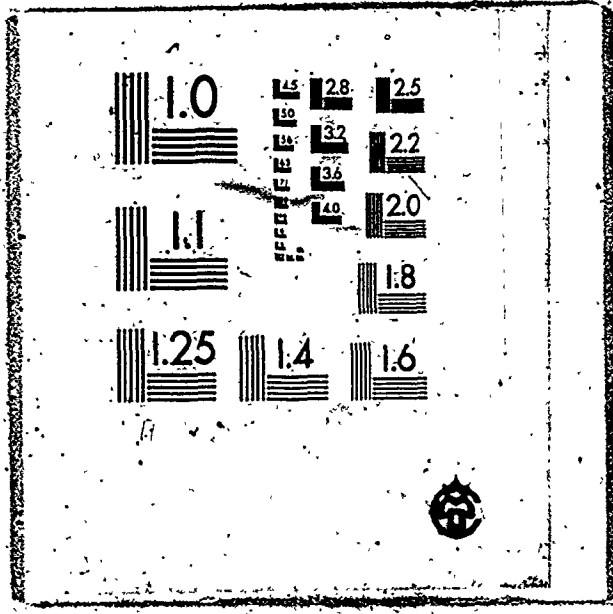
The Mata zone is drained by several rivers flowing to the Atlantic Ocean some of which enter into the Bay of All Saints. The mouth of these rivers, mainly the Paraguacu, Jaguaripê, and the Sergi functioned in the past as gateways between Salvador and the interior, besides furnishing sites for sugar mills in their lower courses. Other rivers north of the Bay played an important role in guiding the occupation of settlement of the hinterland through the expansion of ranching in their valleys, whereas those to the south had more importance after the colonial period.

Bahia's captaincy started on the lands surrounding the Bay of All Saints, named by the earliest settlers the Reconcavo (Figure 5). From the physical standpoint, except for the soils, it is relatively homogeneous, a requirement postulated by von Thünen for "The Isolated State". Indeed the climate and the vegetation are uniform all over the region. But, if one takes into consideration the original area in which the first eighteen sugar mills were established, the landforms and the soil (massape) were also homogeneous. The assumption of physical uniformity in the strict sense of the earliest days of Bahia's colonization, is, therefore, met. Actually, from 1549 to 1570 the plantations did not incorporate other soils and when

this happened another stage of agricultural evolution was already in process.

The agricultural occupation of the Mata zone started with the establishment of sugar cane, followed by foodcrops, cotton and then cattle within the Reconcavo. In the captaincies of Ilheus and Porto Seguro, later incorporated into Bahia, the plantations also started to expand, but their location as well as the administrative inefficiency of their captains resulted in complete failure. From 1571 up to the nineteenth century, cattle raising moved outward and the zone became dominantly occupied by a sequence of cash crops oriented to an external market, including sugar cane, tobacco, coffee, and cocoa, along with foodcrops to supply Salvador. In the beginning of this century, cattle ranching started to move inward, actually replacing areas long occupied by the cash crops as well as contributing to the opening up of new frontiers in the southern part of the Mata zone. In the meantime cash crops to supply the domestic market like oil palm, rubber, coconut, clove, and black pepper have been expanding in the last two decades. Hence, this zone has experienced substantial diversification through time. It is worthwhile to emphasize, however, that in this diversification the perennial crops have predominance upon the temporary crops. Such dominance reflects, therefore, the zonal unit which is particularly characterized by the rainfall conditions. At the present time the highest rates of urbanization and industrialization as well as the densest transportation network of the state are also found within the Mata zone.

2



3.2.2 Agreste Zone

The Agreste zone (Figure 5) has been identified by geographers as a transition area between the coast and the interior. In fact, the colonists did not perceive this geographical nuance. For them there were just two regions in the Northeast, the mata, evergreen and humid, and the sertao, the hot, dry, interior farther from the coast.⁶ The identification of some peculiarities related to the rainfall, vegetation and agricultural occupation have been used to justify the separate identity of the Agreste.

Running from north to south parallel to the Mata zone, the Agreste comprises the second geographical zone of Bahia and incorporates approximately 19% of the state territory. The average annual rainfall ranges from 500 to 1200 millimeters so that two pluviometric regimes dominate in this zone. In the north the regime has mediterranean features with the precipitation concentrated in the fall and winter, whereas in the south the regime is considered tropical with the maximum rainfall concentrated in the summer.⁷ The basic features of the Agreste must be sought in these different rainfall regimes which present a dry period ranging between three and six months. In response to fluctuation in rainfall, the types of vegetation also vary. The major associations are the semi-deciduous forest and the deciduous forest. The former appear concentrated in the southern Agreste and its features resemble the evergreen forest of the Mata zone. The deciduous forest is more complex because it varies according to the dry period (four to six months). It has been described as a mixed vegetation of something between a dry forest and a dense tropical thorn forest (caatinga) in which trees, shrubs, gramineous and bromeliads appear associated. This transition vegetation is called agreste, i.e. rustic, hard to farm and is characterized by the loss of leaves during

the dry season and the dominance of species without³ thorns. Among the variety of species the most common are macambira (Acrocomia intumescens), angico (Piptadenia columbrina), mandacaru (Cereus jamacaru), xique-xique (Cereus gonnellei), canafistula (Cassia excelsa), juazeiro (Ziziphus joazeiro), carnauba (Copernicia cerifera), ouricuri (Syagrus coronata) some of which have commercial value or serve as forage.⁸ The Agreste is viewed as a sample of the Northeast in which a mosaic of landscapes appear alternating. In Figure 5 a long strip of this zone (north-south) is included in the Drought Polygon, i.e. the official boundaries delineated by law to designate the beneficiaries of special federal programs to fight the drought. These boundaries show the areas within the Agreste which present different features from the Mata zone as well as its transition nature.

The landforms of the Agreste are dominantly constituted by the tabuleiros in which the rivers have carved out wide valleys (Figure 8). But most of the soils here are rocky and sandier with a shallower humus layer than those of the Mata zone.

Occupation of the central and northern Agreste started in the seventeenth century through the expansion of cattle from the Reconcavo. In this process the valleys of rivers like the Paraguacu, Inhambupe, Itapicuru and Real played an important role in aiding rapid penetration of ranching into the interior. By the end of the eighteenth century tobacco and cotton were being grown in the peripheral areas of the Reconcavo, but the importance of Agreste as a mixed agriculture zone emerged in the nineteenth century, particularly following construction of the railways. At the beginning of this century the zone produced not only cash crops to supply the internal and external market (coffee and

tobacco) But mainly supplied Salvador in staple foodcrops and beef. From 1950 on, the expansion and the improvement of the highways have played an important role in the transformation of the Agreste. The zone has increasingly specialized in the production of beef, milk, vegetables and potatoes to supply Salvador. Within the zone, the most striking change has occurred in the south where livestock breeding has undergone marked intensification. It is important to emphasize that the impact of the highways has been greater on livestock than on crops, in spite of physical possibilities for the expansion and improvement of both.

3.2.3 Sertao Zone

The Sertao is the largest zone of Bahia, comprising 66% of its territory. The pluviometric regime is tropical with maximum precipitation concentrated in the summer. Within the zone the isohyets show that the average annual rainfall presents a wide variation across the area (Figure 6). The driest part of the Sertao is located in the north, with rainfall between 400 and 600 millimeters: Here the dry season ranges between four to ten months whereas in the centre, south, and west not only are the rainfall amounts higher but the dry season is also shorter (four to six months). Associated with the rainfall conditions three types of vegetation prevail in this zone. The caatinga covers the largest part of the Sertao, appearing in the areas which the amount of rain is the lowest (Figure 7). This vegetation is considered as a tropical, thorn-scrub forest characterized by xerophilous species not higher than three meters. Among these species the most frequent in the caatinga are xique-xique (Cereus gounellei), macambira (Bromelia laciniosa), umbuzeiro (Spondia tuberosa), mandacaru (Cereus jamacaru), faveleira (Jatropha phyllacantha), jurema (Mimosa sp.) as well as different types of Cactaceae.⁹ During the dry season the landscape is

gray, bare of leaves and hostile, the only green plants are the cacti. When it rains the caatinga becomes colorful. Green leaves, coarse grass, and succulent herbs spring up, transforming the landscape and providing forage for the livestock herds, as well as making it possible to cultivate temporary crops. However, this lush season is brief and soon the caatinga becomes gray again.

The second widespread type of vegetation prevalent in the western Sertão is the cerrado, a type of savanna grass-land with scattered trees. It is characterized by short and twisted trees, less than two meters in height and a sparse cover of grasses and other bushes less than half a meter high. Among the species found in the cerrado the most common are andiroba (Carapa guianensis), pequi (Cariocar brasiliensis), capim-flecha (Tristachya leiostachya), mangaba (Hancornia speciosa), and capim-de-campo (Panicum equinoleana).¹⁰ Both the caatinga and cerrado played an important role in the occupation of the interior due to their 'elaborate' value as natural pasture. This natural advantage facilitated the rapid expansion of ranching, as well as the incorporation of parts of other captaincies to Bahia. Although these two types of vegetation prevail in the Sertão, the deciduous forest also appears in the center of the zone where the average annual rainfall is higher. This anomaly is found in the foothills of plateaux, particularly on the windward side of such barriers.

In the Sertão are found the most heterogeneous landforms of Bahia. A traverse section made from east to west (Figure 8) shows that the land rises progressively up to an average altitude of 1,000 meters in the centre of the state where the Diamantina Ridge ranges from south to north separating the eastern and the western basins. The eastern basin is compounded by those rivers flowing through the Agreste and Mata zones to the ocean.

The Sao Francisco River, flows through the western basin the largest valley of the Northeast. The river is incised between the Diamantina Ridge and the Western Plateau from whence several of its tributaries flow. It originates in the central part of Minas Gerais and flows for 3,161 kilometers northward through the Sertao. It is the longest waterway of Bahia. However, it is navigable only in the middle section from Juazeiro in Bahia to Pirapora in Minas Gerais (2,700 kilometers). Up to 1970 the major use of the river was to provide electricity for the Northeast. Recently it was dammed to form the Sobradinho Lake, and, therefore it is expected that part of the regional drought problems can be solved. Besides the Diamantina Ridge the dominant landforms of the Sertao are the plateaux and tabuleiros both reaching average altitudes ranging between 300 and 1,000 meters above sea level.

The soils of Sertao are not generally surveyed but from empirical evidence they have been proved suitable for growing, specifically temporary crops (cereals, tobacco, castor oil, and cotton). Agave, a xerophilous cash crop, was introduced in the 1940's whereas in the humid areas sugar cane and coffee can be also produced. Coffee grows in the central part of the Diamantina Ridge where the ecological conditions have been recently recognized as amongst the best in Brazil.

The physical diversity of the Sertao is unified through the drought and the social structure of land. Actually, it is not the low rainfall per se, which has contributed to the persistence of traditionalism in the zone, but rather the high degree of rainfall variability and the latifundias. The occurrence of droughts and their unpredictable nature, such that there may be ten or twelve rainy years and suddenly a long-lasting drought, has played an important role in making agriculture a precarious activity.

When this phenomenon occurs, people and cattle suffer due to the shortage of water and food. Migration may be stimulated dependent on the duration of drought. The droughts have been reported since the colonial period but in spite of several steps made by the government the problem remains unsolved. Insofar as the social structure of land is concerned, it is in the Sertao where the tenural dualism of latifundium-minifundium is marked. This situation is aggravated by the climatic conditions. Although both land structures are widespread in the zone, minifundia are concentrated in the driest areas. This situation makes the problem of drought more dramatic.

The agricultural occupation of the Sertao started in the early seventeenth century through the granting of huge estates to privileged colonists and the expansion of ranching and subsistence cropping in the Sao Francisco Valley. From there thousands of head of cattle were driven annually to supply the sugar plantations and Salvador. During the eighteenth century the ranching expansion continued from the east bank of the river to central and southern Sertao, whereas cotton started to be grown in a number of different areas of the zone. In the late nineteenth century the loose integration of three zones became tighter through the railway links, and later was reinforced by the highways. This integration has led to widespread transformation of subsistence agriculture in the Sertao through the expansion of cash crops and food crops, mainly in the Diamantina Ridge, where mechanization has also been rapidly spreading. Such improvement forced, for instance, the construction of the so-called "beans highway" to link the producer region to Salvador and other Brazilian markets. Thus the Sertao has been changing from a region specialising in raising cattle to one of more mixed agriculture.

This cursory description of the Bahia's gross geographical zones reveals a heterogeneous physical structure. This heterogeneity resulted, however, from a long historical process of territorial integration through the process of agricultural expansion. From Bahia's physical diversity it was expected that its agricultural landscape presented a marked deviation from that predicted for "The Isolated State". Conversely, the physical dissimilarities in Bahia vary from the coast to the interior almost pari passu with those related to distance costs. This analogy creates a background for the spatial organization of agriculture which, over three centuries, did not differ much from the Thünian landscape. In the present century, however, the spatial organization of agriculture observed in Bahia does not reflect the expected organization predicted by the von Thünen model, as is discussed later in this dissertation.

3.3 Social Structure

It was previously emphasized that in the classic version of the von Thünen model, the social structure of landholding is held constant and, therefore, does not interfere with farmer decisions. In "The Isolated State" the operating units are of uniform size so that the strategic variable influencing the decision as to what to grow and how to use the land is the location of the farm relative to a central market and its demand. Such a theoretical condition of uniform landholding, however, is hardly ever met in the real world, especially when the process of land division and the rights of ownership are operating over a considerable period of time. In this regard, the present situation

of Bahia is the result of centuries of change and does not match that postulated for "The Isolated State". Actually the high degree of inequality in the partition of land in Brazil, and particularly in Bahia at the present time, constitutes one of the major problems in the modernization of agriculture, as well as an obstacle to the social and economic development of the state and of the country as a whole.

However in the beginning, when the colonial system of land division and the ownership rights are taken into account, it is arguable that a stronger resemblance between Bahia and "The Isolated State" may have existed in respect of landholding conditions.

3.3.1 Colonial System of Land Division and Ownership Rights

The Portuguese discovery of Brazil in 1500 did not immediately result in effective colonization. However by 1534, under the influence of the foreign threat of take over of the new land, the Portuguese monarchy of Dom Joao III (1522-1557) was led to search for an efficient colonization policy. In this respect the advice of Diogo de Gouveia had an important effect on the policy devised to colonize Brazil, based on so-called hereditary captaincies.¹¹

In 1534 the colony was divided into fifteen large allotments (captaincies) which were then granted to twelve captains (donatarios) selected from among the top of the wealthiest Portuguese noble, middle and civil servant classes persuaded to invest in the colonial enterprise.¹² Some captains were already landlords in Portugal while several had made fortunes in the India trade, either as military men or as commercial entrepreneurs. Others had been military officers as well as having held high administrative posts in the royal government.

Each captaincy had an average length of fifty leagues¹³ of coastline and extended inland to the limit defined by the Treaty of Tordesillas.¹⁴ The rights and responsibilities of the captains they sought to attract were specified by the Crown. Among these rights some deserve to be mentioned here.¹⁵

1) They had power to judge all criminal and civil cases within their jurisdiction and this power included the right to pass or commute a death sentence.

2) They could transmit the captaincy to their heirs, without the restrictions determined by the Lei Mental.¹⁶ According to the rights of succession the direct descendents had preference over ascendent or collateral relatives; males had preferences over females, and legitimate descendents over illegitimate.

3) They could build villages freely on the coast and in the interior with the condition that they be at least three but no more than six leagues apart.

4) They could appoint public notaries, and as well they could collect fees with interest tribute.

5) They could collect tribute from sugar mills, water mills, and salt works, and authorize their construction.

6) They could separate out for themselves up to sixteen leagues of coastlands extending from the littoral, inland to the sertao, without paying any tribute except the tenth or tithe (dizimo), to the Order of Christ.

7) They had the right to grant land to Catholic settlers, who had to cultivate it for a certain period of time (generally five years), tax free, except for the tithe to the Order of Christ.

¹³ League is a old Brazilian measure of length, equal to 6 kilometers.

8) To them belonged a tenth of the taxes paid to the King (redizimo), as well as they had the right to one-twentieth (vintena) of the net profit obtained for the King by the sale of brazilwood (a royal monopoly). Also one-fifth (quinto) of all minerals found in the captaincies belonged to the King and one-tenth of that quinto belonged to the captains. The right to exploit the brazilwood, the dyes, the drugs and spices, however, was reserved for the Crown.

9) They had the right to enslave Indians and to export up to twenty-four slaves per year to Portugal.

The trade between Brazil and the Portuguese kingdom as well as the fees and taxes were regulated by the King. Foreign ships had to pay 10% tax on any business transacted. The colonists were obligated to defend the captaincy in wartime.

The system of hereditary captaincy was extremely broad and therefore, theoretically, the policy seemed to be most appropriate, considering Portugal's economic situation. In practice, however, there were too many goals for one man to accomplish. The captains accumulated on their shoulders several obligations; they had to be, at the same time, administrators, military commanders, judges, landowners, and businessmen. On the one hand, there were many privileges, if the undertaking achieved the expected success. On the other hand, each captain had to invest his own capital in an unknown environment, in which several difficulties had to be faced.

Among the first fifteen captaincies into which Brazil was divided, three were amalgamated to form the present state of Bahia.¹⁷ The Captaincy of Bahia de Todos os Santos, was granted to Francisco Pereira Coutinho in April 5th, 1534; Ilheus was granted to

Jorge Figueiredo Correia in June 26th, 1534; and Porto Seguro was granted to Pero de Campos Tourinho, in May 27th, 1534. This amalgamation, however, took place in 1761 when the Crown decided to purchase the two last captaincies.¹⁸ Part of Pernambuco Captaincy was also incorporated but as a result of the expansion of the Bahian ranches. Their approximate original boundaries are represented in Figure 9 which shows that they had roughly the same size.

In assessing the economic nature of Portugal's colonial land policy, it has to be admitted that such a policy had a capitalistic (mercantile) rather than feudal orientation. Furthermore, the background of the captains as well as the captaincy size resulted in that, from both a social and economic viewpoint the captains or landlords possessed features similar to those postulated for "The Isolated State". That is, to initiate the colonial enterprise all landlords should possess the same factors of production (land, labour, and capital), so that the only variable differentiating one from another was their location relative to the metropolitan market. In this particular aspect, however, Bahia's Captaincy had one of the best locations on the Brazilian coastline, and this locational advantage, played a very important role in its further economic development.

The colonists were supposed to receive land grants from the captains as long as they had the economic conditions to bring their allotments into cultivation. Both captain and colonists represented, therefore, the potential landlords within each captaincy, the homology of "The Isolated State".

3.3.2 The Royal Captaincy of Bahia

The system of hereditary captaincies, although considered the most clearly defined policy which a colonising power ever attempted, did not however, in practice fully achieve its expected success. The high costs of the colonial enterprise, lack of a labour force adequate for large scale agricultural production, the isolation between the captaincies, Indian attacks, the hostility of the environment as well as the losses of ships in storms and the depredation of foreign pirates, all these factors together contributed to failures of the system. Among the fifteen captaincies, only four (Sao Vicente, Pernambuco, Ilheus and Porto Seguro) were successful.¹⁹

Bahia's Captaincy, in spite of the energetic efforts of its landlord, ended in complete failure. Its captain, Francisco Pereira Coutinho, was killed by the Indians in 1546, and the captaincy reverted to the Crown. The ownership rights of the Coutinho's heir were later transacted by a certain amount of the captaincy income so that Bahia became a royal captaincy.

By 1549 Dom Joao III, decided to take back some of the power he had given to the captains and a central governorship was established. This new policy had the following goals: to coordinate further colonization, to provide effective protection, to unify the execution of justice, to collect taxes properly and to forbid French contraband trade. By the 1530's sugar prices began to climb from the slump of the late fifteenth and early sixteenth centuries, either remaining relatively steady or rising slowly for most of the sixteenth century and early seventeenth centuries.²⁰ The King's new decision, helped by his very accurate geographical perception of location resulted in the choice of Bahia, his own

captaincy, to be the centre of the colony. The King's decision is expressed in Sanceau's translation as follows:

The most convenient site of the coast of Brazil, for this purpose, observed the King, seemed to be the Bay of All Saints, owing to its central position, fine climate and water supply.²¹

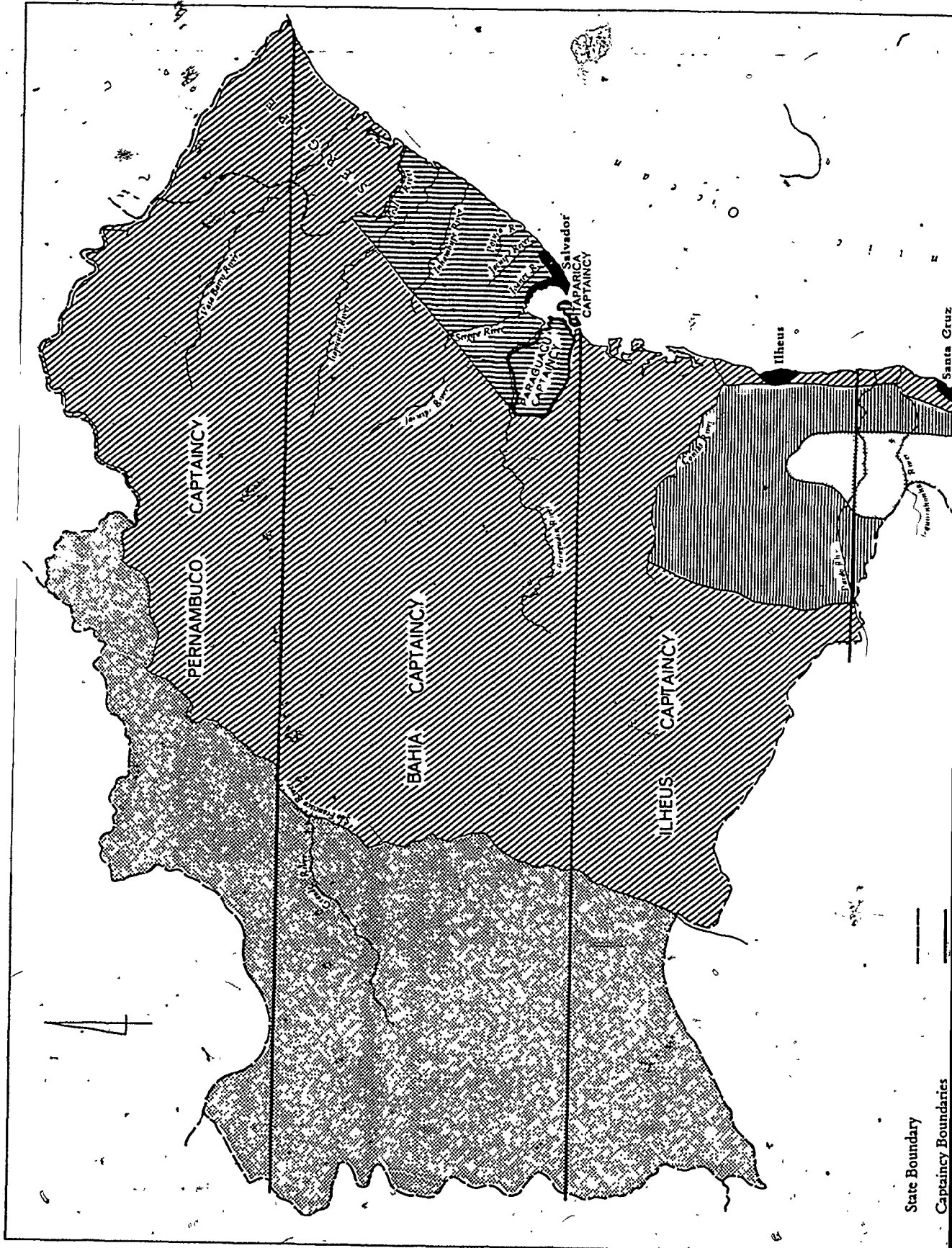
Tome de Souza, the first governor of Brazil, disembarked with his official staff in Bahia, in March 29th, 1549. To accelerate economic development, he granted land to the colonists, encouraged the construction of sugar mills, imported cattle from Cape Verde Islands, introduced other domestic species, and founded Salvador city to provide the site of the colony capital and entrepot.

3.3.3 Social Hierarchical System of Land Division and Ownership in Bahia, 1549-1970

To the knowledge of this author, only Freire's work²² presents a reasonable description of the evolution process of land division and ownership rights in Bahia. Based on his information this author summarizes (Figure 9) the land ownership patterns in Bahia from 1549 to 1900.

One of the first tasks of Tome de Souza was to start granting the land to his colonists. There were all together 1,000 people, but not all of them could have access to the land. The reason for such discrimination was basically economic. Actually, the colonial enterprise was a capitalistic undertaking and few settlers possessed the financial requirements to mobilize the factors of production to accomplish such a goal.

Between 1552, the official date of the first grants, and 1598, large areas of the Mata and Agrêste zones running from the Jaguaripe River (southern Reconcavo) to the Real River (northeast of Bahia) were already granted (Figure 9). Individual grants, called a sesmaria had a size ranging from 10,000 to 13,000 hectares.²³ In practice, however, this



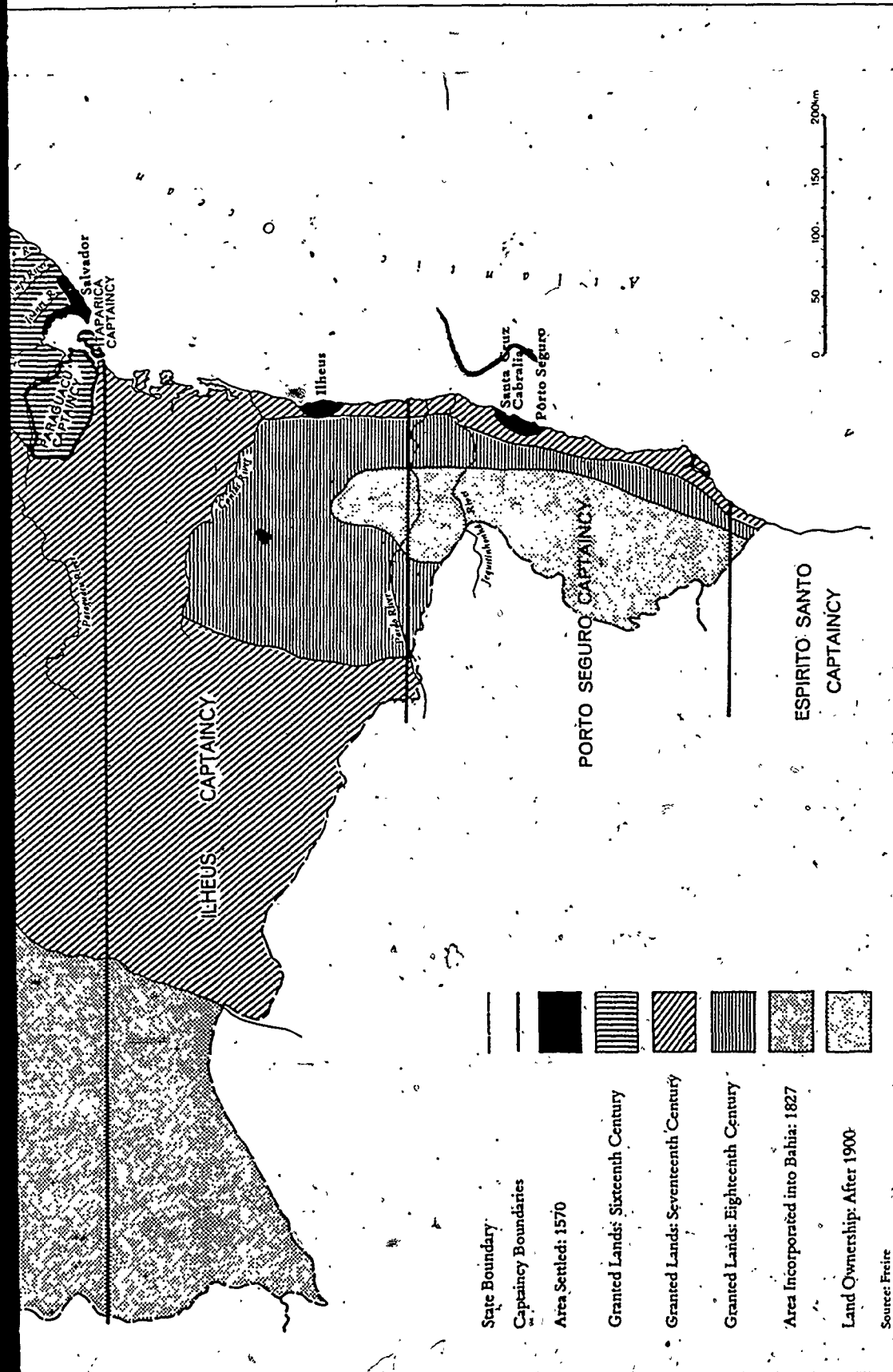


Figure 9 Bahia: Land Ownership Patterns (1549-1900)

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size could be exceeded, as for example in the case of Itaparica Island (granted to Antonio de Atayde in 1556) and Paraguacu (granted to Alvaro da Costa in 1558) which were both considered captaincies due to their huge areas. The large land grant process actually continued throughout the seventeenth, eighteenth and early nineteenth centuries up to 1820 when it was forbidden by the Portuguese Crown.²⁴ By the time the prohibition became effective, however, most of the land including the Sertão, was already granted (Figure 9).

It is common among historians and other writers to misinterpret the patterns of landownership and colonization. The initial dichotomy represented in Figure 9 was prolonged over more than two centuries. It can be noted that by 1570 only a very narrow area on the Bahia coastline contained settlement features whereas land ownership approximately covered 6,534,000 hectares. This huge area was owned by four landlords (Tome de Souza, Miguel de Moura, Luiz de Brito de Almeida, and Alvaro da Costa)²⁵ for whom conditions made it impossible to effectively colonize in so short a time.

The system of land division introduced in Bahia after 1549 has been subjected to contention among social scientists. For Simonsen the grant system had capitalistic features rather than feudal²⁶, whereas other authors hold to a feudal viewpoint. It seems that most of the objectives of the King's policy were capitalist. However, those related to the land division and ownership rights are typically feudal in their nature. This viewpoint is particularly supported by the hierarchical model of land ownership which emerged in the earliest days of colonization as a response to, not only social but also, economic constraints. By and large four major strata can be identified as follows: the King, the captains, the sesmeiros, and the peasants.

The King owned the colony. To him the captains and sesmeiros paid the dizimo. For him was also reserved one-fifth of all minerals found in the captaincies, the right to exploit the brazilwood, dyes, drugs, and spices as well as other types of taxation.

The captains, the second stratum, owned the land which was granted to the sesmeiros under the payment of redizimo besides other privileges previously mentioned (Section 3.3.1). The redizimo although abolished afterwards, seems to have prevailed in Bahia until the eighteenth century when the captaincies (Itaparica, Ilheus, Porto Seguro, and Paraguacu) were incorporated. Parts of these captaincies at the present time, belong to the State of Minas Gerais (Ilheus and Porto Seguro) and the State of Sergipe (the northeast of Bahia's Captaincy). Some of the captains never went to administer their estates. Instead they appointed managers or a procurator to grant, to sell and/or to lease the land and to receive the profits. These were indeed absentee landlords. Ilheus and Porto Seguro for instance were successively sold to different landlords until 1761 when their lower profits led the Crown to amalgamate them to Bahia. Itaparica seems to have had the same end whereas Paraguacu was split up and leased to the colonists.²⁷

The sesmeiros (owners of sesmarias), occupied the third stratum of the rural aristocracy, although they were also landlords. They were indeed the actual rural operators (plantation owners and/or ranchers) living in situ. They had to pay the dizimo to the Crown as well as the redizimo to the captains. In 1780 the ownership rights established since the beginning of colonization changed. The sesmeiros were forced by law to pay a new type of annual taxation called fôro per each league of their properties so that they had the right to use the land but lost

the ownership rights.²⁸ The fôro varied according to the location of the property. Those located in the Mata and Agreste zones paid the highest taxation. It seems that this law theoretically had the intention of forcing the utilization of land and/or reducing the size of sesmarias, a step undertaken by the Crown in 1729 when it forbade grants over 3 leagues in length by 1 league in width (13,100 hectares). In practice, however, it did not work out.

The fourth stratum constituted the peasants (cultivators), including tenants, sharecroppers, squatters (posseiros), and other groups. These colonists were not landlords due to their social and economic situation, but eventually they might become farmers according to the agricultural activity. For instance, in the Sertao where cattle raising was the dominant type of agricultural land use, the social mobility was easier than in the Mata zone where the sugar cane plantation prevailed (see Chapter Seven). The way of payment to the landlords varied also according to the peasant situation. The tenants and sharecroppers paid them in kind mainly in the Mata zone (sugar cane plantations, tobacco growers, etc.). In the Sertao and the Agreste the tenants paid the ranchers in money, likely 10,000 reis per year. The posseiros were the frontier settlers who occupied the underutilized land. They took the risks of becoming small farmers or of losing the land after some years of utilization or of selling it to move farther inland.

So far there is no study which attempts to investigate when or how the colonial system of land division started to break down. Likely by the early seventeenth century the process of fragmentation was already underway. Actually the processes of inheritance established through the system of hereditary captaincy, of purchase, of illegal occupance and others, may

have started it even earlier but no research has been undertaken into such an important study. Between 1858 and 1860 a holding census carried out for the Iguape Parish (Western Reconcavo) shows evidence that at that time a striking fragmentation of the earliest sesmarias (sugar cane plantations) was already in process. The summary of the census published by Mattoso²⁹ shows that 16,000 out of 20,000 hectares belonged to twelve landlords whereas 4,000 hectares were shared among thirty-three smallholders. Further it was found that 0.01% of the total Parish's farmland belonged to ten farmers who owned between 4 and 40 hectares.³⁰ It will be discussed in Chapter Eight that by the end of the nineteenth century there was a trend to consolidate the holding system in the Reconcavo under the structural changes experienced by the sugar cane plantations. However, the dual ownership pattern represented by the minifundia and latifundia was already established in the state and is still prevailing at the present time. The basic feature of such a land holding system is the extremely unequal land repartition involved (Table 1). For agriculture and for society as a whole, this system appears to be inefficient.

From 1940 to 1970 the operating units of more than 100 hectares comprised less than 11% of the total number of farms, but held over 65% of the total farmland. In the other extreme of the size class not only the number of units of less than 5 hectares has been increasing over the decennial periods but their areas have been holding less than 2% of the total farmland. The skewed distribution of the Bahian holding system has some direct effects on agriculture which deserve emphasis here. First, considering that the agricultural activities in the state still remain largely traditional, the small units have been overutilized whereas the largest units remain underutilized and usually through extensive cultivation. Second,

TABLE 1

BAHIA: OPERATING UNITS, 1940-1970

| FARM SIZE CLASS | NUMBER OF FARMS (%) | | | | AREA IN FARMLAND (%) | | | |
|-----------------|---------------------|-------|-------|-------|----------------------|-------|-------|-------|
| | 1940 | 1950 | 1960 | 1970 | 1940 | 1950 | 1960 | 1970 |
| < 4.99 ha | 24.8 | 27.3 | 34.0 | 40.1 | 1.2 | 1.2 | 1.8 | 2.2 |
| 5 - 9.99 ha | 17.1 | 16.1 | 15.3 | 14.8 | 2.0 | 1.9 | 2.4 | 2.5 |
| 10 - 99.99 ha | 48.2 | 46.2 | 42.2 | 37.4 | 25.7 | 24.5 | 29.4 | 29.1 |
| 100-999.99 ha | 9.3 | 9.7 | 8.0 | 7.3 | 39.1 | 38.8 | 42.0 | 43.0 |
| > 1000 ha | 0.6 | 0.7 | 0.5 | 0.4 | 32.0 | 33.6 | 24.4 | 23.2 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

SOURCE: Brasil, Fundacao IBGE, Censo Agropecuario, Bahia 1970, v. 3 (Rio de Janeiro: DECEN, 1975), pp. 2-3.

TABLE 2

BAHIA: OWNERSHIP UNITS, 1972

| TIPOLOGY | NUMBER OF UNITS | % | AREA (ha) | % |
|---------------------|-----------------|------|------------|-------|
| minifundios | 216,796 | 76.2 | 4,677,817 | 17.7 |
| empresas rurais | 5,792 | 2.0 | 1,506,257 | 5.7 |
| latifundios by use | 61,787 | 21.7 | 18,165,789 | 68.7 |
| latifundios by size | 22 | 0.0 | 2,073,452 | 7.9 |
| TOTAL | 284,397 | 99.9 | 26,423,315 | 100.0 |

SOURCE: INCRA, Estatisticas Cadastrais 1, 1972 (Brasilia, 1974), p. 431.

the smaller units are those producing food or less valuable cash crops to supply the domestic market, while the largest units are barely occupied by the plantations, ranches, and/or are not occupied at all. Third, the location of the smaller units are basically concentrated in the driest areas of Bahia whereas the largest units are located in the areas where the rainfall and soil conditions are the best. Finally, the largest number of small units are operated by tenants, sharecroppers, and small farmers whose lack of capital and other type of official assistance preclude a rise in their level of living. This situation in the social structure of the land in Bahia is just one sample of the total Brazilian rural population which led the federal government to devise the first steps toward land reform policies. These reforms were analysed by Ludwig and Taylor³¹ and more recently by Pluijm.³² In short, such policies resulted in two basic objectives. One was a classification of the Brazilian rural ownership units. The other was to regulate the charge of the land tax, which up to 1965 was not paid by the landlords. The first land inventory was conducted in late 1965 and early 1966 and from this survey the following rural property classifications resulted: (1) empresas rurais; (2) latifundios by use; (3) minifundios; and (4) latifundios by size. Minifundios are too small and latifundios by size too large to effectively contribute to the accomplishment of Brazilian economic and social goals, while empresas rurais and latifundios by use fall within an acceptable size range.³³

In 1972 a second cadastral survey was carried out by INCRA (National Institute of Colonization and Agrarian Reform). Table 2 shows that the same skewed pattern of operating units is identified in the pattern of ownership units, i.e. the minifundios dominate in number while the latifundios dominate in area.

This cursory description of the social structure of land in Bahia over time, indicates that to study the agricultural land use patterns the farm size has to be taken into consideration in order to evaluate the real situation of agriculture in the state at the present time. Furthermore, the crucial problem of food shortage is a result of the historical process of land division not yet overcome, and which hampers any attempt to modernize agriculture or to raise the standard of living of the rural population.

Presentation of the spatial and social background to agricultural land use indicates that, from an historical viewpoint, there is a strong resemblance between the assumptions held by von Thünen for "The Isolated State" and those faced by the early colonists in Bahia. Uniform physical and social conditions are met in the beginning of the colonization. The historical process of agricultural expansion, settlement, land fragmentation, and technological and economic changes, however, has caused a substantial transformation in the organization of agricultural space through time. Deviations between the strict model situation and Bahia's agricultural land use patterns are, therefore, expected as a result of the processes combining to move through the temporal framework, affect the geographical space.

REFERENCES AND FOOTNOTES, CHAPTER 3

1. Felisbello Freire, Historia Territorial do Brasil, vol. 1: Bahia, Sergipe, e Espirito Santo (Rio de Janeiro: Typ. Jornal do Commercio, 1906), pp. 321-322 (hereafter cited as F. Freire).
2. See Manuel Correia de Andrade, A Terra e o Homem no Nordeste, 3d. ed. rev. (Sao Paulo: Brasiliense, 1973), pp. 23-55 (hereafter cited as MCA, A Terra e o Homem) and Kempton E. Webb, The Changing Face of Northeast Brazil (New York, Columbia University Press, 1974), pp. 18-21 (hereafter cited as Webb).
3. Edmon Nimer, "Chima" in Geografia do Brasil: Regiao Nordeste, vol. 2 (Rio de Janeiro, SERGRAF-IBGE, 1977), pp. 60-68 (hereafter cited as Nimer).
4. Edgar Kuhlmann, "Vegetacao" in Geografia do Brasil: Regiao Nordeste, vol. 2 (Rio de Janeiro, SERGRAF-IBGE, 1977), pp. 85-89 (hereafter cited as Kuhlmann).
5. Ibid., pp. 89-90.
6. See, MCA A Terra e o Homem, pp. 33-40 and Webb, pp. 74-78.
7. Nimer; pp. 62-71.
8. Kuhlmann, pp. 90-92.
9. Ibid., pp. 92-99.
10. Ibid., pp. 99-102.
11. Roberto C. Simonsen, Historia Economica do Brasil (1500/1820), 7a. ed. (Sao Paulo: Ed. Nacional/MEC, 1977), pp. 79-80 (hereafter cited as Simonsen).
12. Ibid., p. 81.
14. Ibid., p. 80.
15. Ibid., pp. 83-85; Webb, pp. 93-94; A.H. de Oliveira Marques, Historia de Portugal, vol. 1: From Lusitania to Empire (New York: Columbia University Press, 1972), pp. 254-255 (hereafter cited as Marques); and Luis Henrique Dias Tavares, Historia da Bahia, 4a. ed. rev. (Salvador: Ed. Itapoa, 1969), p. 51 (hereafter cited as L.H.D. Tavares).

16. Portuguese law, according to which all the royal land grants, should be transmitted only through the legitimate male line and should not be considered feudal. Margues, pp. 87-88.
17. See F. Freire 1: 6-8 and H.D. Tavares, p. 55.
18. F. Freire 1: 170-173.
19. Simonsen, pp. 84-86.
20. Kit Sims Taylor, Sugar and the Underdevelopment of Northeastern Brazil, 1500-1970 (Gainesville: The University Presses of Florida, 1978), p. 16 (hereafter cited as K.S. Taylor).
21. Elaine Sanceau, Captains of Brazil (Porto: Civilizacao Brasileira, 1965), p. 203.
22. F. Freire 1: 15-214.
23. Mircea Buescu, Evolucao Economica do Brasil, 3a. ed. (Rio de Janeiro: APEC, 1977), p. 46 (hereafter cited as Buescu, E.E.B.).
24. F. Freire 1: 200.
25. Ibid., pp. 16-19.
26. Simonsen, pp. 80-83.
27. See F. Freire 1: 15-21.
28. Ibid., pp. 136-137.
29. Katia M. de Queiros Mattoso, Bahia: A Cidade do Salvador e seu Mercado no Seculo XIX (Sao Paulo: HUCITEC, 1978), pp. 41-42 (hereafter cited as Mattoso).
30. Ibid., p. 41.
31. Armin K. Ludwig and Harry W. Taylor, Brazil's New Agrarian Reform: An Evaluation of its Property Classification and Tax System (New York: Frederick A. Praeger, Inc., 1969), pp. 3-92 (hereafter cited as Ludwig & Taylor).
32. Theodore van der Pluijm, "A Policy Analysis of Brazil's Agriculture: Is the Long Term Strategy Jeopardized at Last?", Tijdschrift voor Econ. en Soc. Geografie 69 (1978): 258-269.
33. Ludwig & Taylor, p. 12.

CHAPTER 4

METHODOLOGICAL PROCEDURE

4.1 Introduction

The literature review of the von Thünen model (Chapter Two) revealed that, in spite of its theoretical simplicity, researchers have often faced difficulty in operationalizing variables with which to verify the model in the real world. The large number of investigations carried out do not use a common set of measures. This heterogeneity indicates that land rent, intensity, and transportation costs are complex variables to measure. In addition, data are either not readily available or they are discontinuously recorded, especially in developing countries. This difficulty increases when the use of a dynamic approach of the model is attempted. Alternative variables must be used, including measures of supply and demand, prices, cropped area, and transportation costs, over time, some of which are problematical to assemble, especially when study of a long time period is undertaken.

In facing the aforementioned difficulties, and considering the poverty of the literature and records on agriculture in Bahia, this author decided to try to overcome the data problem by using a combination of available qualitative and quantitative information. It is expected that these sources may provide enough support to study the extent to which

von Thünen's generalizations, stated in Chapter One, are verified in Bahia through time. These sources used will be presented here in detail, together with comment on them, limitations for this study, and the methodological procedures used to analyse the information.

4.2 Source of Information and Criticism

Unfortunately, the definitive economic history of Bahia has not yet been written, nor has detailed research on agriculture so far been carried out. These omissions created a serious problem for this author in the search for references and data, most of which were scattered and/or only reported at the national scale. In spite of these difficulties, the following sources were used.

4.2.1 Qualitative

These sources embody monographs, essays, text-books, papers and articles, theses and dissertations, reports, unpublished studies, chronicles, traveller diaries, and other types of bibliographical references, in Portuguese and other languages. Some of these sources are unknown in Brazil. Extensive use was made of the works of the earliest Portuguese chroniclers and other travellers which, in the view-point of this author, are the best sources for the study of the historical evolution.¹ Although descriptive in content, most of them are very rich in insight. Most contemporary literature deals with Brazil at the national level. However, a critical assessment of the overall bibliography shows that it still presents several gaps. There are few studies using a theoretical framework.² Quantification has been rare. Little research has been done in the archives, especially with regard to Bahia.³ Also early work has been accepted without question. Several concepts

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deserve a more thorough review in order to reinterpret some aspects of the economic history of Brazil. Among these concepts some are related to: the orientation of agriculture, the plantation system, colonization and landownership.⁴ Other aspects relate to the classification of types of agriculture.⁵ In spite of these general criticisms the number of good works has been increasing recently.⁶ It would be advisable that future research in Brazil reviews available literature very carefully. In this dissertation, some issues are posed in the hope that subsequent work may clarify particular arguments by adding additional evidence.

4.2.2 Quantitative

There are no time series data available from the sixteenth century up to the nineteenth century related to prices, gross production, exports and their values. According to Balbi⁷ the reason for such an omission lies in the fact that the Portuguese Crown forbade publications related to the colonial trade and profits. In spite of this poverty of data, text-books, articles, theses, dissertations, official publications,⁸ reports of institutions⁹ and the censuses published up to 1970 were extensively used.¹⁰ Many of the best sources are incomplete.¹¹ There are inconsistencies in the units of measurement used and in the quantities and values presented.¹² The physical production, cropped area, prices and other important information are not recorded in the earliest sources, whereas data on transportation costs are not available at all.

The censuses are the most reliable sources but there are difficulties in working with them. In some instances data related to natural pasture do not necessarily conform with the geographical reality. For example in Salvador county the recorded value for natural pasture in

1950, 1960, and 1970 is 70.9%, 45.6%, 22.1% of agricultural land respectively; and yet this area was originally covered by forest. This type of problem can be identified in many other areas. The variables reported may vary with the edition (e.g. value of production, use of fertilizer, types of crops, irrigated area). Occasional errors in the data were noted by this author (e.g. area in farmland greater than the county area). So far, Brazil has published five agricultural censuses (1920, 1940, 1950, 1960 and 1970) but the inconsistent information (variable choice of data and mode of presentation) limit their usefulness to the researcher. Small scale information is given at the município (county) level. The units vary widely in size. Also the units, through time, have been subdivided. To minimize the problem of working with so many different units over time, aggregation of the data was done.

4.2.3 Cartographic

This type of source is one of the poorest at the state level. Except for a few maps taken from secondary sources, most of the cartographic material presented in this dissertation was developed by this author on the basis of the qualitative and quantitative sources mentioned. The base map used was that published by the government in the Atlas of the State of Bahia (scale 1:2,500,000)¹³ and the município boundaries from 1872 to 1970 were worked out on the basis of the official publications.¹⁴

4.3 Limitations of Study

As has been pointed out in Chapter Three, the State of Bahia had a complex political evolution involving both annexation and partition of

territory. One limitation to this study is that investigation covers only that area defined by the present boundaries, so that the State of Sergipe and the north of Minas Gerais which were part of Bahia are excluded, whereas the west bank of the Sao Francisco River only part of Bahia since 1827 has been incorporated. This procedure results in the loss of some historical information but on the other hand it simplifies some complexity in the political and settlement processes.

Another limitation to this study is related to the exclusion of silviculture from this investigation. In "The Isolated State" it is considered an important type of land use, located closer to the market than other types of agricultural land-uses such as grains and stock farming. Such a location, explained in terms of transportation costs (firewood and timber are heavy related to their market/price) contrasts with the study area. Actually, there was in Bahia a huge area covered by forest, the Mata zone, described in Chapter Three, from where those products were extracted. Firewood and timber could be shipped to Salvador, at low transport cost, and therefore, their location did not present an economic problem. These products are eventually mentioned as inputs for the plantations, but are not classed as an agricultural land use.

The map series showing the agricultural patterns do not present correspondence because the historical maps use data, not from the census, but from qualitative sources. In addition, more sophisticated treatment of data and statistical testing of an hypothesis are carried out only for the last stage of agricultural evolution (1931-1970).

4.4 Comparative Statics

In the search for an appropriate strategy to overcome the problems inherent in the literature and records, comparative statics appeared to present the most convenient method to undertake this investigation. This procedure consists of dividing the time path into stages, each being treated as one of a succession of equilibrium solutions for different time periods.¹⁵ As one state of equilibrium is replaced by another, the changes brought into the spatial system are detected and then compared with the model. This procedure, therefore, deals with change and by assumption it defines the path of change. It also assumes that the shift to a new equilibrium follows a continuous path. This treatment of space and time is not considered truly dynamic because the input variables accounting for the changes cannot be measured continuously in their amount or rate of flow.¹⁶ On the other hand, it partially solves the methodological problem of handling both time and space dimensions over a long time period. In addition, it facilitates incorporation of the use of qualitative information.

In this dissertation the following criteria were used to define the succession of equilibrium solutions: (a) von Thünen's assumptions and his subsequent generalizations; (b) the major historical processes which have affected the overall spatial organization, and therefore, the agriculture in Bahia, and (c) the availability of historical evidence and quantitative records. These criteria led this author to identify four broad stages of agricultural evolution (quasi-equilibrium periods). In each one of these phases, the major historical processes are first described; secondly their effects on agricultural space are examined; and thirdly, the observed patterns in Bahia are compared with those expected

by the Thunian model. The deviations and generalizations are analysed accordingly. The stages identified are the following:

4.4.1 Origin (1500-1570)

In this stage of Bahia's agricultural evolution (Chapter Five) the Portuguese discoveries are briefly described as is the overseas trade which gave way to the development of the mercantilistic policies and consequently the colonization of Brazil. The origin and features of the plantation system introduced in Bahia are also discussed. Given Bahia's physically uniform conditions, large estates, economic similarity of the entrepreneurs, steady sugar prices, trade isolation from all other captaincies, and a single local market (Salvador), by 1570 the first types of agricultural land use emerging around Salvador do present a spatial organization very close to that predicted for "The Isolated State". That is, the intensity of agriculture is inversely proportional to distance from Salvador. This statement is supported by historical evidence. For example location of sugar mills and capital outlay to operate a sugar mill indicate the influence of distance. Finally this empirical data will be compared to a theoretical model of the basic types of agriculture in Bahia based on von Thünen's economic arguments. The date 1570 was selected for the end of this stage of Bahia's agricultural development because information indicated that the colonial policy undertaken in 1549 was already consolidated.

4.4.2 Gradual Expansion (1571-1822)

In this stage a thorough description of the plantation system and its expansion is given. Its positive effect on the emergence and

expansion of other types of agriculture, population growth and settlement in Bahia is considered (Chapters Six and Seven). The assumption of steady sugar prices is relaxed and the effect of fluctuation on agricultural land use is then examined. Historical evidence shows that during this long period the general trend of agriculture was expansion, although sugar prices remained low after 1650. Based on the literature available for the period, illustrative techniques including maps, diagrams, and graphics as well as simple descriptive tables showing rates, indices, averages etc. have been extensively used to provide evidence that the external competition of sugar production did not affect the evolution of the agricultural process in Bahia. On the contrary, it stimulated the diversification and the specialization of agriculture via the vertical integration of the plantation system, and the increase of demand (Bahian and metropolitan) for agricultural commodities. At the end of Chapter Seven, a theoretical comparison of the areal expansion of agriculture during the first two stages is analyzed and discussed in the light of generalizations made in the von Thünen model. That is, under certain conditions a fall in prices does not lead to a spatial contraction of agricultural land use regions but rather to an expansion. The relationship, however, between the intensity of agriculture and distance from the major local market (Salvador) remains consistent. This stage covers the overall colonial period, closing with Brazil's political independence. On the one hand, the length of time is imbalanced, when the other stages are taken into account. On the other hand, the scattered information over the period, as well as the author's interest in analyzing the overall agricultural land use patterns of Bahia, precluded a sub-division of the period.

4.4.3 Rapid Expansion (1823-1930)

In this stage the impact of the European technological improvement on the expansion of international trade is briefly described. The diffusion of innovations into Bahia, particularly those related to the structural transformation of sugar cane plantations, the development of processing plants and of the transportation network, are thoroughly described (Chapter Eight). The rapid spatial expansion of population and agriculture is analyzed in relation to von Thünen's assumptions of lower transportation costs and increase of overall demand. Diagrams and maps as well as descriptive tables showing rates, indices and ratios were used to document this expansion process. Two specific types of quantitative techniques, were used in Chapter Eight. They will be described below in order to justify their use and to guide further interpretation of the results.

4.4.3.1 Connectivity. This technique is based on topological concepts, so distance, direction, and other Euclidean notions are ignored. A basis for making comparison between and/or studying the expansion of a given spatial system may be provided by summarizing particular features of a transportation network. Basically, topology works with points (nodes or vertices) and lines (routes or edges) through which just the structure of the network or its geometrical pattern is taken into account. The calculation of some indices may then measure the degree to which the nodes of a network are directly connected to each other.

In Chapter Eight connectivity indices were used to analyze the expansion process of Bahia's railway network from 1853 to 1930 and to evaluate the increase in demand for transportation facilities to move

goods and people. The following indices were calculated:

(1) The beta index (β) which measures the simple linkage connectivity, defined as

$$\beta = \frac{e}{v}$$

Where e = the number of edges (routes or linkages)
and v = the number of vertices (nodes)

(2) The gamma index (γ) which measures the relative linkage connectivity expressed by the equation

$$\gamma = \frac{e}{3(v-2)}$$

Where e = the actual number of edges
and $3(v-2)$ = the maximum number of edges

(3) The alpha index (α) which measures the relative circuit connectivity expressed by the equation

$$\alpha = \frac{e-v+1}{2v-5}$$

Where $e-v+1$ = the actual circuits
and $2v-5$ = the maximum circuits

Gamma and alpha indices are useful and they may range between 0 and 1. The highest degree of connectivity is expressed by the highest indices which for convenience in the interpretation, are expressed as percentages.

4.4.3.2 Location Quotient (L.Q.). This technique is used in geography for comparing variables through their degree of concentration.¹⁸ In this dissertation it is used for mapping the agricultural patterns in 1920 as follows:

$$L.Q. = \frac{DCM}{DCS}$$

$$L.Q. = \frac{CAM/CAS}{FLM/FLS}$$

- Where DCM = density of cattle at municipio scale
- DCS = density of cattle at state scale
- CAM = cropped area at municipio scale
- CAS = cropped area at state scale
- FLM = farmland at municipio scale
- FLS = farmland at state scale

Where L.Q. is more than 1, the density of cattle or cropped area is above the state average; where less than 1, it is below. By the combination of the L.Q. four major patterns emerged:

- (1) High concentration of cattle, index > 1; cropped area < 1.
- (2) High concentration of cropped area > 1; density of cattle < 1.
- (3) Both indices > 1.
- (4) Both indices < 1.

The next step was to label the agricultural patterns according to the prevalent types.

In the last part of Chapter Eight again a theoretical comparison of the spatial expansion of agriculture during the three stages of evolution already mentioned is analyzed and discussed in terms of von Thünen's generalizations mentioned in Chapter One. That is, the effect of lowering transportation costs and increasing demand on the expansion of agriculture, of the emergence of smaller local market on the spatial organization of

agriculture, and the relationships between intensity of agriculture and distance from Salvador, are all considered. The variations observed through time are discussed accordingly. This stage of evolution takes into consideration the beginning of Brazil's political independence, and the mid-nineteenth century trend toward free-trade, culminating with the beginning of the Great Depression.

4.4.4 Spatial Adjustment (1931-1970)

This last stage of Bahia's agricultural evolution considered in this dissertation, deals with the substantial changes introduced into the state's agriculture (Chapter Nine). Firstly, the processes responsible for this drastic change are described. It began with the world economic and political crises which led the Brazilian government to undertake the sectorial policy of industrialization. As a result of the latter process the country's economic isolation started to breakdown. In the study the assumptions that were part of the von Thünen model, and that had held for the first stage of Bahia's agricultural evolution (Chapter Five) are relaxed and a more accurate study of the effect of external processes on the spatial organization of agricultural land use is carried out in Chapter Nine. In so doing, the availability of the four decennial censuses (1940, 1950, 1960, and 1970) so far published, allowed the division of this stage into four sub-periods of quasi-equilibrium (cross sections) in order to classify the agricultural land use as well as to analyze their distribution and variation through the period. To undertake this task the following procedures were followed:

4.4.4.1 Data Aggregation and Sampling. The partitioning of municipios has taken place in Bahia since 1872. In that year the demographic

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census recorded 118 political units but in 1920 they were 136 increasing to 336 in 1970. To work with statistical techniques and mapping from 1940 to 1970, this author decided to aggregate the municipios. To do so, a problem readily emerged related to the partition system, whereby two types of municipios resulted. One type is formed wholly by the partition of an old unit, and therefore, does not pose boundary problems. The second type is made of parts of two or more old municipios. This last type was the hardest to aggregate, because to use 1940 as the base year a large number of municipios had to be aggregated. On the one hand, this strategy presented the advantage of a uniform number of units. On the other hand, the sample size would be reduced from 150 municipios to 137.

Hence, two different sample sizes were used in Chapter Nine. One sample has 150 municipios to work with the 1940 and 1950 agricultural censuses. In this decade no partition was carried out. The other sample after the aggregation of the 1960 and 1970 censuses resulted in 183 municipios. The aggregation used in this study created some information loss. However, it seemed to be the most appropriate procedure in the search for a solution which minimized the loss of information and at the same time provided comparable units. For the purpose of this study the data units will be the municipios.

4.4.4.2 Selection of Data and Variables. The census series provided the basic information from which to study the spatial organization of agriculture and to map patterns. As has been pointed out, however, the most important information is not fully available, nor is it successively recorded under the same headings. These conditions severely limited the selection of data used either to map the patterns or to carry out the test

of the hypothesis previously mentioned in Chapter One. Such limitations led the author to select from the decennial census series (1940, 1950, 1960, and 1970) the following variables which represent at the same time the structure and the intensity of the agricultural land use patterns:

(1) PERENNIAL CROPS, total land under coffee, cocoa, bananas, oranges, coconut, rubber, oil palm, agave, etc., as a percentage of total agricultural land, in hectares (hereafter labeled PPC).

(2) TEMPORARY CROPS, total land under sugar-cane, tobacco, beans, rice, manioc, corn, cotton, castor beans, etc., as a percentage of total agricultural land, in hectares (hereafter labeled PTC).

(3) NATURAL PASTURE, total land under natural grazing as a percentage of total agricultural land, in hectares (hereafter labeled PNP).

(4) IMPROVED PASTURE, total land under permanent grassland as a percentage of total agricultural land, in hectares (hereafter labeled PIP).

(5) MIXED PASTURE, total natural and improved pasture as a percentage of total agricultural land, in hectares (hereafter PMP).

The proportion of area in each crop to agricultural land would have been more appropriate, but it has been discontinuously recorded. The fifth variable results from the criterion followed by the 1940 census in which both types of pasture were aggregated.

These variables were used to classify and to map the agricultural patterns through the four time cross sections, because they do implicitly reflect levels of intensity as well as spatial organization. In addition, these types of variables have been used as a surrogate of intensity to test von Thünen's model, as was previously pointed out in Chapter Two.

4.4.4.2.1 The Use of Factor Analysis to Select Variables --

To analyze the location of the agricultural land use classes for each time cross section a set of variables was selected. This selection was based on the availability of data, from the set suggested by von Thünen's model(s), and factor analysis was used to select these variables. This statistical technique has been used in geography for dealing with many variables. It works by selecting a certain number of factors through the correlation among a set of variables. In so doing, these factors indicate which variable and/or variables have the strongest relationships with each factor. At the same time it suggests which variables are uncorrelated, and therefore, independent of each other. This strategy minimizes the possibility of collinearity and/or multicollinearity between two or more variables, facts too common in the social sciences.¹⁹ In this dissertation, factor analysis was used to select the dependent and independent variables to use in the statistical test. The computer algorithm was provided by the Statistical Package for the Social Sciences, hereafter SPSS.²⁰ The following variables were thus selected:

(a) DEPENDENT VARIABLES. The same set previously selected to classify and to map the agricultural patterns (PPC, PTC, PNP, PIP, and PMP).

(b) INDEPENDENT VARIABLES. These variables comprise some of those suggested by von Thünen.

(1) DISTANCE. This variable was measured in straight line of each data unit from Salvador in kilometers (labeled hereafter DSL).²¹ Distance by road is not available for 1940, 1950 and 1960 neither is relative distance measured in transportation cost or time-travel.

(2) AVERAGE ANNUAL RAINFALL. The data are based on the averages of twenty-five years (1945-1970), provided by an official publication.²²

For some data units, records are not provided, however, this problem was overcome through the calculation of isohyet averages²³ (labeled hereafter AAR).

(3) AVERAGE FARM SIZE. The Brazilian census bureau defines an agricultural operating unit (called an establishment) as any type of farm, of any size which is operated individually. To calculate the mean of the establishments which are recorded in both ways, total number and per size classes, the latter was selected. The formula used was that from grouped data²⁴ (labeled hereafter FS).

All measurements were carried out in both the interval and the ratio scales.

4.4.4.2 Complementary Data -- Besides the aforementioned data, others were also used to support arguments and viewpoints held throughout this chapter. Physical quantum, value of exports, net domestic product, income regional, per capita income, prices of agricultural outputs, etc. have been extensively used.

4.4.4.3 Classification and Mapping of Agricultural Land Uses: Cluster Analysis. This technique has been successfully used in several fields for classifying events. In geography, among several applications it has revealed good results in dealing with the typology of agriculture.²⁵ In this dissertation cluster analysis was used for classifying the agricultural land use from the variables previously defined (PPC, PTC, PNP, PIP, and PMP). They were selected for clustering and the resultant groups (clusters) are mapped.

For clustering data units and variables the available methods²⁶ work with a measure of similarity which defines every pairwise combination

of the entities by their proximity usually expressed in distance. Individuals which are close together will be similar and will identify as a cluster.

Among the several algorithms for clustering, Ward's hierarchical method has proved to be one of the most powerful because many variables may be worked. His procedure proposes: (a) to reduce the number of groups from n to $n-1$ in a manner that the "losses" are minimized and then, without modifying the groups formed, to repeat the process until the number of groups is systematically reduced from n to 1, if desired; and (b) to evaluate "loss" in terms of whatever functional relation best expresses an investigator's criterion for grouping.²⁷ By reasoning on the "loss" of information that results from treating n scores as one group with a mean (\bar{x}), Ward developed a mathematical device to indicate the "loss" by a "value-reflecting" number, the error sum of square (ESS), which expresses the functional relation as follows:

$$ESS = \sum_{i=1}^n x_i^2 - \frac{1}{n} \left(\sum_{i=1}^n x_i \right)^2$$

Where x_i is the score of i th individual.

To this functional relation, Ward labeled an "objective function" which reflects the investigator's purpose. In this study, the operational use made is to cluster the data units by maximizing their similarities with respect to the agricultural land use.

Ward's algorithm was implemented by Wishart²⁸ through updating a stored matrix of squared Euclidean distance between cluster centroids. Wishart's work entitled CLUSTAN is a statistical package used in this dissertation.²⁹

The HIERARCHY procedure, uses 8 "combinatorial" transformations of the similarity matrix. It starts with "n" clusters each being a single individual. In each of n-1 fusion cycles the two clusters which are most similar are fused and the resulting union cluster is labeled with the lesser of the two codes of its constituent cluster. It also assumes that a similarity matrix has been computed with procedure CORREL, and produces the fusion hierarchy by means of a variable combinatorial transformation of the similarity coefficients.³⁰ This transformation is expressed as follows:

Let cluster P and Q be fused, then the similarity $S(R, P+Q)$ between any cluster R and the new cluster (P+Q) is obtained from the transformation

$$S(R, P+Q) = AP*S(R, P) + AQ*S(R, Q) + B*S(P, Q) + G[S(R, P) - S(R, Q)]$$

Where AP, AQ, B and G are assigned the following values in Ward's method (error sum of square):

$$AP = (NR+NP)/(NR+NP+NQ) \quad AQ = (NR+NQ)/(NR+NP+NQ) \quad B = -NR/(NR+NP+NQ) \quad G = 0$$

The use of this method gives to the investigator the choice of selecting from 1 to 8 clusters, a matter which depends on the research purpose. Nevertheless, the computer prints the coefficient values $S(P, Q)$ which are twice the increase in the error sum caused by fusion and the total error sum of square for any grouping is obtained on division by two of the cumulative sum of value which precedes that grouping in the print-out.³¹ Usually, a sharp jump between the coefficients of two clusters, represents a threshold which may be observed.

The search for details on the one hand and the observation of the previous rule on the other hand, led this author to take into consideration 7 clusters (1940, 1950, and 1970) and 6 clusters (1960). The major results

for each of these clusters will be further presented in tables (Chapter Nine). They are summary descriptive statistics much like the mean, variance, and standard deviation. When the objective of classification is for mapping patterns, the most important diagnostic statistics are given by the following values: the SMALL F - Ratios, indicate variables having comparatively low variation within the cluster and LARGE T - Values, indicate continuous variables having cluster means substantially different from the population sample means for those variables.

In this study the largest T - values were then taken into consideration for labeling the patterns. Moreover, there were cases in which two or more variables appeared in the same clusters with large T - values. In this situation all were considered, however, the word "prevalent" was used to qualify the dominant agricultural land use.

4.4.4.4 Modification of von Thunen's Model: The Use of Multiple Regression. It was emphasized in Chapter One that the location of the agricultural land use classes in a further stage of evolution, could not be explained by a simple deterministic causation. That is, the spatial variation of agricultural intensity should be influenced by other variables than distance from a market alone. Hence, to make the model more realistic one had to introduce modifications into the model according to the case study. To do so, the author selected multiple regression to measure the spatial variation of Bahia's agricultural intensity through the sub-periods under consideration.

Multiple regression is one of the most powerful statistical techniques. It can be used either as a descriptive or inferential technique. These uses have different purposes according to the research interest. Its

use as a descriptive technique provides possibilities for experimentation, explanation and/or prediction of events. Moreover, the omission in most statistical text books of when, how, and under what conditions it must be used, has compromised several works in geography.³²

In this study, multiple regression will be basically used as a descriptive technique. As such, the search for the best functional relationships between the dependent variables (PPC, PTC, PNP, PIP and PMP) and the independent variables (DSL, AAR, and FS) constitutes, therefore, its major use hereafter. Unfortunately, the scarcity of data and the multicollinearity among the variables precluded this author from a more ambitious analysis of the location of Bahia's agricultural land use classes.

The general regression model used to test the statistic hypothesis is expressed as follows:

$$y = a + b_1x_1 + b_2x_2 + b_3x_3$$

Where y = the dependent variables
 a = the constant (refer to the y-intercept)
 b_i = the coefficient of x_i
 x_i = an independent variable

To perform the calculations, the stepwise procedure was selected because there is no intrinsic order in the relationships among the variables. This procedure starts with a bivariate equation and proceeds by adding one variable at a time until the complete equation is finally calibrated. The order in which variables enter the regression sequence is not arbitrary but depends on their contribution to the explanation of the remaining variance in the dependent variable.³³ It presents the advantage of ordering the independent variables according to their

highest correlation with the dependent variable. This order may be influenced by multicollinearity. The algorithm to execute the computation was provided by SPSS.³⁴

REFERENCES AND FOOTNOTES, CHAPTER 4

1. See Pero de Magalhaes Gandavo, Tratado da Terra do Brasil (Rio de Janeiro: Anuario do Brasil, 1924), hereafter cited as Gandavo, T.T.B.; Fernao Cardim, Tratado da Terra e Gente do Brasil (Rio de Janeiro: J. Leite & Cia., 1925), hereafter cited as Cardim; Gabriel Soares de Souza, Tratado Descritivo do Brasil em 1587, 3a. ed. (Sao Paulo: Ed. Nacional, 1938), hereafter cited as G. Souza; Frei Vicente do Salvador, Historia do Brasil 1500-1627, 5a. ed. (Sao Paulo: Melhoramentos, 1965), hereafter cited as F. Salvador; Diogo de Campos Moreno, Livro que Da Razao do Estado do Brasil, 1612 (Recife: Arquivo Publico Estadual, 1955), hereafter cited as Moreno; Joao Antonio Andreoni [Andre Joao Antonil], Cultura e Opulência do Brasil (Texto da edicao de 1711), introducao e vocabulario por A.P. Canabrava, 2a. ed. (Sao Paulo: Ed. Nacional) hereafter cited as Andreoni; Luis dos Santos Vilhena, A Bahia no Seculo XVIII, notas e comentarios de Braz do Amaral, 3 vols. (Salvador: Itapoa, 1967), hereafter cited as Vilhena; Captain Richard F. Burton, The Highlands of the Brazil, vol. 2 (London: Tinsley Bros. 1869), hereafter cited as Burton; Henry Koster, Travels in Brazil, ed. with an introduction by C. Harvey Gardiner (Carbondale: Southern Illinois University Press, 1966), hereafter cited as Koster; Thomas Lindley, Narrativa de Uma Viagem ao Brasil, traducao de Thomaz Newlands Neto (Sao Paulo: Ed. Nacional, 1969), hereafter cited as Lindley; and J.B. Sipix and C.F.P. von Martius, Viagem pelo Brasil, traducao de Lucia Furquim Lahmeyer, revisao de B.F. Ramiz e anotacoes de Basilio de Magalhaes, 2 vols. (Rio de Janeiro: Imprensa Nacional, 1938), hereafter cited as Sipix & Matius.
2. See G. Frank; B. Becker; and MCA, Polos de Desenvolvimento; Katzman; Katzman, IASFS; Mesquita; DeWitt; and SCBM Silva.
3. Among the published sources, good information is found in F. Freire, also in Mattoso and in Thales de Azevedo, Povoamento da Cidade do Salvador (Salvador: Itapua, 1969), hereafter cited as T. Azevedo; Pedro Calmon, Historia da Casa da Torre, uma Dinastia de Pioneiros, 2a. ed. (Rio de Janeiro: Jose Olympio, 1958), hereafter cited as P. Calmon; Wanderley de Pinho, Historia de um Engenho do Reconcavo (1552-1944) (Rio de Janeiro: Ed. Zelio Valverde, 1946), hereafter cited as W. Pinho; and Rollie E. Poppino, Feira de Santana, traducao de Arquimedes Pereira Guimarães (Salvador: Itapua, 1968), hereafter cited as Poppino.

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4. The Brazilian colonial agriculture was classified into two groups: large scale agriculture, i.e. the agriculture oriented toward the external market (sugar cane, cotton, tobacco, etc.) and subsistence agriculture, i.e. the agriculture oriented to the domestic market. See Caio Prado Jr., *Formacao do Brasil Contemporaneo*, 6a. ed. (Sao Paulo: Ed. Brasiliense, 1961), pp. 136-163 (hereafter cited as Prado Jr.). The plantation system will be discussed in Chapter Five and Chapter Six. Landownership was interpreted as the expansion of colonization by F. Freire, 1: 15-58, 107-133.
 5. Discussion on this subject will be undertaken in Chapter Seven.
 6. See Mircea Buescu, *Historia Ecônômica do Brasil: Pesquisas e Analises* (Rio de Janeiro: APEC, 1970), hereafter cited as Buescu, H.E.B.; 300 Anos de Inflacao (Rio de Janeiro: APEC, 1973), hereafter cited as Buescu, 300 Anos de Inflacao; Jose Jobson de Andrade Arruda, "O Brasil no Comercio Colonial (1796-1808), Contribuição ao Estudo Quantitativo da Economia Colonial" (Tese de Doutorado, Universidade de São Paulo, 1972), hereafter cited as Arruda; M. Istvan Jancso, "As Exportacoes da Bahia Durante a Republica Velha (1889-1930)", in L'Histoire Quantitative du Bresil de 1800 a 1930, pp. 335-359 (Paris: Centre National de la Recherche Scientifique, 1973), hereafter cited as Jancso; Stuart B. Schwartz, "Free Labor in a Slave Economy: The Lavradores de Cana of Colonial Bahia", in Colonial Roots of Modern Brazil: Papers of the Newberry Library Conference, pp. 147-197, ed. by Dauril Alden (Berkeley: University of California Press, 1973), hereafter cited as Schwartz; Michael Joseph Rodell, "City Growth and Regional Development: Salvador and Bahia in Northeastern Brazil, 1940 to 1970" (Ph.D. dissertation, University of California, 1975), hereafter cited as Rodell; Virgilio Noya Pinto, "Balanco das Transformacoes Economicas no Seculo XIX", in Brasil em Perspectiva, pp. 126-145, organizacao e introducao de Carlos Guilherme Mota, 8a. ed. (Rio de Janeiro: DIFEL, 1977); hereafter cited as Noya Pinto; and Mattoso.
 7. Adrien Balbi, *Essai Statistique du Royaume du Portugal et Algarves, 1821* (n.p., n.d.), cited by Simonsen, p. 112.
 8. Bahia, Diretoria Geral de Estatistica do Estado, Anuario Estatistico da Bahia, 1923, 1924-1925, 1926-1927, 1929-1930, 1931-1932, 1933, 1934, 1935; Brasil, Instituto Nacional de Estatistica, Anuario Estatistico da Bahia, 1936; Brasil, Instituto Brasileiro de Geografia e Estatistica, Anuario Estatistico da Bahia, 1937; Brasil, Instituto Brasileiro de Geografia e Estatistica, Sinopse Estatistica da Bahia 1938-1940; Brasil, Banco do Nordeste S.A., Manual de Estatisticas Basicas do Nordeste (Fortaleza: ETENE, 1977); Bahia, Secretaria do Planejamento Ciência e Tecnologia/Fundacao GPE, A Insercao da Bahia na Evolucao Nacional 1a Etapa: 1850-1889, 5 vols. (Salvador, 1979); and 105 Anos de Economia Baiana, Estatisticas Basicas, 1872-1976, vol. 2, t. 2: Aspectos Econômicos, 1945-1976 (Salvador, 1979).

9. Associacao Comercial da Bahia, Relatorio da Junta Diretora, 1870; 1879; 1882; 1893; 1895; 1900; Relatorio da Diretoria, 1901; 1906; 1911; 1916; 1921; 1926; 1930; Relatorio da 98a. Diretoria, 1938; Relatorio da 99a. Diretoria, 1939; Relatorio da 101a. Diretoria, 1941; Miguel de Teive Argollo, Estrada de Ferro do S. Francisco, Relatorio de 1877 (Bahia: Oficinas dos Dois Mundos, 1898); Viacao Ferea Federal Leste Brasileiro, Relatorio do Exercicio de 1935 (Bahia: Cia. Ed. e Graphica da Bahia, 1936); Relatorio do Exercicio de 1936 (Bahia: Cia. Ed. e Graphica da Bahia, 1937); Relatorio do Exercicio de 1941 (Bahia: Tipografia da Leste, 1942); Relatorio do Exercicio de 1944 (Bahia: Tipografia da Leste, 1945); and Brasil, Banco do Nordeste S.A, Suprimento de Generos Alimenticios da Cidade do Salvador (Fortaleza: ETENE, 1965).
10. Brasil, Diretoria Geral de Estatistica do Ministerio da Agricultura, Industria e Comercio, Recenseamento Geral do Brasil, 1920, vol. 3, tomo 1, 2a. Parte (Rio de Janeiro: IBGE); Brasil, Instituto Brasileiro de Geografia e Estatistica, Censo Agricola: Estado da Bahia, 1940 (Rio de Janeiro: IBGE); Censo Agricola 1950, Bahia (Rio de Janeiro: IBGE); Censo Agricola de 1960, Bahia (Rio de Janeiro: IBGE); and Brasil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Censo Agropecuario: Bahia, 1970 (Rio de Janeiro: DECEN).
11. Bahia's yearbooks have been published discontinuously after 1922. Few editions of the Associacao Comercial da Bahia's reports record the value of exports.
12. Most reports of the Associacao Comercial da Bahia, record the physical quantum of exports in boxes (sugar), number (hide), sacks (coffee and cocoa), packages (tobacco) and other types of measurements precluding a uniform evaluation of weight. The values published by official sources (Bahia's yearbooks and/or Brasil's yearbooks) and the reports of the Associacao Comercial da Bahia for the same year often do not conform.
13. Bahia, Secretaria do Planejamento Ciencia e Tecnologia/CEPLAB, Atlas do Estado da Bahia (Salvador, 1976).
14. Bahia, Secretaria do Planejamento Ciencia e Tecnologia/CEPLAB, Evolucao Territorial e Administrativa dos Municipios Baianos (Salvador, 1976) and Brasil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Areas Minimas de Comparacao, 1960-1970 (Rio de Janeiro: DECEN, 1970), pp. 8-10.
15. See Dunn, pp. 71-82 and Harvey, Models of Evolution, pp. 563-564.
16. See Douglas Amadeo and Reginald G. Colledge, An Introduction to Scientific Reasoning in Geography (New York: John Wiley & Sons, Inc., 1975), pp. 82-83.

17. See Edward J. Taaffe and Howard L. Gauthier, Geography of Transportation (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1973), pp. 100-101; Peter J. Taylor, Quantitative Methods in Geography: An Introduction to Spatial Analysis (Boston: Houghton Mifflin Company, 1977), pp. 58-59 (hereafter cited as P. Taylor); and Robert Hammond and Patrick McCullagh, Quantitative Techniques in Geography: An Introduction (Oxford: Clarendon Press, 1974), pp. 50-51 (hereafter cited as Hammond & McCullagh).
18. See Hammond & McCullagh, pp. 57-58, 308 n.
19. See P. Taylor, pp. 232-254; R.J. Johnston, Multivariate Statistical Analysis in Geography: A Primer on the General Linear Model (London: Longman, 1978), pp. 127-201 (hereafter cited as Johnston); and D.P. Hauser, "Some Problems in the Use of Stepwise Regression Techniques in Geographical Research", Canadian Geographer 18 (1974): 151-154.
20. Norman Nie et al., Statistical Package for the Social Sciences, 2nd ed. (New York: McGraw-Hill Book Company, 1975), pp. 468-514 (hereafter Norman Nie et al.).
21. Bahia, Secretaria do Planejamento Ciencia e Tecnologia/DGE, Anuario Estatístico da Bahia, 1973, vol. 2, t. 1 (Salvador: 1975), pp. 16-22.
22. Bahia, Secretaria do Planejamento Ciencia e Tecnologia/CEPLAB, Atlas Climatológico do Estado da Bahia, doc. 2: Análise Espacial da Pluviosidade (Salvador: CEPLAB, 1976), pp. 77-151.
23. Bahia, Secretaria do Planejamento Ciencia e Tecnologia/CEPLAB, Atlas Climatológico do Estado da Bahia, doc. 4: Potencial Agroclimático do Estado da Bahia (Salvador: CEPLAB, 1977), cartograma 03.
24. See Hubert M. Blalock, Jr., Social Statistics, 2d ed. (New York: McGraw-Hill Book Company, 1972), pp. 61-66.
25. Michael J. Troughton, An Atlas of Canadian Agriculture: Portfolio of Maps Based on the 1971 Census of Agriculture (London: University of Western Ontario, n.d.), pp. 82-89.
26. See Michael R. Anderberg, Cluster Analysis for Applications (New York: Academic Press, 1973), pp. 131-181 and D. Wishart, Clustan User Manual: Cluster Analysis Package (Edinburgh: Edinburgh University, 1978), p. 12 (hereafter cited as Wishart).
27. Joe H. Ward, Jr., "Hierarchical Grouping to Optimize an Objective Function", Journal of the American Statistical Association 58 (1963): 236-237.
28. Wishart, pp. 5-20.

29. The computer program and the technical assistance was provided by Dr. Michael F. Goodchild.
30. Wishart, pp. 31-34.
31. Ibid., p. 34.
32. David M. Mark and Thomas K. Peucker, "Regression Analysis and Geographic Models", Canadian Geographer 22 (1978): 51-64.
33. See P. Taylor, pp. 215-219; Johnston, pp. 37-45; and Norman et al., pp. 320-345.
34. Norman et al., pp. 342-367.

CHAPTER 5

THE ORIGIN OF SPECIALIZED AGRICULTURE:

THE COLONIAL PLANTATIONS, 1500-1570

5.1 Introduction

"The Isolated State", as presented in Chapter Two, represents a model of agricultural development, constructed on the basis of the scientific, technological, economic, social, and political understanding prevalent in early nineteenth century Europe. Von Thünen devised, therefore, what should be an advanced stage of economic development, of that time period, under certain defined conditions. He did not take into consideration, however, how an "isolated state" might originate. In this chapter the processes accounting for the development of agriculture in Bahia will be presented to illustrate the origin of one such "isolated state". Included will be a brief description of the Portuguese discoveries and the initiation of overseas trade which led to the development of mercantilistic policies and, consequently, to the colonization of Brazil. Thereafter the origin and features of the plantation system introduced into Bahia are discussed.

The first types of agricultural land use that emerged around Salvador provide a rationale for a comparison between conditions in Bahia and the spatial organization predicted for "The Isolated State".

The comparison takes into account the relatively homogeneous situation based on the physical uniformity of conditions in Bahia's coastal area, the almost immediate establishment of large estates, steady sugar prices prevailing in the sixteenth century, and the isolation of the area within Brazil. The viewpoint advanced is that the profitable objective of the colonial enterprise and the transportation conditions of the sixteenth century provided the basis for the emergence of an agricultural landscape in Bahia very close to a Thünean landscape. From the earliest beginning there was a marked trend for the most intensive type of agriculture, the sugar cane plantations, to be located in the most advantageous site closest to Salvador, displacing the agricultural land use oriented to supply the internal market to a more peripheral situation.

5.2 The Age of Exploration

The sixteenth century is identified by historians as the time of radical change in Europe, growing out of some earlier trends, and resulting in major social and economic change after 1500.

The new factors were not all economic, though most of them had important economic implications and connections. They included the rise of nation states, the break-up of feudalism, the Renaissance, and the Reformation, each contributing substantially to the transformation of the medieval society and economy. New conditions contributed to an increase in the standard of living and population numbers grew. The introduction and diffusion of innovations brought into the continent from the old Eurasian civilization were added to indigenous technological improvements already underway. By the late fifteenth century the metal industry, the armament industry based on the production of gunpowder,

the printing press, all reached a marked state of development. The European economy was, therefore, experiencing a growth process. However, increased acceleration was further stimulated by the discoveries and exploration including the vast areas of the New World.

Clough and Cole¹ suggest that the reasons for the beginning of explorations in the fifteenth century were twofold. One was to find new trade routes to the East in order to bypass the Arabs and therefore to break the Italian (Venetian) monopoly of trade between the Orient and Europe. The other reason was that the growing power of the Arabian people was seen as a threat to Europe. Particularly important to the process of discoveries was the emergence of increasing national identities, the peripheral location of the oceanic states such as Spain and Portugal, and the improvement of techniques in navigation and shipbuilding. In this regard the modern world owes to Portugal the first planned and organized program of geographical discovery.

5.2.1 The Portuguese Discoveries and Trade Monopoly

Until 1095 the history of Portugal was linked to Spain. Thereafter the country successively became a county (1096) and kingdom (1140).² Under the rule of the House of Burgundy (1096-1383), named by some historians "the agrarian monarchy", the Moors were defeated (1139-1249), Portugal attained its European limits and started on the way to becoming an independent and wealthy nation. The peak of this early improvement was achieved, however, under Dom Diniz's rule (1279-1325). He encouraged the development of agriculture by founding agricultural schools, homes for orphans of farmers and established model farms. His main accomplishment, however, was his land policy. He ennobled the rural occupations as well

as distributing the uncultivated land to smallholders under the payment of a rent to the crown. Other land was also distributed to settlers on condition that it was brought into production within four years. Based on this agrarian reform, a true innovation in the Middle Ages, agricultural production increased. Marshes were drained and trees planted to furnish lumber for construction and shipbuilding. Grain as well as wine, olive oil and dried fruits were exported to other European countries.³ Some Portuguese authors, impressed by that period of prosperity have stated that Portugal's agriculture was better developed than in countries to the north. Unfortunately, it did not survive. In spite of the "Farmer King's" agricultural policy, the feudal system, under which the country districts were ruled, was left almost untouched.

The replacement of the House of Burgundy by the House of Aviz (1385-1578) resulted in drastic economic and political changes for Portugal. In the 1400's the Egyptian-Venetian monopoly of the Eastern spice trade through the Red Sea and Alexandria created an adverse trade balance that drained Europe of its currency. There was a shortage of gold in Portugal as elsewhere in Western Europe.⁴ In the meantime Prince Henry "the Navigator" (1394-1460) established a school of navigation at Sagres (southwest of Portugal) thus initiating an organized effort that had an important influence in preparing Portuguese sailors for the so-called "age of explorations".

The first result of Portuguese efforts was the discovery and colonization of the mid-Atlantic islands of Madeira and the Azores (1418 and 1431 respectively). Madeira soon became an exporter of sugar and wine whereas the Azores produced cattle and wheat. In the following years (1434 to 1488) the Portuguese discovered and dominated the west coast of

Africa. The most important achievements of the fifteenth century, however, were the parallel and competitive discoveries of the Western Hemisphere by Christopher Columbus in 1492, exploring on behalf of Spain and the route to India via the Cape of Good Hope with Indian Ocean by Vasco da Gama for Portugal in 1498.

Portugal was ruled by Manuel I (1495-1521) "the Fortunate" when preparations were made in Lisbon to exploit the contract with India. In 1500 Pedro Alvares Cabral, following Vasco da Gama's route in the South Atlantic, but moving further west, reached the Brazilian coast in the region of Porto Seguro (south of Bahia).

Portugal and Spain were in competition to find new lands; but in 1494 the Treaty of Tordesillas between the two nations was signed. This agreement, drafted by the Pope divided the global area of exploration by an imaginary line drawn from pole to pole through the Atlantic 370 leagues west of Cape Verde Islands, approximately the line of the forty-sixth meridian. East of the line Portugal gained exclusive rights and Spain received the same rights to the west. According to this treaty of the lands in the New World those of Brazil belonged to Portugal, while western South America was the Spanish domain.

As a result of its widespread maritime discoveries Portugal became an important trading power supplying Europe with large amounts of commodities brought from Africa, Asia, and Brazil. Table 3 shows an example of the annual profit derived by the Crown from overseas trade.

Spices and metals (gold, silver and copper) accounted for over 80% of the total trade. Such a commercial advantage led Portugal to struggle to achieve a spice monopoly. In India the local princes were subjugated, fortifications were built, and a huge amount of money was

TABLE 3

PORTUGAL'S REVENUE FROM OVERSEAS TRADE, 1515

| ITEMS | REVENUE IN CRUZADOS | % ^a |
|------------|---------------------|----------------|
| Spices | 1,000,000 | 55.10 |
| Metals | 475,000 | 26.17 |
| Sugar | 250,000 | 13.77 |
| Brazilwood | 50,000 | 2.75 |
| Slaves | 30,000 | 1.65 |
| Dyestuffs | 10,000 | .56 |
| TOTAL | 1,815,000 | 100.00 |

SOURCE: A.H. de Oliveira Marques, History of Portugal, vol. 1: From Lusitania to Empire (New York: Columbia University Press, 1972), p. 261.

^a Percentages calculated by this author.

spent to protect the fleets and to support the overseas administration. This policy had two immediate consequences. One, that the Portuguese commercial rules became the basic principles of mercantilism, the other, was a delay in the colonization of Brazil.

5.3 The Mercantilistic Policies

The impact of overseas explorations, especially those of Portugal and Spain was to initiate a further commercial revolution in Europe. The volume of European trade increased rapidly and new demands emerged. Commodities which had been consumed exclusively by the rich, began to reach the lower social classes. The flow of bullion from America to Europe was

of enormous volume. As bullion came to be exchanged for goods, it lost value in terms of actual merchandise and prices went up. New methods of payment were developed to cover the great bulk of imports. The manufacturing process also improved, thereby more merchandise was available to meet demand. The center of international commerce shifted from the Mediterranean to the Atlantic especially to Iberian and North Sea ports. Such drastic changes in Europe were embodied in a new economic model called mercantilism or commercial capitalism, the rationale of which can be inferred from the following statement by Thomas Mun:

Although a Kingdom may be enriched by gifts received, or by purchases taken from some other Nations; yet these things are uncertain and of small consideration when they happen. The ordinary means therefore to encrease [sic] our wealth and treasure is by Forraign [sic] Trade, where wee [sic] must ever observe this rule; to sell more to strangers yearly than wee [sic] consume of theirs in value.

It is clear that the new economic trend was based on international trade. A country had to maintain a favorable balance of trade to be powerful. It is outside of the scope of this dissertation to discuss mercantilistic principles thoroughly, however, some of them may be enumerated here to emphasize the type of European rules which were applied to the new lands overseas as well as providing motivation for their colonization.

As a set of policies, mercantilism had its roots in the Middle Ages, with the growth of nation states. However, it reached its peak as a recognized system in the seventeenth century, thereafter entering in a relative decline from the eighteenth to the nineteenth century.

The mercantilistic principles which were important to the development of colonization policy include the following:⁸

First, a belief that for a country to become rich and powerful, it had to acquire and retain as much gold and silver as possible. Bullion per se meant wealth, as epitomized by Spain which accumulated treasures brought from South and Central America. This became a model to be followed by other nations. The increase in the use of money in business, the fact that taxes were paid in money rather than goods, contributed to the belief that money was the chief source of political power, military strength, national prestige and internal prosperity. For nations which lacked mineral wealth at home and had found none abroad, as was the case of Portugal in Brazil, the situation was more complex. In such a case by developing trade in exports and reducing imports, money could come into the nation from commerce. From this policy, emerged the doctrine of balance of trade, which held that only by an excess of exports over imports could a nation obtain wealth and power.

Second, a closely related but more elaborate concept was that of balance of payment. It took into consideration not only the sale and purchase of goods but also the money spent for freight, insurance, church fees, and travelers' expenses. To secure a favorable balance of trade or of payment, mercantilists advocated import and export duties, the encouragement of industry, agriculture, mining, a large merchant marine and the acquisition of colonies. In general, tariffs within the colonial 'Empire' should be high on the import of manufactured goods and the export of raw materials, and low on the import of raw materials and the export of manufactured goods.

Third, colonization was a very important aspect of mercantilistic policy. To have colonies, meant prestige and wealth. They created an additional market for the domestic manufactures as well as providing raw

materials, not available in the metropolitan area. In addition, the colonial trade kept the merchant marine active while the colonial population represented an additional source of manpower. It was also forecast that the increase of production and the population demand would enlarge the extension of trade, and therefore, the overall economic growth of the nation.

Although mercantilistic concepts became general among the European nations seeking the same ends, political power and economic growth, the method, by which they achieved those goals, varied between countries, according to local conditions and tradition. From a combination of these principles, one may seek to understand the emergence of Bahia as an economic extension of Europe developed by Portugal.

5.4 Colonization of Brazil: Bahia as the Centre of the Colony

Brazil did not immediately impress the Portuguese king. It did not yield any gold or silver, or even spices, and it was these items that were the goal of the explorers. As has been pointed out, the agricultural policies carried out by the House of Burgundy had already been abandoned by the Aviz kings, whose interest had turned totally to trade.

Although the new colony did not provide precious minerals or spices, it did yield other items, including a variety of woods, such as brazilwood, already appreciated in Europe. Nevertheless, to carry out the exploitation required investment, in which the Crown was not interested. It was from Asia that Portugal obtained the most profitable commodities, so that Brazil lay outside the king's immediate concern. Portuguese neglect is characterized by Marques in the following statement:

The natives were very primitive, with a tribal organization, many of them cannibals. No possible alliances with local rulers could be envisioned; ... Furthermore, the Brazilian natives did not point the way toward Prester John or well-known or rumored gold mines. Little effective trade could be carried on with them.⁹

Actually, King Manuel I did not completely neglect Brazil. In order to retain the ownership of the colony he leased the trade monopoly of Brazil to a private company of wealthy ex-Jews, headed by Fernao de Loronha. The contract clauses bound Loronha and his partners to undertake the systematic and gradual exploration of the coast. By 1506-1507 a total of 20,000 quintais (1,179,640 metric tons) of brazilwood were imported from Brazil to Portugal and sold in Europe at a high profit. This first contract which seems to have ended by 1512, was followed by another, which probably ran from 1515 to 1516.¹⁰ By taking into account that brazilwood was not a Crown monopoly, the revenue of 50,000 cruzados or 2.8% of total Portuguese trade (see Table 3) represented a significant amount in 1515. As a matter of fact, in fifteen years the prospect offered by Brazilian trade had changed. The monopoly had enriched its owners, calling attention to the new colony. Both Portuguese and foreigners were now interested. Increasing numbers of French ships explored the Brazilian coastline in open challenge to Portuguese claims. To protect the colony, Dom Joao III, King Manuel's successor (1521-1555) ordered a coastguard detachment to police the coastline. But it was impossible to contain the French threat. To hold Brazil a more effective colonial policy had to be devised. However, the early 1500's saw the beginning of Portugal's relative decline as a major power. Stephens¹¹ suggests the causes:

First, this involved the banishment of the Jews from Portugal. This group possessed a high reputation all over Europe for wealth, integrity and commercial acuteness, and had business agencies and banks in every land. To please Spain's king, whom King Manuel I hoped to succeed, as well as to absorb the whole trade from East, the Jews were expelled from the country (1496-1497).

Second, Portugal's king spent much more of his wealth on art and architecture than in productive activities.

Third, the king's predecessor had changed the monarchy of Portugal to an absolute one, in which the king's will was everything. Yet, enormous salaries were paid to the nobles as a compensation for their overseas services.

Fourth, there was the introduction of the Inquisition (1536) and the Jesuits (1540) into the country by Dom Joao III. The former destroyed all that was left of the old Portuguese spirit. When the rest of Europe was advancing in civilization under Renaissance influences, Portugal regressed. The Jesuits speedily obtained control of the national education system and thereby checked intellectual development.

Fifth, was the rapid depopulation of Portugal. It is estimated that by 1500 the population of the country was no more than one million. It was depleted by crusades against the Moslems and by migration to the newly opened colonies in Africa and Asia. Earthquakes and the Black Death also disrupted Portugal's growth.

Lastly, mal-administration and weak policy led the country into bankruptcy. The agrarian policy, undertaken by the House of Burgundy was completely destroyed and the feudal system continued to prevail. In addition, internal migration started and the rural labour force ran away

to Lisbon, where the needs of the Eastern trade afforded work for all. Manufacturing, never important, was almost completely forgotten. Finally, Portugal's budgets were being exhausted to provide military protection for trade monopoly and colonies.

From the aforementioned points the reasons why Portugal could not effectively colonize Brazil are perfectly clear. Instead the system of hereditary captaincy was devised in 1534. This system has been already described in Chapter Three (Section 3.3) in which Figure 9 showed the component captaincies of the present State of Bahia. The hereditary captaincies, although considered a very well elaborated policy in practice, however, did not fully achieve the expected success. The captain of Bahia for instance, after facing several difficulties was killed by the Indians. Recognition, by the Crown, of Bahia's potential as sugar producer, prompted the king to take direct control of the captaincy in 1549. He founded the City of Salvador on its large sheltered embayment as the administrative center for all the captaincies and introduced sugar cane plantations.

5.5 Origin and Features of the Colonial Plantation

The considerable literature dealing with the conceptualization, features, and classification of plantation agriculture, indicates that the study of this agricultural system involves great complexity.¹² In part this complexity is due to the intrinsic nature of the original system, the sugar cane plantations, which combined different activities such as farming, processing, and distribution. On the other hand, the historical evolution and diffusion of the system over the world has led to the emergence of various types of plantation agriculture, creating serious

difficulties in defining the system and/or generalizing its features. In this dissertation, the term colonial plantation refers to the agro-industrial system for producing sugar, introduced by the Portuguese into Brazil during the sixteenth century, remaining virtually unchanged until the end of the nineteenth century. Although the early origin of sugar cane plantations must be sought in Asia, it was in Brazil where the system was codified and acquired some of its peculiar features. Brazil was also the centre of diffusion of the system to other Latin and Central America colonies and the Caribbean.

5.5.1 Assembling the Factors of Production

The emergence of the colonial plantation in Bahia resulted from a long historical process involving four continents. In Figure 10 this author has diagrammatically represented the basic aspects of this process which provided the basis of agricultural occupation in Bahia, beginning in 1549.

From the historical viewpoint, the diffusion of sugar cane and the sugar industry started with the Arab expansion into the western world through the islands and the littoral of the Mediterranean.¹³ In 1425 sugar cane was taken from Sicily to Madeira, but the establishment of the industry there may be regarded as having begun in 1432. Later the sugar industry was also introduced into the Canaries (1480) and Sao Thome (1483). According to Deerr¹⁴ sugar production failed in the eastern Mediterranean with the Mongol invasion, followed by that of the Turks; and disappeared from Europe, except in Spain, as uneconomic in competition with production on the African islands, and later with that of the New World. In 1500, Madeira was one of the most prosperous producers of sugar, with 120

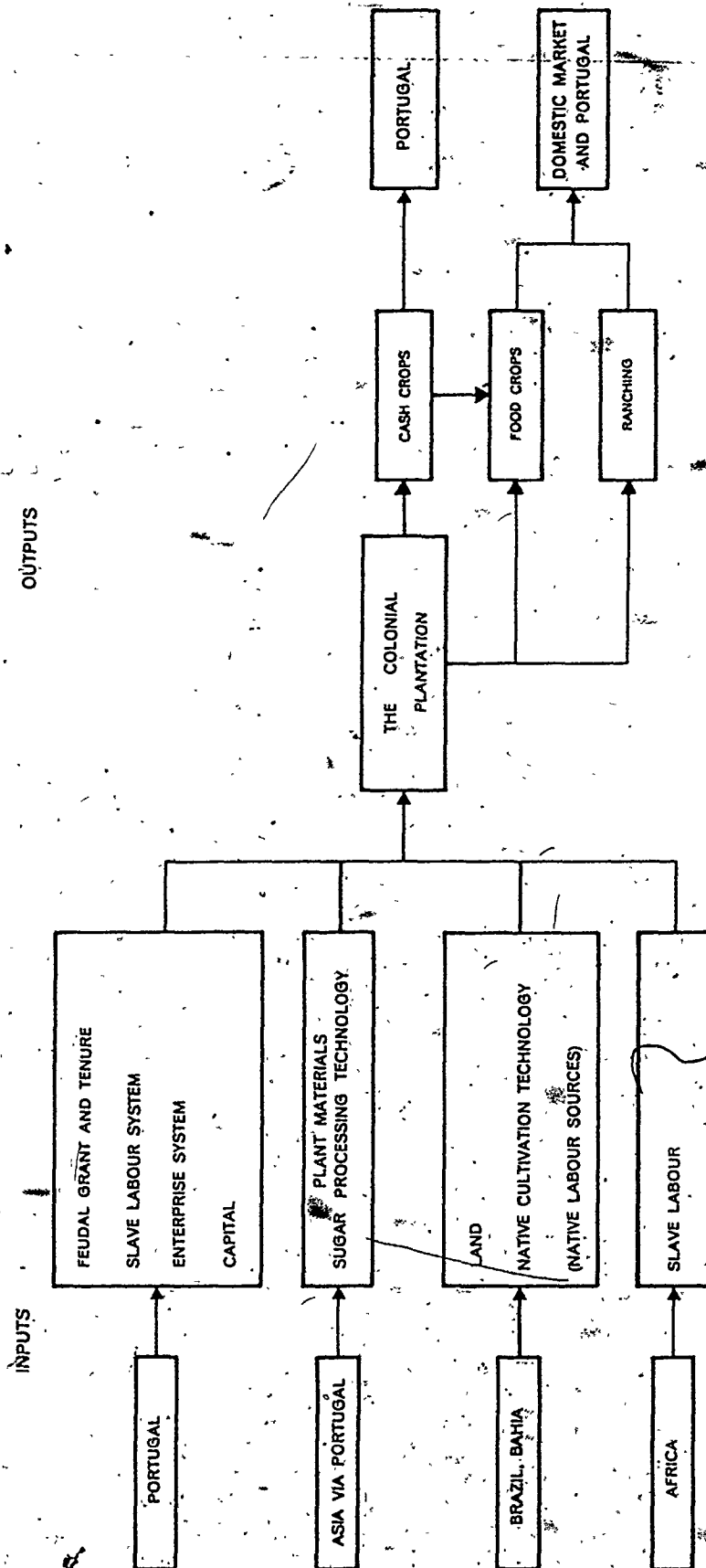


Figure 10 Origin of Specialized Agriculture in Bahia (1549).

factories.¹⁵ But, with the competition of Brazilian sugar (the price of which was half that of Madeira) after 1560 and disease affecting the canes, production fell to 271 tons in the 1580's and still less in the following decades.¹⁶ From the African islands the Portuguese took the sugar cane and the processing technology and introduced it into Bahia.

It was also on the African islands and in Asia where the Portuguese colonists and traders learned how to organize and operate the colonial plantation enterprise. As was previously pointed out, the Portuguese commercial rules became the basic principles of mercantilism. Several of the landlord candidates already had previous experience in overseas affairs (see Chapter Three).

The Bahian land as a natural resource presented all the basic requisites (climate, soil, abundant wood, natural ports and a good location) for the development of the agricultural enterprise. As a factor of production it was freely available and plentiful, facilitating the introduction of the Portuguese system of land grant and tenure already described in Chapter Three. The amount of available land in Bahia also facilitated continued use of native technology of slash-and-burn and land rotation, which reduced the costs of production. In Asia, Mediterranean regions and Africa sugar cane was usually produced using irrigation. Bahia's ecological and economic advantages are emphasized by Souza in the following statement:

... in the islands of Madeira, Cape Verde, Sao Thome, Trudente, Canaries, Valencia and in India, sugar cane does not grow unless it be irrigated and manured as the vegetable gardens, whereas in Bahia it grows on the highlands and on the lowlands without manuring and without irrigating ... In the island of Madeira and the other parts where the sugar is produced ... the sugar canes are short sized and the soil does not produce more than two harvests. And in Bahia there are many sugar cane fields yielding for thirty years; and usually the lowlands never lose their fertility and the highlands yield four and five harvests and over.¹⁷

The combination of native and foreign technologies in the production process of both the raw material and sugar, as well as its natural resources and location gave Bahia an economic advantage over the other production areas which resulted in the complete success of the agricultural enterprise.

There was a problem of availability of manpower but this was resolved through the use of slaves. According to the Stephens' statement:

It is strange that Prince Henry ... should have been the founder of the African slave trade, but so it was, and the reasons are not hard to find ... Prince Henry and Duke of Coimbra felt the need of procuring labour to cultivate the southern provinces, ... This idea greatly impressed the Portuguese nobles with Prince Henry's sagacity; they did not understand his scheme about discovering a direct route to India, but they highly appreciated the introduction of cheap forced labor.¹⁸

Stephens' evidence reinforces Deerr's viewpoint as to the difference between the sugar industry developed by the Arabs and that implemented by Christian Europeans. According to the latter author although Islam recognized slavery, the Mediterranean industry was free from "that ruthless and bloody reproach".¹⁹ Both statements, therefore, induce one to accept the Portuguese as the revivalists of the slave labour system. This system introduced into Bahia had as its immediate effect, the enslavement of the native population. This attempt, however, failed because the Indians were not prepared to engage in disciplined agricultural work. An illustration of this fact is reported by Gandavo:

... one of the reasons why Brazil does not prosper much more is that the slaves revolt and flee back to their own land and run away every day; and if these Indians were not so fickle and moveable, the wealth of Brazil would be incomparable; ...²⁰

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A solution was offered by extending the traffic of African slaves to Bahia which must have started after 1549. Once the movement was under way the influx of servile labour did not cease until the abolition of the slave trade in 1850. The African slaves proved to be superior to the Indians as labourers. They knew how to work metals, quickly learned how to use tools and above all, they were low cost manpower to the agricultural enterprise, without which the colonial undertaking would not have been economically feasible. Although the basic manpower consisted of slaves there was a smaller group of free workers represented by technicians, tenants, and others who were immigrants from both Portugal and other European countries. This labour force controlled by the Portuguese entrepreneurs was the basis on which the formation of the colonial society took place.

Finally, the amount of capital needed to invest in the sugar business transformed the colonial enterprise into a private undertaking, instead of a monopoly, as had been the slave and spice trade. Portugal's economic decline forced Dom Joao III to leave the financing affair in charge of captains and sesmeiros. In this regard some historians agree that the source of capital was basically Portuguese (bank, traders and landlords).²¹ However, the enterprise was costly as can be inferred from the figures presented in Table 4.

Although the figures do not provide enough support for a thorough analysis of the capital demanded and invested, it is clear that the amount of capital required per sugar mill was quite high. Actually, the sugar enterprise involved not only the mill expenses, but also expenses of the production of raw material, food, clothes, etc. In this regard, Furtado's viewpoint is that the Dutch capitalists did not restrict themselves to the

TABLE 4

INVESTMENT REQUIRED TO ESTABLISH A SUGAR MILL, 1635.

| INPUTS | CAPITAL | | |
|--------------------------|------------------|-------------------|----------------|
| | In reis 1,000 | In £ [*] | % [*] |
| Fixed equipment | 4,000 | 3,846 | 20.0 |
| Slaves (80) | 3,200 | 3,077 | 16.0 |
| Oxen (30-40) & materials | 8,000 | 7,692 | 40.0 |
| Floating capital | 4,000 | 3,846 | 20.0 |
| Others | 800 | 769 | 4.0 |
| TOTAL | 20,000 | 19,230 | 100.0 |

SOURCE: J. Lucio de Azevedo, Epocas de Portugal Económico (Lisbon: n.p., 1947) cited by Buescu, E.E.B., p. 44.

* The currency transformation and percentages were made by this author. From 1530 to 1649, 1£ = 1.04 mil reis. Buescu, E.E.B., p. 213.

financing of sugar refining and marketing, but that Flemish capital also shared in the financing of production facilities in Brazil as well as in the import of slave manpower.²² According to the same author, such Portuguese association with the Dutch started only in the second half of the sixteenth century. This assertion reinforces other viewpoints that the capital outlay to start the colonial enterprise was originally from Portugal.

5.5.2 Basic Features of the Colonial Plantation

The development of mercantilistic policies, the increase of European demand for tropical commodities, the high costs of the trans-oceanic freight, and the ecological conditions of the middle latitudes

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may be viewed as the major factors for the establishment of the plantation agriculture in Brazil. - Its features, described below reflect, therefore, the ways in which the colonists mobilized the factors of production under the prevalent conditions of the early sixteenth century.

First, to offset the investments, the colonists had to operate their farms oriented toward the European market. This necessity, added to the high cost of transoceanic freights, led them to select a valuable product, sugar, as well as to concentrate their efforts on agricultural specialization instead of diversification.

Second, large estates were required to provide some basic inputs (timber, firewood, draught animals, and food) as well as land on which to rotate sugar cane. Further, the land was free, but to bring it into cultivation required capital. This precondition could only be met by a few colonists, resulting in early economic and social stratification.

Third, a large, disciplined and unskilled labour force was needed. On the one hand, to pay a salary to a large number of workers implied increasing the costs of production. To solve the manpower problem, slavery was institutionalized. On the other hand, the maladjustment of the native population to forced work directed the Portuguese to go to African sources for manpower.

Fourth, the technical and managerial staff had to be supplied by the colonial country (Portugal).

Fifth, the high amount of investments required to operate a sugar cane plantation led some of the colonists to search for financial support in the mother land and/or foreign countries.

The high amount of capital invested in the plantation areas had as a result the accomplishment of mercantilistic goals. That is, it

reinforced the political and economic power of the European nations based on the principle of authority and dependence. The colonies were restricted to the development of primary activities and to be the market for the merchandise manufactured in the metropolitan area. Royal decrees forbade Brazil to produce spirit (1647), wine (1650), salt (1665) and to be involved in manufacturing (1785) except coarse cloth.²³ Furthermore, the commercial monopoly (Pacte Colonial) assured the metropolitan intermediation in all transactions of the colony. For instance, the Crown authorized the Companhia Geral do Comercio do Brasil (created in 1649) to levy duties on all Brazilian exports, ranging from 100 reis for a hide to 3,400 reis for a chest of white sugar.²⁴ It was given a wide range of fiscal immunities and customs exemptions in Portugal (on wine, flour, olive oil, and codfish), and it was provided by the Crown with land for its arsenal at Lisbon.²⁵

The aforementioned features have been recognized by various scholars, however, there is a disagreement as to the institutional nature of the colonial enterprise based on the plantation system. Some take the viewpoint that Brazil started its colonial existence under the slave productive system.²⁶ Another group defend the capitalistic orientation of the colonial system²⁷ whereas Freyre²⁸ interprets the hereditary captaincies and large scale agriculture as having a decidedly feudal character. Guimaraes²⁹ on the other hand, identifies the colonial production of sugar in Brazil as sui-generis in the history, because it combined elements of two systems of production. That is, the feudal system of property and the slave system of work. Actually, all viewpoints have partial validity depending on which aspect of the sugar economy is being discussed.

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Most scholars have concentrated their focus on separated sectors of production instead of looking at the sugar economy as a system integrating three basic stages. The first stage involves the production of raw material accounting for approximately 50% of the total costs of sugar production. However, to produce the raw material on a large scale needed a large amount of land and labour. To reduce this cost a combination of feudal and slave labour was, therefore, adopted. In addition, the land grant system per se was based on feudal features such as aristocratic landlords who had been granted hereditary titles, so that they controlled the means of production (sugar mills, water mills, pressers, etc.) and could rent them or grant them against the payment which could include either labour service or a share of production. The second stage of sugar production, is the processing of raw material which also involved a high investment in equipment, labour, and other inputs. In this stage, a significant amount was expended using wage labour (sugar master, overseers, artisans, manager, sale agent, etc.) but it also needed a large number of semi-skilled and unskilled workers, most of whom were slaves. Capitalistic and slavery systems of production were, therefore, combined to reduce the total costs. Also the trend to the division of labour, the search for maximum exports and profits, capitalization, response to price fluctuations, increase of economy of scale, and specialization are other capitalistic features found in the colonial plantation. Finally, the last stage, is the distribution of sugar which although carried out outside the plantations had an indirect effect on them. This stage was typically capitalist, involving interest rates paid by the mill owners to the middlemen, transportation costs, a wage labour force (the fleet workers) and the trade monopoly. By taking into consideration these stages of the sugar economy and the

historical transition underway in Europe during the sixteenth century, one may accept that the colonial plantations represented an elaborate synthesis of three systems of production (slave, feudal and capitalistic), transplanted and adapted to the internal conditions of the tropical regions. This author's viewpoint reinforces Cardoso's³⁰ who interpreted the systems of colonial production introduced into the New World as a mixture of proslavery, feudalism and capitalism. The latter author, however, does not analyse in particular any of the types of economy which emerged. Rather he presented methodological suggestions of inquiry in order to throw more light in the subject. Although the focus of this dissertation is a theoretical interpretation of Bahia's agricultural land use patterns through time and space, the aforementioned contention will be taken up again in Chapter Six when the colonial plantation will be analyzed in detail based upon historical evidence.

5.6 Spatial Organization of the Colonial Enterprise, 1570

By 1570 the economic consequences of the Crown's policy in establishing the central governorship in Bahia were already obvious. The geographical conditions of the Recôncavo (climate, soil, rivers, and forest), the transportation facilities offered by the Bay of All Saints (natural harbours reducing the costs of overland transportation) as well as the market opportunity for sugar, contributed to rapidly increasing prosperity for agriculture. Such advantageous conditions may be evaluated through the location of the earliest agricultural land uses: sugar cane plantations, ranching, cotton and food crops.

5.6.1 Location of the Earliest Plantations

The historical sources do not provide a thorough description of the first plantations. However, based on the scarce information available this author's attempt to reconstruct Bahia's agricultural landscape is represented in Figure 11. The linear distribution of mills in Recôncavo's seashore indicates that under similar ecological conditions, the location of the operating units was based on the minimization of costs of transportation related to distance from the entrepôt (Salvador). Such a locational advantage can be clearly inferred from Abreu's statement:

The mills were all located in the forest which is explained by the highest fertility of the soil and the abundance of firewood needed for the furnaces. And they should not be far away from the seashore because of the export price of sugar being just one, the mill owners, located farther, would not be able to compete with those closer to the market, whose products would not be burdened by the extra transportation cost.³¹

The minimization of costs by the mill owners reinforces previous discussion related to the capitalistic character of the processing stage of the sugar economy. Also the number of mills in operation, the economic condition of their owners and the size of mills are reasonable indicators of the capitalistic nature of the sugar industry.

According to Gandavo's report, in 1570 there were eighteen mills in the Bahia Captaincy, eight in the Ilheus Captaincy and five in the Porto Seguro Captaincy.³² The economic superiority of Bahia related to the southern captaincies, was, therefore, early established. However, the chronicler does not provide information about the precise location of the mills and their owners. Such investigation was carried out by Mariani³³ for those constructed in the Recôncavo (Table 5). Among the eighteen mills, three were owned by the Crown (the Royal mill), the Provedor-Mor

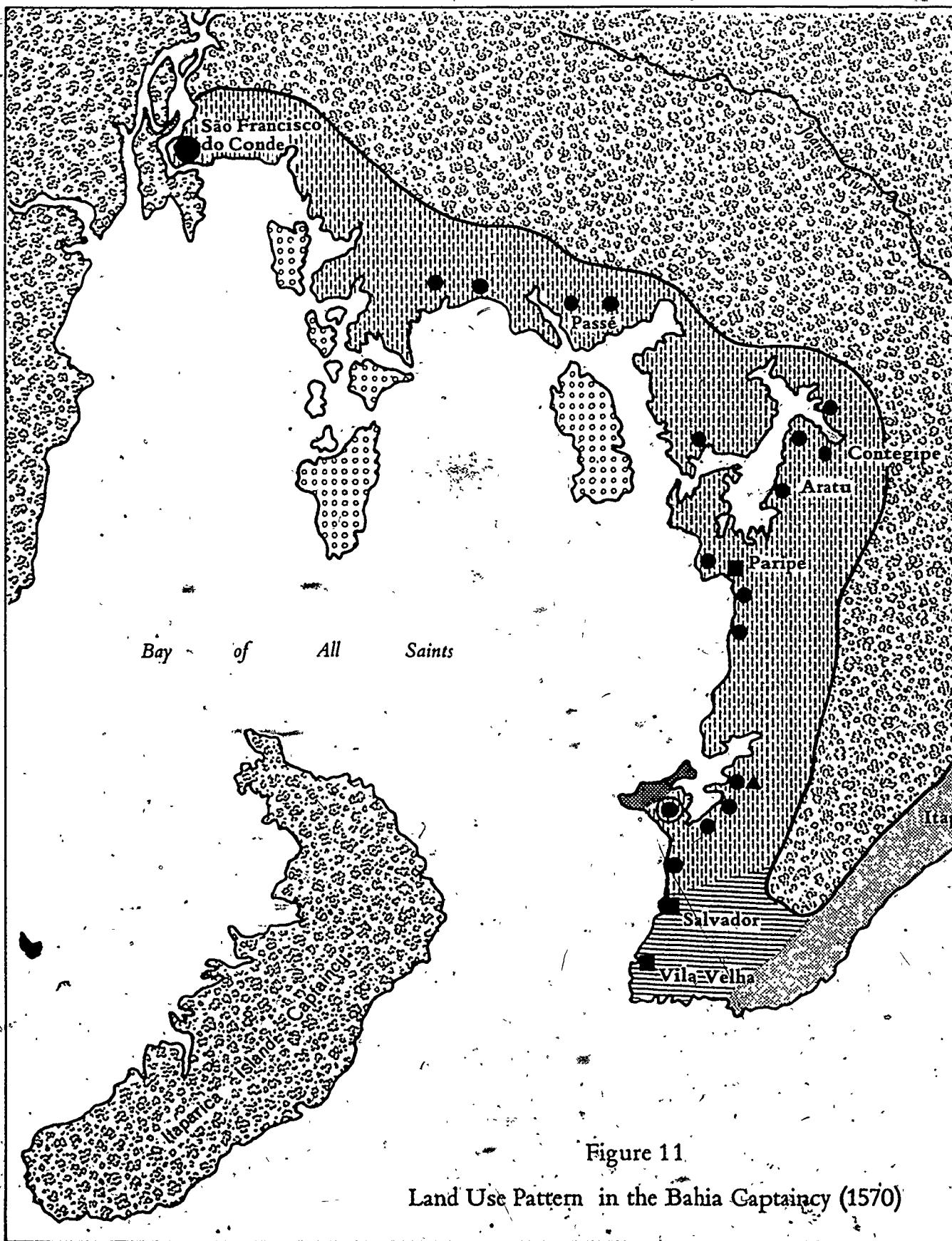


Figure 11

Land Use Pattern in the Bahia Captaincy (1570)

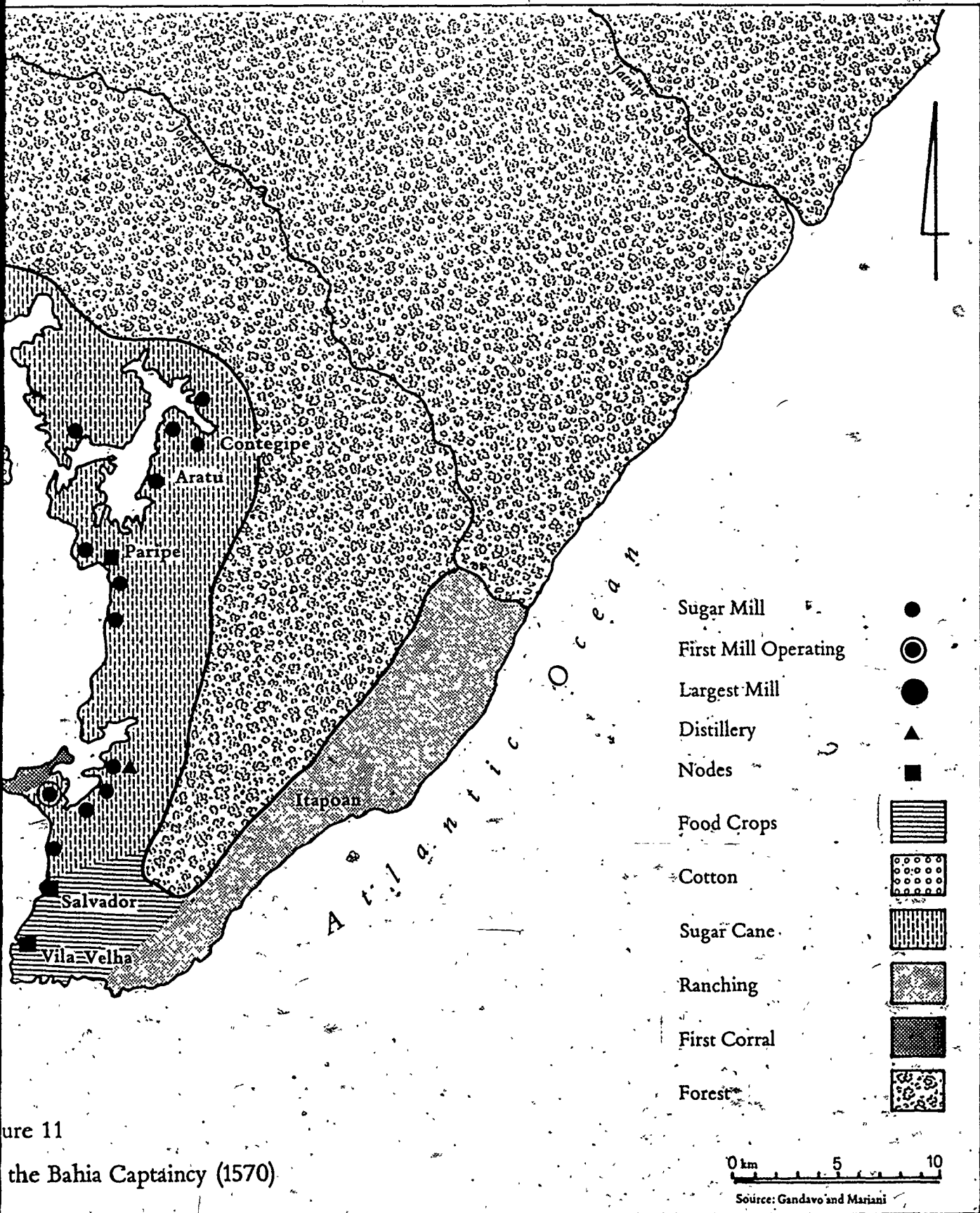


Figure 11
the Bahia Captaincy (1570)

0 km 5 10
Source: Gandavo and Mariani

TABLE 5

THE SUGAR MILLS OF RECONCAVO, 1570

| NO. | OWNER | LOCATION | COUNTY |
|-----|-----------------------------|------------------------|---------------------------|
| 1 | Cristovao Aguiar de Alitero | Agua de Meninos | Salvador |
| 2 | Antonio Cardoso de Barros | Uruguai | Salvador |
| 3 | Engenho Real | Piraja | Salvador |
| 4 | Diogo da Rocha de Sa | Piraja | Salvador |
| 5 | Simao da Gama de Andrade | Piraja | Salvador |
| 6 | Vasco Rodrigues Lobato | Paripe | Salvador |
| 7 | Baltazar Pereira | Paripe | Salvador |
| 8 | Afonso de Torres | Paripe | Salvador |
| 9 | Sebastião de Faria | Aratu | Salvador |
| 10 | Sebastião da Ponte | Cotejipe | Simoes Filho ^a |
| 11 | Jorge Antunes | Cotejipe | Simoes Filho |
| 12 | Gaspar Dias Barbosa | Cotejipe | Simoes Filho |
| 13 | Sebastião de Faria | Matuim | Candeiasb |
| 14 | Tristao Rodrigues | Passé | Candeias |
| 15 | Luiz Goncalves Varejao | Passé | Candeias |
| 16 | Belchior Dias Porcalho | Paramirim | Sao Francisco do Conde |
| 17 | Antônio da Costa | Paramirim | Sao Francisco do Conde |
| 18 | Mem de Sa | Sao Francisco do Conde | Sao Francisco do Conde |

SOURCE: Jose Bonifácio de Abreu Mariani, "O Povoamento de Salvador: Seculo XVI", Salvador, n.d., pp. 7-9. (Mimeographed).

^aSeparated from Salvador after 1970.

^bSeparated from Salvador after 1960.

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of Bahia Captaincy (Antônio Cardoso de Barros), and the third governor of Brazil (Mem de Sa). Also Sebastiao de Faria owned two mills. This fact indicates the high capitalization associated with ownership as well as an early trend toward the horizontal integration of the sugar industry.

With respect to the size of mills, the sources are not precise but it has been reported that the largest mill of Bahia was that belonging to Mem de Sa called Sergipe do Conde (Figure 11). The total production of the overall mills was estimated by Gandavo³⁴ in a yearly average of 796 tons (average of 44 metric tons per mill). Considering the sugar technology in the sixteenth century as well as the problem of manpower faced by the earliest colonists, the prosperity of the sugar business in Bahia may be considered outstanding. Unfortunately, there are no available records related to exports, prices or cost of production, however, there is no doubt that the colonial plantation represented the major economic activity of Bahia.

.5.6.2 Ranching

The first cattle were disembarked in Bahia in 1549. In the earliest days of colonization there was probably no spatial separation between cattle raising and the plantations. According to Calmon,³⁵ the famous cattle raiser, Garcia d'Avila established his first corral in Itapagipe (Figure 11). However, this location, close to the plantations, did not seem appropriate for further expansion. It is estimated that in 1552 he had already two hundred head.³⁶ Such a rapid increase led d'Avila to ask the governor for a sesmaria northeast of Salvador in Itapoa.³⁷ This grant, represented the first attempt to establish a ranch separated from the plantations.

The earliest sources are vague in their descriptions of the live-stock activity. Mariani informs that by 1555 there was a ranch farther from Itapoa whereas between that site and Vila Velha (Figure 11) there were several corrals in which five cowboys worked with slaves.³⁸ By 1570, cattle were raised in all captaincies, and according to Gandavo's statement:

The most of cattle on this coast are oxens and cows, of which there is great abundance in all captaincies, because there is much grass and the land is always covered with verdure; ...³⁹

Based on the above information the earliest ranches can be located in the narrow coastal plain in areas not suitable for growing sugar cane, either due to the soil conditions or lack of natural harbours. The expansion of ranching inland (the Sertao) started only in the seventeenth century.

5.6.3 Cotton and Food Crops

The historians have not paid much attention to the cotton crop in the earliest period of Bahia's colonization. Nevertheless, this crop played an important role in the economic life of the first settlers. It was used for manufacturing clothes as well as for trading. In the Gandavo descriptions the role of cotton, sugar, and brazilwood is mentioned as follows:

The farms from where they [the farmers] get the greatest profits are sugar, cotton, and brazilwood, which are used to pay the merchants who bring cloth from the reign, because there is little money in the country and so they sell and bargain one good for another at its just value.⁴⁰

Also Father Nobrega in a letter written to a Jesuit called for artisans to come to Bahia and weave cotton. "There is a great need of people here to weave cotton because there is much of it."⁴¹

Most of the cotton farms were located on the islands of the Bay on which the soil condition was suitable for growing that crop. As Gandavo pointed out: "There are many islands of luxuriant soil which produce an infinite quantity of cotton."⁴²

The conditions under which the farmers grew cotton are unknown. It seems that these farmers were tenants and/or colonists without sufficient capital to construct a sugar mill.

Food crops such as manioc, corn, sweet potato, pineapple, banana, and different types of vegetables were grown on all farms, particularly those closer to Salvador. However, among the food crops, manioc was the most important staple because from it could be made flour and other products. Also it was used for bartering as Gandavo referred: "All the inhabitants of this country grow food crops and sell much manioc flour one to the other, from which they make much profit."⁴³ This statement seems to provide support to accept the semi-commercial orientation of food production.

From the description of the agricultural land use that emerged around Salvador it can be inferred that from the beginning there was a strong trend to an areal specialization in which the best location was occupied by the sugar cane plantations.

5.6.4 Settlement Nodes and the Population Growth

The mercantilistic policy developed by the Portuguese did not have the settlement of their overseas territories as a basic goal. The foundation of the urban nodes, scattered along the coastline of Asia, Africa, and Brasil, were more a replica of the Phoenician and the Greek style of colonization with an economic objective, rather than effective intention

of organizing settlement. While the land grant system introduced in Brazil resulted in a political dominance of the territory, as was pointed out in Chapter Three, such a policy resulted in a striking lag between the landownership pattern and the settlement, which still persists at the present time.

By 1570 Bahia's settlement pattern had hardly changed from the earliest days of the colonization. In spite of an increasing number of sugar mills and a growing white population, the settlement remained concentrated along the coastline in three basic foci: the Recôncavo, Ilheus, and Porto Seguro. There were seven "urban" nodes, most of which were founded by the captains in the 1530's (Table 6). Twenty-one years after the establishment of the central governorship, only Salvador city appears as a new urban node. However, an estimate of the white population, indicates that the population of Bahia captaincy was the largest. This means that the 1,000 inhabitants disembarked in 1549 with the first governor, grew 450% in two decades or an average of 21% a year. This was a net increase incorporating both natural increase and immigration. Considering the demographic conditions of the sixteenth century, the growth of Bahia's white population was relatively high compared for instance with the southern captaincies (Ilheus and Porto Seguro).

The emergence and slow expansion of the nodes on the Bahia coastline resulted in an economic life completely oriented to the ocean. In the earliest days there was no overland route linking the settled areas, so that their relationships were possible only by maritime routes as Gandavo pointed out when referring to the Bay of All Saints: "The inhabitants of the region all use it to go by boat to their farms."⁴⁴ Salvador as the capital of the colony and the entrepôt, grew as the

TABLE 6

URBAN NODES AND WHITE POPULATION, 1570

| NODE | FOUNDATION | CAPTAINCY | HOUSEHOLD ^a | TOTAL POPULATION ^b |
|--------------|-------------|--------------|------------------------|-------------------------------|
| Vila Velha | 1534 - 1535 | Bahia | | |
| Paripe | data n.a. | Bahia | 1100 | 5500 |
| Salvador | 1549 | Bahia | | |
| Ilheus | 1536 | Ilheus | 200 | 1000 |
| Santa Cruz | 1536 | Porto Seguro | | |
| Porto Seguro | 1535 | Porto Seguro | 220 | 1100 |
| Santo Amaro | data n.a. | Porto Seguro | | |
| TOTAL | | | 1520 | 7600 |

SOURCE: Pero de Magalhaes Gandavo, Tratado da Terra do Brasil (Rio de Janeiro: Anuario do Brasil, 1924), pp. 29-34 and Aroldo de Azevêdo, "Vilas e Cidades do Brasil Colonial", Anais da Associacao d'os Geografos Brasileiros 9 (1957): 91-95.

^aThe Indian and African population is not included.

^bCalculation based on average of 5 people per household.

leading city of new agricultural civilization established in tropical America.

5.7 Theoretical Implications of Agricultural Location, 1570

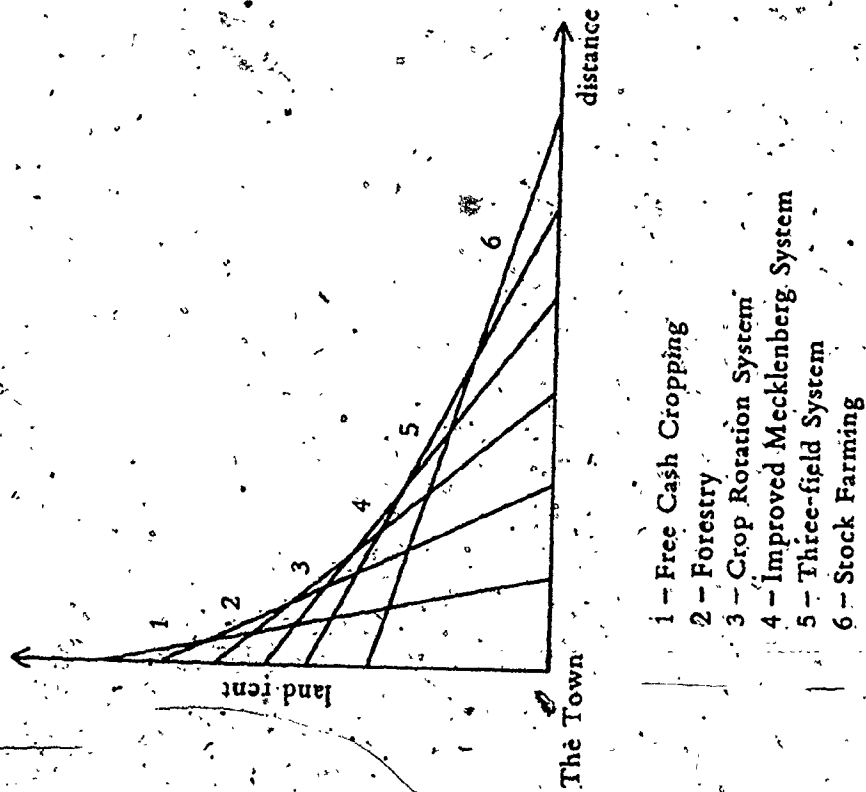
So far the processes relating to the origin of specialized agriculture in Bahia have been described, along with the spatial organization of the earliest agricultural land uses and of settlement. Evidence shows that the location of agriculture in the Recôncavo was not random, rather that it developed a linear pattern of distribution based on accessibility.

Yet, in spite of this linearity there was a marked differentiation in the location of the agricultural land use: food crops, sugar cane plantations, cotton, and cattle, were related to distance from Salvador. For the analysis of the types of land use may be summarized in two zones. One is the Cash Crop Zone closest to Salvador and the other, is the Ranching and Subsistence Agriculture Zone, farthest from it.

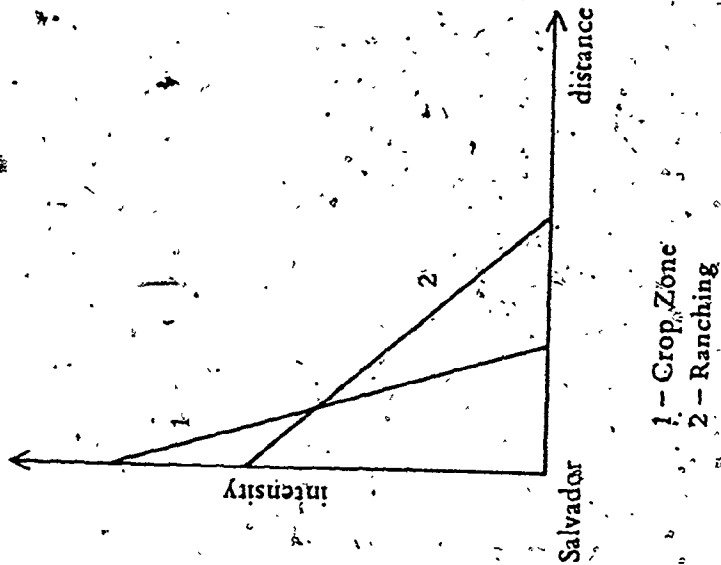
As was emphasized in the beginning of this chapter, the von Thünen model does not take into consideration the origin of "The Isolated State". He devised a relative advanced stage of agricultural development. The spatial organization of agriculture in Bahia cannot present in any period of time an homologous zoning to that imagined for "The Isolated State" due to the natural gap between a model and reality. However, the basic economic principle of the model remains valid to explain the agricultural location of land use in Bahia even in 1570. That is, in both situations agriculture was market oriented, and therefore, the costs of transportation were the strategic variable in determining the land rent and consequently the intensity of agriculture (amount of capital and labour). Figure 12 compares the predicted von Thünen model (Figure 12a) with the observed agricultural pattern in Bahia developed by this author (Figure 12b). To be consistent with further measurement, intensity of agriculture was selected as the surrogate of land rent (dependent variable often graphically represented). This comparison basically shows that the principle of distance decay governing the spatial organization of "The Isolated State" is similar to that verified in Bahia. This resemblance becomes more evident when the assumption of overland transportation is relaxed. Actually, according to von Thünen, the water freights are one-tenth the cost of land freights.

Figure 12 Von Thünen's Model and Bahia in 1570

a) Predicted Von Thünen Model



b) Observed agricultural zoning in Bahia, 1570



In "The Isolated State" the relaxation of that assumption led to a linear shape of the zoning, similar to that observed in Bahia (Figure 11). The difference, however, between the theory and the reality is that in "The Isolated State", stock farming remains farther from the river (Figure 3b) whereas in Bahia, the first ranches emerged on the coastline (northeast Salvador). However, this location in the early centuries of colonization did not present any advantage for growing cash crops and cattle were never sent to the market by the maritime routes (see Chapter Seven). The elimination of the forestry ring from "The Isolated State" and the reduction of farming systems to a general crop zone bring theory and reality closer.

Although von Thünen devised his model of agricultural location in the nineteenth century, the basic economic principle (land rent is a function of distance from a market) may be verified for the earliest days of colonization based on commercial capitalism. The reason for such verification in Bahia is the intensity of capital and labour applied in the colonial plantations whereas other farming systems employed fewer inputs graduated according to their location and market orientation. This fact per se justifies the location of mills closer to Salvador (the entrepôt) in a zone with good accessibility to the major port and at the same time where the friction of distance was minimised in terms of high transoceanic freights.

REFERENCES AND FOOTNOTES, CHAPTER 5

1. Shepard Bancroft Clough and Charles Woolsey Cole, Economic History of Europe, 3d. ed. (Boston: D.C. Heath and Company, 1952), p. 27 (hereafter cited as Clough & Cole).
2. See H. Morse Stephens, Portugal, 2d. ed. (London: T. Fisher-Unwin, 1899), pp. 18-59 (hereafter cited as Stephens) and Marques, pp. 35-45.
3. See Stephens, pp. 85-87; H.V. Livermore, A History of Portugal (Cambridge: University Press, 1947), pp. 153-154; and Charles E. Nowell, Portugal (Englewood Cliffs, N.J.: Prentice-Hall, Inc. 1973), pp. 18-20.
4. Marques, p. 139.
5. See Herbert Heaton, Economic History of Europe, rev. ed. (New York: Harper & Bros., 1948), pp. 234-239 (hereafter cited as Heaton); Shepard B. Clough, European Economic History: The Economic Development of Western Civilization, 2d. ed. (New York: McGraw-Hill Book Company, 1968), pp. 129-147 (hereafter cited as S. Clough); and Charles E. Nowell, The Great Discoveries and the First Colonial Empires (Ithaca: Cornell University Press, 1954), pp. 25-38 (hereafter cited as Nowell, The Great Discoveries).
6. Thomas Mun, England's Treasure by Forraign Trade (n.p. Blackwell, 1949), cited by Robert Lekachman, A History of Economic Ideas (New York: McGraw-Hill Book Company, 1959), p. 33.
7. Melvin M. Knight, Harry Elmer Barnes, and Felix Flügel, Economic History of Europe (Boston: Houghton Mifflin Company, 1928), pp. 314-317.
8. Clough & Cole, pp. 197-200.
9. Marques, pp. 251-252.
10. Ibid., p. 252.
11. Stephens, pp. 171-219.

12. See Derwent Whittlesey, "Major Agricultural Regions of the Earth", AAAG 26 (1936): 223-226 (hereafter Whittlesey); Leo Waibel, "A Forma Econômica da 'Plantage' Tropical", in Capitulos de Geografia Tropical e do Brasil (Rio de Janeiro: IBGE, 1958), pp. 31-50 (hereafter cited as Waibel, A Forma Econômica da 'Plantage'); Edgar T. Thompson, "The Plantation Cycle and Problems of Typology", in Caribbean Studies: A Symposium, ed. by Vera Rubin (Seattle: University of Washington Press, 1960), pp. 29-33 (hereafter cited as Thompson); Howard F. Gregor, "The Changing Plantation", AAAG 55 (1965): 221-238 (hereafter cited as Gregor); P.P. Courtenay, Plantation Agriculture (London: G. Bell & Sons, Ltd., 1965), pp. 7-25 (hereafter cited as Courtenay); Lloyd Best, "Outlines of a Model of Pure Plantation Economy", Social and Economic Studies 17 (1968): 283-326 (hereafter cited as Best); George L. Beckford, Persistent Poverty, Underdevelopment in Plantation Economies of the Third World (New York: Oxford University Press, 1972), pp. 3-52 (hereafter cited as Beckford); and Grigg, pp. 210-240.
13. See Noel Deerr, The History of Sugar, 2 vols. (London: Chapman & Hall Ltd., 1949-1950), 1: 73-99 (hereafter cited as Deerr) and Waibel, A Forma Econômica da 'Plantage', pp. 42-50.
14. Deerr, 1: 73.
15. Ibid., p. 101.
16. Marques, p. 369.
17. G. Souza, p. 177. Translated in part for this author by Roberto Aichinger. See also Marques' references about obstacles to the development of agriculture in the African islands, p. 153.
18. Stephens, pp. 148-149.
19. Deerr, 1: 74.
20. Gandavo, T.T.B., pp. 38-39. Translated in part for this author by Roberto Aichinger.
21. See Simonsen, pp. 87-91 and Buescu, E.E.B., p. 45.
22. Celso Furtado, Formacao Econômica do Brasil, 6a. ed. (Rio de Janeiro: Fundo de Cultura, 1964), p. 20 (hereafter cited as Furtado).
23. Buescu, E.E.B., pp. 63, 94.
24. C.R. Boxer, The Portuguese Seaborne Empire, 1915-1825 (New York: Alfred A. Knopf, 1969), p. 222 (hereafter cited as Boxer, The Portuguese Seaborne Empire).
25. Ibid., p. 222.
26. Furtado, pp. 62-69 and Nelson Werneck Sodre, Formacao Historica do Brasil, 2a. ed. (Sao Paulo: Ed. Brasiliense, 1963), pp. 77-82 (hereafter cited as Sodre).

27. See Simonsen, pp. 80-84 and G. Frank, pp. 221-246.
28. Gilberto Freyre, The Masters and the Slaves [Casa-Grande & Senzala], A Study in the Development of Brazilian Civilization, trans. by Samuel Putnam (New York: Alfred A. Knopf, 1946), p. 191 (hereafter cited as G. Freyre).
29. Alberto Passos Guimaraes, Quatro Seculos de Latifundio (Sao Paulo: Fulgor, 1964), p. 42 (hereafter cited as Passos Guimaraes).
30. Ciro F.S. Cardoso, "Sobre os Modos de Producao Coloniais da America" in America Colonial organizacao de Theo Santiago (Rio de Janeiro: 1975), pp. 63-70.
31. J. Capistrano de Abreu, Caminhos Antigos e Povoamento do Brasil (Rio de Janeiro: Sociedade Capistrano de Abreu, 1930), p. 76 (hereafter cited as Abreu, C.A.P.B.). Translated in part for this author by Roberto Aichinger.
32. Gandavo, T.T.B., pp. 29, 31, 34.
33. Jose Bonifacio de Abreu Mariani, "O Povoamento de Salvador: Seculo XVI", Salvador, n.d., pp. 7-9 (hereafter cited as Mariani). (Mimeographed).
34. Gandavo, T.T.B., pp. 27-34. The original source provides the amount in arrobas. 1 arroba = 14.74 kilograms.
35. P. Calmon, p. 20.
36. Ibid., p. 20.
37. Ibid., p. 21.
38. Mariani, p. 1.
39. Gandavo, T.T.B., p. 34. Translated in part for this author by Roberto Aichinger.
40. Ibid., pp. 38-39. Translated in part for this author by Roberto Aichinger.
41. Padre Manuel da Nobrega, Cartas do Brasil, 1549-1560 (Rio de Janeiro: n.p., 1931), p. 85. Translated in part for this author by Roberto Aichinger.
42. Gandavo, T.T.B., pp. 29-30.
43. Ibid., p. 39.
44. Ibid., p. 29.

CHAPTER 6

GRADUAL EXPANSION OF AGRICULTURE: OPERATION AND ECONOMICS OF THE COLONIAL PLANTATIONS, 1571-1822

6.1 Introduction

In the preceding chapter processes were described which gave rise to the origin of agriculture in Bahia. By 1570 the spatial effects of Portuguese colonial policy were already evident. A number of sugar mills, spread along the Recôncavo seashore, indicated the early prominence of the sugar industry as well as the expansion of the colonial plantation. Other types of agricultural land use also emerged and began to expand. The spatial pattern reflected Bahia's internal characteristics but control of the process remained outside the colony.

Europe, by the end of the sixteenth century was experiencing striking economic growth; a consequence of expanding overseas trade. The influx of precious metals brought into the continent contributed to a large increase in the total amount of money in circulation. Inflation moved prices upwards including that of sugar. In addition, the market expanded as a result of population growth and this, along with an increase of real income also led to greater consumption of sugar. These and other factors contributed to the success of the agricultural enterprise in Bahia. The monopoly of overseas trade held by the Portuguese excluded the

possibility of other competitors in the short run. The Spanish involvement in mining led them to leave sugar production to the Portuguese. The Portuguese in Brazil engaged in agriculture, not so much for their preference for it but, because Brazil at that time appeared poorly endowed in other desirable natural resources. Sugar marketing elsewhere in Europe without Dutch middlemen was also impossible due to their skill and control of sugar distribution. On account of the relationship between the Portuguese and Dutch, a large part of the financial support for the sugar industry was, therefore, assured. Finally Portuguese control of manpower sources, and of the slave trade, favoured large scale production as well as a steady and cheaper supply.

Brazilian historians have identified the period from 1550 to 1650 as the economic cycle of sugar. That is, the era marked by the economic dominance of sugar in the country's export list and when Brazil was the world's leading exporter of sugar. As a result of this position sugar plantations attracted capital and labour. After 1650, it is said, competition from the West Indies and the Brazilian gold rush disorganized the plantation economy; prices fell in the external market, the costs of production increased, and therefore, the volume of exports decreased. Short periods of economic recuperation may be identified, however, after 1650. On the other hand, the available records indicate that sugar remained as the major Brazilian export from approximately 1540 until 1830 when it was replaced by coffee.¹ In addition, the number of mills continued to increase, particularly in Bahia.

From the above it might be expected that, with sugar being the center of Bahia's colonial economy, economic disturbances which occurred after 1650 would have affected the spatial expansion of agriculture.

However, the historical evidence shows that both the plantations and agriculture in general, continued to expand gradually and to diversify. Lower prices for a major product and areal expansion may be viewed, however, as a deviation from von Thünen's dynamic model as it was explained in Chapter Two. Other things staying constant the persistence of lower prices would lead to the contraction of agricultural space rather than its expansion. This theoretical explanation of the laws of demand and supply does not necessarily hold true in reality when other conditions start to have an impact; for example a relaxation of the steady price for sugar allowing it to fluctuate in the European market. The viewpoint held here is that the colonial plantation system and the overall agricultural space continued to expand. The reason for this deviation between theory and reality may be sought in the reduction of the variable costs of sugar production. This reduction might be possible in Bahia where availability of land favoured the vertical integration among the plantations, cattle, and tobacco. That is the powerful mill owners were also ranchers and tobacco growers. This concentration of operating units under the same entrepreneur allowed for the provision of some basic inputs which absorbed a significant part of costs. Cattle for example provided food, and were used for transportation and as draft animals, whereas twisted tobacco was bartered for slaves. The feudal system adopted to supply part of the raw material reduced the cost of investment and at the same time shared the risks between the mill owner and the sugar cane growers. There were also two markets involved (European and Bahian) allowing for gradual expansion and diversification.

The relationship between the intensity of agriculture and distance from Salvador, remains, however, consistent. That is, the types of agriculture

employing more capital and labour tended to be located closer to the entrepôt, whereas those less intensive spread into the hinterland. The agricultural zoning around Salvador presented a spatial organization influenced by the amount of investments and market orientation.

In order to analyze the long stage of agricultural evolution from 1571 to 1822, in which the processes of settlement and agricultural development became more complex, the discussion will be undertaken in two chapters. In this chapter, first a detailed study of the colonial plantations will be carried out. Second, an overview of competition from West Indies and of the impact of the Brazilian gold rush on the sugar industry situation will be examined. Third, an attempt will be made to interpret the response of the colonial plantations to the new conditions of production. The final element will be a discussion of the deviation between Bahian reality and the Thünian prediction. The impact of the colonial plantation on Bahian space will be evaluated in Chapter Seven.

6.2 Operation of the Colonial Plantation

It was argued in Chapter Five (Section 5.5.2) that the colonial plantation emerged as a result of a combination of systems of production, transplanted and adapted to the internal conditions of specific tropical regions. The particular combinations represented economic strategies devised by the colonial entrepreneurs in order to lower the costs of production and maximize profits. To throw more light on this subject it is suggested in Chapter Five that the colonial plantations should be analyzed on the basis of each of the three components of its agroindustrial system, i.e. the production of the raw material (farming activity), processing of the raw material (industrial activity) and the distribution

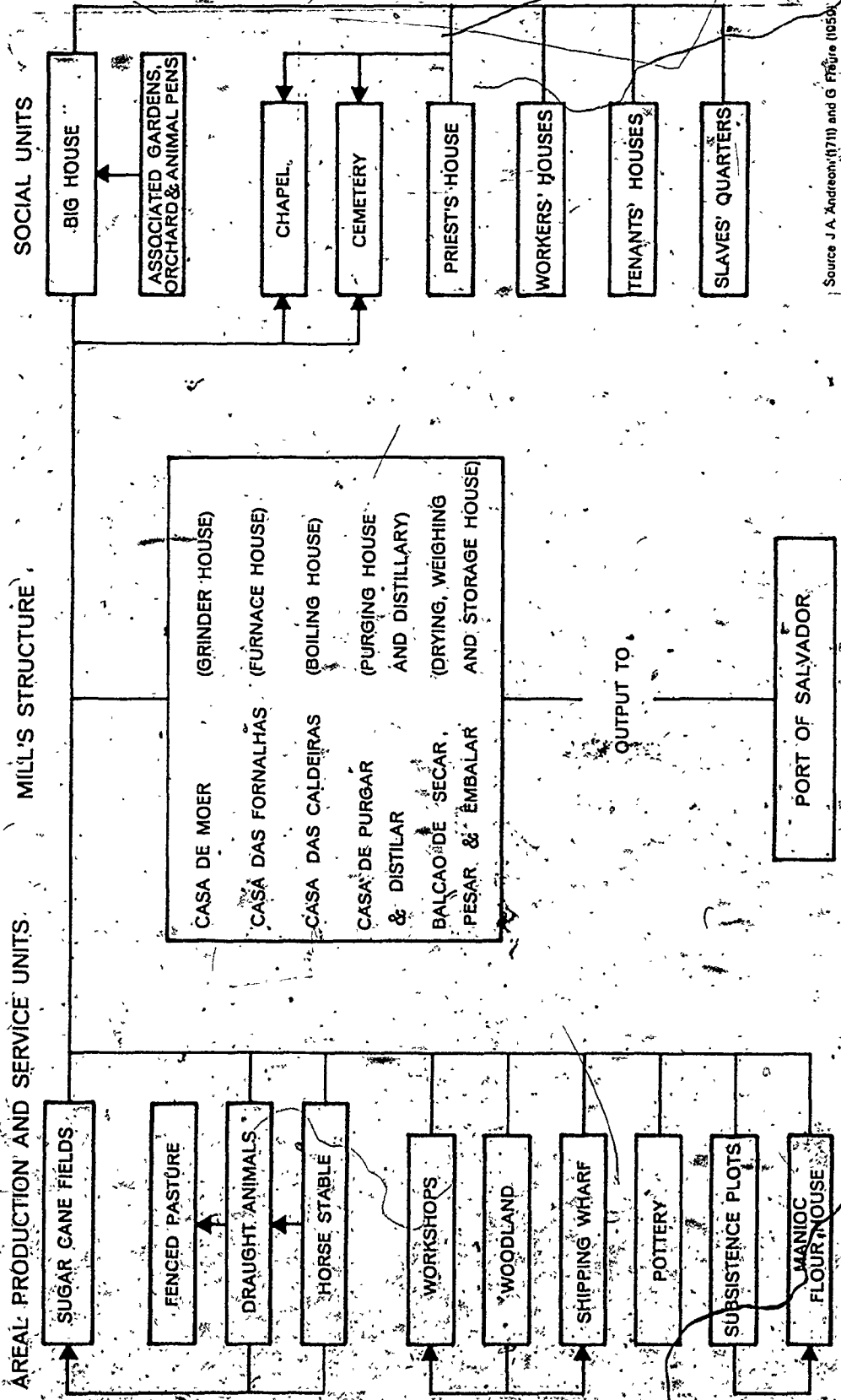
of sugar (commercial activity). Although all these stages are equally important in the analysis of the sugar economy the two first stages are more relevant to this study, due to their spatial implications. In this section, detailed investigation will be undertaken with respect to the operational units, the technological aspects of production, and the costs of production.

6.2.1 The Engenhos de Acucar

In the strict sense the engenhos de acucar (sugar mills) refer to the processing units. However, in Brazil the term was used as a synonym for the sugar plantation. That is, an operational unit integrating both activities of farming and processing in the same enterprise. The attempt to describe this type of operational unit is based on the thorough information provided by Andreoni's² survey, carried out in one of the largest sugar plantations of the Recôncavo, the Engenho Sergipe do Conde, in the early 1700's. This information has been summarized under the headings of spatial and functional structure, and social and economic relationships in the engenhos de acucar.

6.2.1.1 Spatial and Functional Structure. From a spatial and social viewpoint the engenhos de acucar may be considered a settlement node, whereas from an economic viewpoint they are complex units of production. Figure 13 diagrammatically represents a large engenho de acucar operating on the Recôncavo seashore in which the spatial, social, and economic aspects can be visualized.

From the spatial viewpoint, the engenhos de acucar presented an elaborate spatial organization in which the mill itself, with its several processing stages, occupied the center of the landscape, whereas the big



Source J. A. Andreoni (1711) and G. Pfreure (1050)

Figure 13 Bahia's Largest "Engenho" De-Açúcar: Spatial and Functional Structure

house represented the political and social power. To serve both, the mill and the big house, there were several dependent units, linked according to their functions. From the structure of land use, it can be inferred that most major facilities were found in this type of settlement and that the engenhos tended to be relatively self-sufficient. It produced the raw material, although it could also absorb extra cane supplied by other planters. It had its own supply of animals for different services and it had workshops for building and repairing equipment. Subsistence plots were worked by the slaves to supply their own foodstuffs. The engenhos located on the seashore also owned wharfs and a fleet of boats to transport sugar to Salvador, as well as to bring in firewood and other inputs to the mills. A trend to self-sufficiency, which reduced dependence on external services indicates that the engenhos de acucar had an organization very close to a feudal village (the manor). The features which differentiate these two settlement units are the mill's dependence on imports and their function. The engenhos had an industrial function, oriented to the exterior, therefore, a capitalistic goal whereas the manor had a subsistence function oriented to social and military purposes.

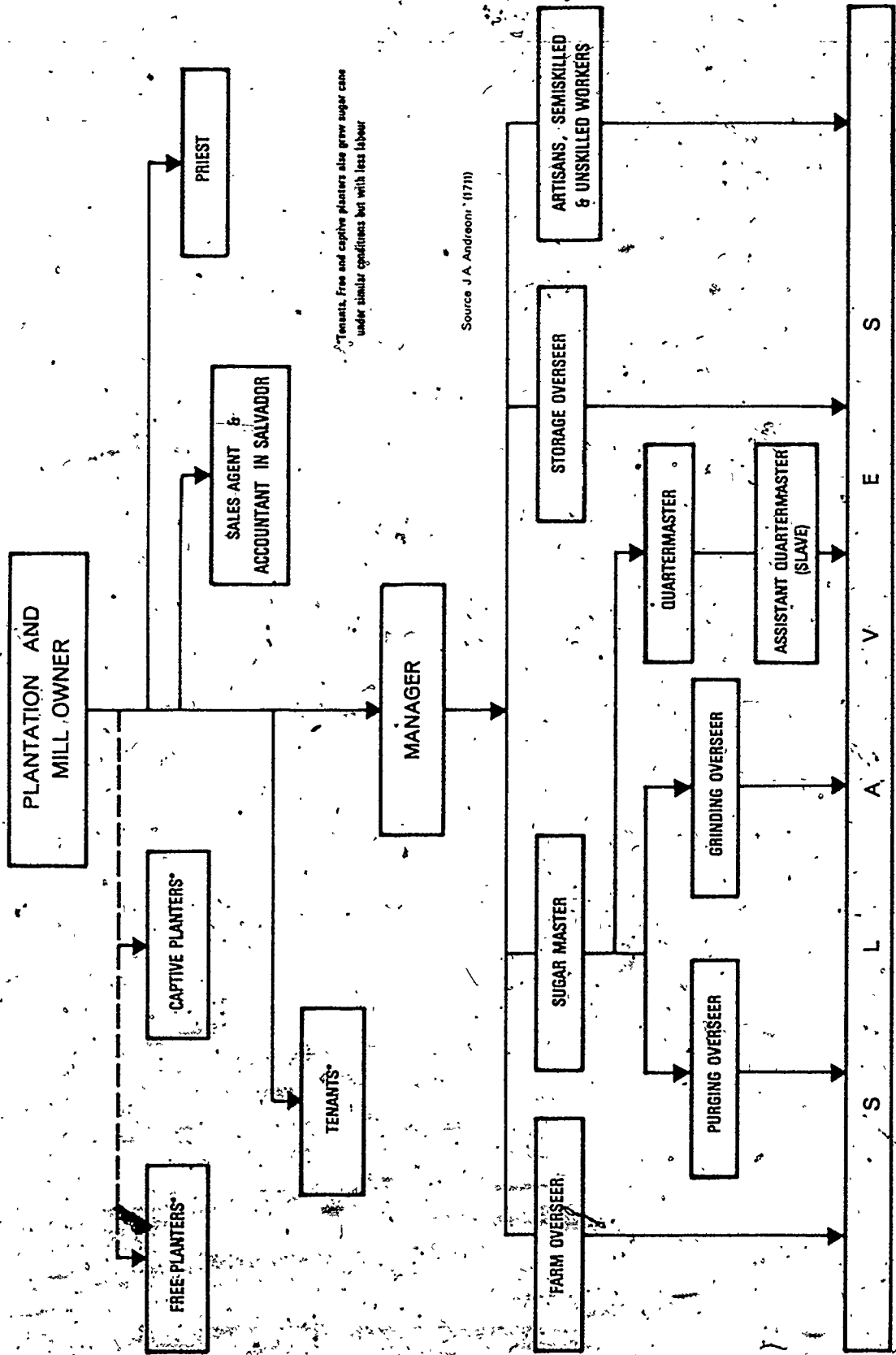
In social terms the engenhos de acucar developed a peculiar type of society in which the three systems of production appeared stratified. At the top, the landlord or mill owner represented the combination of social and political prestige as well as the apex of economic power. On the one hand, he acted as a true capitalistic entrepreneur seeking to reduce costs and maximize profits, on the other hand, he behaved as a feudal lord, head of a "clan" of relatives, farmers, artisans, workers, and slaves working for and dependent on him. The luxury of the big house, linked to Europe through imports of costly merchandise was the material expression

of the owners' social and economic situation. In the middle of the hierarchy were the free workers, also ruled by both capitalistic and feudal principles, and at the bottom of the hierarchy were the slaves, the base of the operation of the plantation system. The priest was employed by the mill owner to provide religious service for all workers.

Economically this type of settlement was marked by large capital investment in buildings and equipment, of which the mill itself was the most expensive. The several stages of processing indicate the industrial complexity of even the earliest mills, as well as the degree of specialization required from the labour force. These features and its external dependence, illustrated by the link to the port of Salvador, typify the capitalistic character of the enterprise.

6.2.1.2 Social and Economic Relationships. Class stratification emerged in the engenhos de acucar as a result of the complex activities and the combination of the systems of production. This stratification may be better evaluated through the social, functional, and economic relationships represented in Figure 14. Immediately below the engenho owner there was a second class of owners (free planters and captive planters) whose links with the mill owner will be treated separately. From this arrangement three types of production relationships can be identified: capitalistic, feudal, and slave.

The capitalistic relationships, which have received less attention from social scientists, can be inferred from the occupations and wages paid to the manpower. Table 7 shows the rank of the yearly wages paid for service and work carried out in the mills according to their size. The column minimum refers to the smallest mills whereas the



*Tenants, Free and captive planters also grew sugar cane under similar conditions but with less labour

Source: J. A. Anderson (1711)

Figure 14. A Colonial Sugar Mill Plantation: Social and Economic Relationships (1600-1888)

TABLE 7

SUGAR MILL'S YEARLY WAGES BY OCCUPATION, 1711

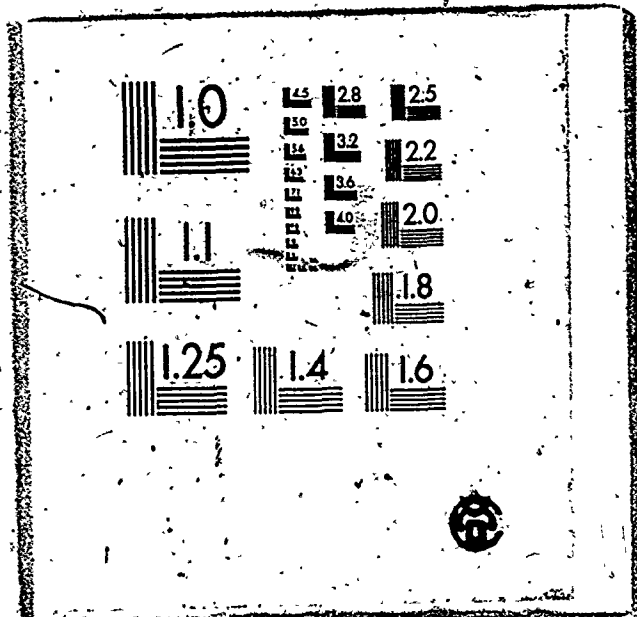
| OCCUPATION | MINIMUM | | MAXIMUM | | AVERAGE | |
|--------------------------|---------|-----|---------|-----|---------|-----|
| | Reis | l* | Reis | l* | Reis | l* |
| Sugar Master | 100,000 | 28 | 120,000 | 34 | 110,000 | 31 |
| Manager | 60,000 | 17 | 60,000 | 17 | 60,000 | 17 |
| Purging Master | 50,000 | 14 | 50,000 | 14 | 50,000 | 14 |
| Sales Agent & Accountant | 40,000 | 11 | 50,000 | 14 | 45,000 | 13 |
| Grinding Overseer | 40,000 | 11 | 50,000 | 14 | 45,000 | 13 |
| Priest | 40,000 | 11 | 50,000 | 14 | 45,000 | 13 |
| Farm Overseer | 40,000 | 11 | 45,000 | 13 | 42,500 | 12 |
| Storage Overseer | 30,000 | 8 | 50,000 | 14 | 40,000 | 11 |
| Quartermaster | 30,000 | 8 | 40,000 | 11 | 35,000 | 10 |
| Total | 430,000 | 119 | 515,000 | 145 | 472,500 | 134 |

SOURCE: Joao Antonio Andreoni [Andre Joao Antoni], Cultura e Opulencia do Brasil (Texto da edicao de 1711), introducao e vocabulario por A.P. Canabrava, 2a. ed. (Sao Paulo: Ed. Nacional, 1966), pp. 150; 154, 156-158.

* Currency transformation, 1l = 3.55 mil reis. Buescu, E.E.B., p. 213.

column maximum refers to the largest ones. The comparison between Figure 14 and Table 7 shows, that position in the hierarchy and income did not necessarily match, for example both the priest and the sales agent had a social position superior to that of the sugar master and manager but they earned a lower salary. However, the amount of work and responsibilities differed considerably. The priest provided the religious service but in some particular cases he also tutored the owner's children, and thereby

3



earned extra income. The sales agent lived in Salvador, from where he represented the owner in his external and financial affairs. The manager exercised overall supervision of the workers with a detached position, but his salary was not the highest. After the manager a group of free workers (skilled and semiskilled technicians) occupied different positions according to their specialization. Among them was the sugar master, who although socially inferior, earned the highest salary, as well as a house and board. On him depended the good quality of sugar as well as the operation of the processing tasks. The different occupations shown in Table 7 represent permanent staff of a mill, of which there were usually altogether between ten and twenty. In addition to the permanent staff, there were the artisans (smith, carpenter, potter etc.). They were paid on a daily basis or for piecework. Although the total number of free workers was less than the total number of slaves, the free workers accounted for a higher percentage of the total costs of production. An evaluation made in 1635 for the Engenho Sergipe do Conde shows that the value of wages and slaves (replacement, food, and cloth) were 11.9% and 5% respectively of the total costs of production (see Table 11). Evidence related to division of labour, specialization of the labour force, and wages, therefore, reinforce the capitalistic nature of the colonial plantation.

At the bottom of the hierarchy of economic relationships were the slaves, the base of the labour system. The number per mill varied according to its size. Sources mention an average ranging from sixty slaves (small mill) to two hundred slaves (large mill).³ Buescu evaluated the Engenho Sergipe do Conde at 274 slaves.⁴ From this total, 172 slaves worked in the mill whereas 102 worked in the sugar cane fields, called partidos. The

latter group performed the farming tasks under the supervision of the farm overseer (Figure 14). There is information that in the earliest days of colonization the engenhos did not grow sugar cane, the raw material being supplied by the lavradores de cana (sugar cane planters).⁵ However, in Andreoni's lifetime the integration of farming and processing, under the same enterprise, was commonplace, giving rise to the need for a large number of slaves. In general there was an average replacement of five slaves a year and the overall cost for supporting them was relatively low (5% of the total costs of production) compared with other inputs. Such low cost is reinforced by Andreoni's statement:

In Brazil one used to say that for a slave three P's are needed that is, pau [thrashing], pao [food], and pano [cloth].⁶

This reduction in the costs of production represented, therefore, profit for the mill owners and planters who had an interest in maintaining the slavery system. The evidence presented illustrates the combination of the capitalistic and slavery systems in the colonial plantation. The feudal relationships are discussed below.

6.2.2 Sugar Cane Farms

The engenhos de acucar were integrated with three other types of operational units differentiated according to the type of operator such as free planter, captive planter, and tenant. The relationships between the mill owners and the lavradores de cana (planters) were feudal and based on two major factors, supply of raw material and the tenure system.

The free planters owned the land which was acquired through the grant or purchase systems. They depended on the mill owners to grind the sugar cane but they were free to supply any mill according to their

preference. From this special situation the expression "free planter" derived, but it was common practice for the planter to sell his grinding rights for a period of time.⁷ To regain freedom, however, the planter had to pay back the amount of money received from the mill owner.

The captive planters differed from the previous category in the sense that their relationships to a mill owner lasted forever. That is, their grinding rights were determined by the grant document or the land sale. In this last instance the mill owner sold part of his sesmaria at a cheaper price on condition that the farmer became his supplier of sugar cane.⁸

Both the free planters and captive planters supplied the mills under an agreement whereby they were paid 50% of the sugar produced from the cane. This type of economic relationship between lavradores and the senhor de engenho (mill owner) thus included feudal features as well as the grind obligation.

The lavradores also operated their farms by means of slave labour. According to Andreoni, a prosperous planter needed thirty to forty slaves to produce 1,000 sugar loaves (approximately 51.6 metric tons) per harvest.⁹ Records are not generally available but from scattered information provided by Andreoni this author concludes that to produce such an amount of sugar it was necessary to cultivate approximately 40 hectares.¹⁰ Andreoni's viewpoint is that it was more profitable to be a lavrador than to own a mill. The reason for this judgment lies on the amount of capital invested. Table 8 shows that in fact the capital outlay of a lavrador in the 1720's was much lower than that invested in a mill (Table 4) in spite of the high price of slaves which increased 250% between 1635 and the 1720's.

TABLE 8
LAVRADOR'S CAPITAL OUTLAY, 1720'S

| ITEM | IN REIS | IN £* |
|------------|-----------|-------|
| Slave (20) | 2,800,000 | 789 |
| Ox (36) | 288,000 | 81 |
| Others | 168,000 | 47 |
| Total | 3,256,000 | 917 |

SOURCE: Stuart B. Schwartz, "Free Labor in a Slave Economy: The Lavradores de Cana of Colonial Bahia", in Colonial Roots of Modern Brazil: Papers of the Newberry Library Conference, ed. by Daurel Alden (Berkeley: University of California Press, 1973), p. 176.

* Currency transformation 1£ = 3.55 mil reis. Buescu, E.E.B., p. 213.

The third category of lavradores was represented by tenants working land leased from the mill owner. Andreoni¹¹ states that the lease usually lasted between nine and eighteen years under several conditions. The tenants were forbidden to cut timber and sublet the land without previous agreement. Also at the end of the lease, the tenant had to give back the land with sugar cane planted. With respect to the economic relationships, the historical sources contain many discrepancies. It is known that the tenants, like the other planters, supplied the mill with sugar cane against a payment in sugar. Canabrava's¹² evaluation indicates that the mill owner retained from 60% to 62% of sugar while Simonsen¹³ refers to an amount between 62.5% to 66.6%. The variation is accounted for by the location of the sugar cane fields: the tenants located closer to the seashore or rivers, transported the raw material to the port where

the mill owner's boats transported it to the mill.¹⁴ When the tenant was located inland the transportation overland was more expensive, and therefore, he received more sugar (37.5%). There is indication that the soil quality was also taken into consideration in this feudal type of agreement. The tenants also worked the land with slaves, however, the numbers are unknown.

The historical evidence presented above, reinforces the contention. That the production of raw material on the colonial plantation was based on the combination of the slave and feudal systems. Such a combination had, therefore, as an objective minimization of the total costs of sugar. However, there were also feudal features related to the social relationships. Schwartz points out that at the Engenho Sergipe do Conde, several lavradores de cana bore the honorific title of militia captain as an indication of social prestige rather than military prowess.¹⁵

The total number of lavradores linked to a mill varied per harvest as well as with the area farmed. Buescu¹⁶ presents records for the Engenho Sergipe do Conde (1622-1652) in which an average of twenty-five lavradores supplied the mill, tilling an average area of 203 tarefas (89 hectares). Considering the area per lavrador, 84.5% tilled less than 15 tarefas (6.6 hectares), 14.1% from 16 to 30 tarefas (7 to 13 hectares), and 1.4% up to 40 tarefas (17.6 hectares).¹⁷ Buescu does not specify the type of planters but whether the figures are reliable or not, they reinforce two aspects of the colonial plantation; one is that in the early seventeenth century the fragmentation of sesmarias was already underway and two, a reinforcement of the role of a feudal approach to the production of raw material. From both situations one may infer the economic inferiority of the lavradores. However, this inference is based upon

scanty records and figures for one mill might be highly misleading, as a lavrador could supply more than one mill and be farming a larger area than reported in the data for that one mill.

6.2.3 Technology and Production

The technology used in the colonial plantation, particularly that of farming, did not show much improvement over the long period from 1571 to 1822. The description below is an attempt to generalize the major operational aspects of the plantation production system.

The indigenous method of "slash-and-burn" land clearance, using equipment such as the hoe, axe, and scythe was commonly used in the Recôncavo to prepare the soil for cane and other crops. By the end of the eighteenth century, Vilhena refers to the use of a wooden plough pulled by a yoke of oxen and employed in the task of opening trenches in which the cane cuttings were then laid longitudinally and covered with soil by the slaves.¹⁸ The sugar cane fields (partidos) were squares divided into tarefas¹⁹ (tasks) each measuring 0.44 hectare. This measure corresponded with the production for a daily grinding, and therefore, it was the base for calculating the amount of sugar produced by each farmer. The tarefas were separated from each other by wide lanes along which cane was transported.

The planting season started at the end of February (highlands) continuing until late July or August (lowlands). Two or three times a year the cane fields were weeded and cleaned. Failure to maintain these practices resulted in poor sugar. Usually it took seventeen or eighteen months for the cane to mature and to be harvested. Souza,²⁰ a mill owner reported that during the cane growing period, it was common to intercrop

cane and corn. However, there is no direct evidence of such practice in the plantation region.

The harvest season started in September, lasting for six or eight months according to the mill capacity. After the first harvest, the dry leaves and stems remaining on the ground were set on fire. Such a practice was used to renew growth; the sprouts (ratoons) from the old roots were more vigorous and larger. The ratoons of the first year were called soca, those of second year, resoca, etc. Production from a single planting could last over six years according to the location of the fields, i.e. whether they were on the highlands or lowlands (varzeas). Because the land was plentiful, when yields decreased, the fields were abandoned and left fallow, and new areas were brought into cultivation. The land rotation method had obvious economic advantages over alternative methods. However, in terms of natural resource conservation, both land rotation and sugar processing were harmful to the environment. Vilhena²¹ reports that by the end of the eighteenth century the plantations on the seashore were facing two problems, exhausted soils and shortage of firewood. It is probable that the fallow became shorter as the mills expanded, or that during the expansion, sugar cane occupied soils of lower fertility (the saloes). Shortages of firewood were to be expected because the mill processing remained primitive during the colonial period; sugar cane residue was wasted whereas the consumption of firewood increased.

Some Brazilian historians have explicitly called both the production of sugar cane and the sugar industry as a whole, extensive.²² Such a generalization, however, may lead to a misinterpretation of this important sector of Brazil's economy. As has been pointed out, the

colonial plantation operated with large amounts of labour and capital. Considering these factors of production, no other agricultural economy in Bahia has ever been more intensive. Insofar as the use of land is concerned, while the land rotation is in fact an extensive method of farming, the soil fertility of the Recôncavo permitted continuous sugar cane production for five or six years, which, in the absence of fertilizer, may be considered a long period. Evaluation made by this author based on Andreoni's information indicates that sugar cane yielded approximately 1.3 metric tons of sugar per hectare (see footnote 10). To produce such an amount, the fields should be weeded two or more times a year with a harvest requirement of approximately twenty-five slaves. By taking into consideration the land use, sugar cane can be accepted, therefore, as a semi-intensive crop. The plantation system, however, must be viewed as a whole. As such it was an intensive system, particularly considering the amount of labour and capital which was mobilized.

Processing technology did not improve much until the nineteenth century. Of the references during the colonial period relating to processing improvements, Salvador²³ informs us that the first technological innovation brought into Brazil was after 1608 when the three upright rollers (engenhos de três paus) started to replace the earliest mills (two horizontal rollers). The fact that such a system was cheap to construct led to a rapid diffusion and a consequent increase in the number of mills. Mauro²⁴ refers to the improvement of a furnace, introduced in 1656, which reduced firewood consumption by one-third. Classified according to energy use and grinding capacity three types of mills operated in Bahia throughout the colonial period. The water-driven (engenho real) was the largest followed by the animal-driven (trapiche)

and the engenhoca or banguê (small animal-driven). Table 9 shows some basic differences among these mills. Souza's²⁵ description of the mills operating in Bahia (1587) identifies twenty-one out of thirty-six mills as water-driven, whereas fifteen were ox-driven. From this information Bahia's annual sugar production could be roughly calculated. Unfortunately there is no time series available for production. In 1587 for instance Souza²⁶ reports a total production of 120,000 arrobas (1,770 metric tons) increasing by 1711 to 507,500 arrobas (7,486 metric tons). These scattered records make it difficult to attempt to analyze the plantation economy.

6.2.4 Costs of Production

Information on the costs of production of colonial plantations is based on the analysis of the accounting book of the Engenho Sergipe do Condé (water-driven mill) for the period 1622-1652. Although the period under consideration coincides with the so-called sugar cycle, the records contain surprising results. Available are detailed figures of total production, of different types of sugar, the prices received, and gross revenue (Table 10), and a summary of the cost of production for 1635 (Table 11). The latter table reinforces the statement previously made with respect to the costs of raw material (50.92%), wages, replacement of slaves (average of five per year), their upkeep and other variable costs. Both records provide information from which Mauro calculated the net revenue of the mill in that specific year, as well as the returns on the gross revenue and on the original capital outlay. This accounting may be compared with a British West Indies plantation operating at the end of the eighteenth century (Table 12). The operating costs of the latter area, included clothing, tools, provisions, overseers' salaries etc. but

TABLE 9

TYPES OF MILL BY SIZE AND CAPACITY

| TYPE | AVERAGE NO. OF SLAVES | AVERAGE NO. OF FREE WORKERS | AVERAGE NO. OF AVERAGE CANE CARTLOADS/DAY | AVERAGE NO. OF OXEN | AVERAGE YEARLY PRODUCTION IN ARROBA* | AVERAGE YEARLY PRODUCTION IN METRIC TONS |
|---------------------------------|-----------------------|-----------------------------|---|---------------------|--------------------------------------|--|
| Engenho real (water-driven) | 100 | 20 | 30 - 45 | 39 | 8,000 | 118 |
| Trapiche (animal-driven) | 50 | 10 | 24 | 60 | 5,000 | 73 |
| Engenhoca (small animal-driven) | 20 | 5 | data n.a. | data n.a. | 3,000 | 44 |

SOURCE: Carmen Vargas, "A Historia do Acucar no Brasil (IV)", Brasil Acucareiro 80 (1972): 31 and C.R. Boxer, The Dutch in Brazil 1624-1659 (Oxford: Claredon Press, 1957), p. 141.

* 1 arroba = 14.75 kilograms.

TABLE 10

ENGENHO SERGIPE DO CONDE: PRODUCTION AND GROSS REVENUE, 1635

| | TOTAL PRODUCTION IN ARROBA ^a | TOTAL PRODUCTION IN METRIC TONS | PRICE/ARROBA IN REIS | GROSS REVENUE IN REIS | GROSS REVENUE IN £* |
|-----------------|--|------------------------------------|-------------------------|--------------------------|------------------------|
| Branco (white) | 7,000 | 103.25 | 800 | 5,600,000 | 5,385 |
| Mascavo (brown) | 3,500 | 51.62 | 360 | 1,260,000 | 1,212 |
| Panela | 2,000 | 29.50 | 180 | 360,000 | 346 |
| Branco Batido | 80 | 1.18 | 600 | 48,000 | 46 |
| Mascavo Batido | 150 | 2.21 | 240 | 36,000 | 35 |
| Total | 12,730 | 187.76 | | 7,304,000 | 7,024 |

SOURCE: Frederic Mauro, Le Portugal et L'Atlantique au XVIIe Siecle (1570-1670), Etudes Economique (Paris: S.E.V.P.E.N., 1960), pp. 213-214.

^a 1 arroba = 14.75 kilograms.

* Currency transformation 1 £ = 1.04 mil. reils. Buescu, E.E.B., p. 213.

TABLE 11

ENGENHO SERGIPE DO CONDE: COSTS OF PRODUCTION, 1635

| | TOTAL COSTS IN REIS | TOTAL COSTS IN £* | % |
|----------------|------------------------|----------------------|--------|
| Raw Material | 3,430,000 | 3,298 | 50.92 |
| Wages | 806,000 | 775 | 11.97 |
| Fuel | 704,000 | 677 | 10.45 |
| Copper | 364,000 | 350 | 5.40 |
| Transportation | 389,000 | 374 | 5.78 |
| Slaves | 340,000 | 327 | 5.06 |
| Others | 701,913 | 675 | 10.42 |
| Total | 6,735,633 | 6,476 | 100.00 |

SOURCE: Frederic Mauro, Le Portugal et L'Atlantique au XVIIe Siecle (1570-1670), Etudes Economique (Paris: S.E.V.P.E.N., 1960), pp. 214-217.

* Currency transformation 1 £ = 1.04 mil reis. Buescu, E.E.B., p. 213.

TABLE 12

ACCOUNTING OF PLANTATIONS: BAHIA AND
BRITISH WEST INDIES

| | BAHIA, 1635 £* | BRITISH WEST INDIES, 1700'S (£) |
|---------------------|-------------------|------------------------------------|
| (A) Original Outlay | 19,230 | 30,000 |
| (B) Gross Revenue | 7,024 | 4,300 |
| (C) Total Costs | 6,476 | 2,000 |
| (D) Net Revenue | 548 | 2,300 |
| % D of A | 3.0 | 7.7 |
| % D of B | 7.8 | 53.5 |

SOURCE: Frederic Mauro, Le Portugal et l'Atlantique au XVIIe Siecle (1570-1670), Etudes Economique (Paris: S.E.V.P.E.N., 1960), p. 217 and P.P. Courtenay, Plantation Agriculture (London: G. Bell & Sons, Ltd., 1965), p. 18.

* Currency transformation 1 £ = 1.04 mil reis. Buescu, E.E.B., p. 213.

not wages.²⁷ Even though the wages were not calculated the figures show the West Indies as having an economic advantage over Bahia. The accounting for Bahia, however, contains an omission which completely distorts the facts. Mauro in calculating the costs of raw material, assumed that all lavradores who supplied sugar cane to the Engenho Sergipe do Conde were free and/or captive planters. Such an assumption led Mauro to reduce the gross revenue by 50% (3,430,000 reis) to pay the lavradores, but he did not take into consideration the tenants who received less than 50% of the sugar. Such a distortion, due to the lack of precise information on the condition of the lavradores could substantially alter the net profits. Hence, the returns on the gross revenue and the original outlay might be considerably higher than those shown.

The Engenho Sergipe do Conde was also studied by Buescu using its accounting book which records production, sugar prices, gross revenue, total costs, and net revenue between 1622 and 1652 (Table 13). The mill had the capacity to grind over 200 metric tons a year which indicates that it was indeed large. However, comparison between production and price suggests that lower prices were followed by larger production (1622-1635) whereas higher prices often coincided with a decrease in production. In addition, only five harvests out of twenty-one resulted in a positive revenue. Comparison of Mauro's calculation and Buescu's records reveal opposite results for the same harvest (1635). Such discrepancies do not allow any categorical conclusions. Buescu himself states that the accounting presents weaknesses. For instance the owners' expenses, investments, old debts, and even costs of operating other enterprises often appear included in the same accounting and in different years.²⁸ Based on vague information and unreliable records, some historians conclude that the sugar

TABLE 13

ENGENHO SERGIPE DO CONDE: PRODUCTION AND REVENUE, 1622-1652

| ANNUAL HARVEST | TOTAL PRODUCTION IN ARROBAS ^a | TOTAL PRODUCTION IN METRIC TONS | AVERAGE SUGAR PRICE REIS/ARROBA ^b | GROSS REVENUE IN REIS | TOTAL COSTS IN REIS | NET REVENUE IN REIS (+ OR -) |
|----------------|--|---------------------------------|--|-----------------------|---------------------|------------------------------|
| 1622/23 | 13,881 | 205 | 452 ^o | 3,503,295 | 4,900,295 | - 1,397,364 |
| 1623/24 | 14,195 | 209 | 421 | 2,401,780 | 5,786,220 | - 3,384,440 |
| 1624/25 | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. |
| 1625/26 | 11,722 | 173 | 516 | 3,434,425 | 4,934,455 | - 1,500,030 |
| 1626/27 | 11,853 | 175 | 477 | 3,209,845 | 3,375,175 | - 165,330 |
| 1627/28 | 11,949 | 176 | 688 | 5,006,690 | 3,160,065 | + 1,846,625 |
| 1628/29 | 10,993 | 162 | 684 | 4,352,695 | 5,297,448 | - 944,753 |
| 1629/30 | 9,889 | 146 | 544 | 5,250,270 | 6,875,360 | - 1,625,090 |
| 1630/31 | 10,474 | 154 | 460 | 3,959,090 | 4,093,235 | - 134,145 |
| 1631/32 | 5,625 | 83 | 505 | 1,867,582 | 3,538,055 | - 1,670,473 |
| 1632/33 | 10,849 | 160 | 583 | 4,018,445 | 3,976,450 | + 41,995 |
| 1633/34 | 10,554 | 156 | 686 | 4,534,685 | 6,088,433 | - 1,553,748 |
| 1634/35 | 11,462 | 169 | 658 | 4,725,155 | 3,248,444 | + 1,476,711 |
| 1635/36 | 8,270 | 122 | 838 | 4,212,785 | 5,714,094 | - 1,501,309 |
| 1636/37 | 4,242 | 62 | 1,082 | 3,190,965 | 3,500,727 | - 309,762 |
| 1637/38 | data n.a. | data n.a. | 1,160 | 2,726,342 | 2,632,989 | + 93,353 |
| 1639/42 | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. |
| 1643/44 | 9,235 | 136 | 855 | 5,556,445 | 8,268,720 | - 2,712,275 |
| 1644/45 | 10,941 | 161 | 824 | 5,426,555 | 7,845,136 | - 2,058,581 |
| 1645/46 | data n.a. | data n.a. | 843 | 5,462,852 | 6,528,306 | - 1,065,454 |
| 1646/47 | data n.a. | data n.a. | 938 | 3,738,671 | 2,721,729 | + 1,016,842 |
| 1647/49 | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. |
| 1650/51 | 10,318 | 152 | 828 | 5,039,630 | 7,070,158 | - 2,030,528 |
| 1651/52 | 9,440 | 139 | 962 | 7,001,275 | 7,110,940 | - 109,665 |

SOURCE: Mircea Buescu, Historia Econômica do Brasil, Pesquisas e Análises (Rio de Janeiro: APEC, 1970), pp. 118, 123, 153.

^a 1 arroba = 14.75 kilograms. ^b White and brown sugar.

industry in Brazil had limited profits even during the sugar cycle, but the landlords were compensated by the social prestige and other benefits.²⁹

Other sources present a different picture of Brazilian sugar economy. Taylor³⁰ calculated the rate of profit for a sugar-producing unit of maximum efficiency. According to his evaluation the rate of profit from 1610 to 1640 was 32.2% decreasing to 7% by ca. 1780. Taylor's viewpoint is that nearly 70% of the income generated by the sugar sector initially accrued to the senhores de engenho and lavradores. Jose da Silva Lisboa,³¹ also considered the situation of the sugar plantation in Bahia (1781) as the most advantageous in Brazil. Lisboa estimated that 0.44 hectares (1 tarefa) planted with sugar cane could yield from 16 to 20 sugar loaves (from 44 to 59 kilograms each loaf). This evaluation is more optimistic than that based on Andreoni (see footnote 10). Further, the gross revenue of the same area was also estimated as 57,000 reis (416). Unfortunately, Lisboa does not evaluate the costs of production. It has been recognized that the Brazilian plantations operated at lower costs than other areas. In Chapter Five it was recorded that the African Islands, for example, could not face the Brazilian competition. Williams also reports that "in 1671 a West Indian petition to Parliament stated that the Brazilian planter could produce 30 per cent more cheaply than his English rival".³² Brazilian specialists, however, have emphasized the decline of the sugar economy after 1650 due to the competition of foreign colonies (English, French, and Dutch) and the gold rush.³³ On account of these factors the costs of production increased, and prices fluctuated, leading to successive crises.

6.3 External Competition and Gold Rush

The Portuguese sugar monopoly started to break down when the Dutch invaded the Pernambuco Captaincy in 1630. They stayed for twenty-four years, controlling a large area of the Brazilian plantations. Driven out of Brazil in 1654, the Dutch simultaneously introduced the secrets of sugar cane cultivation and processing into Barbados, Guadeloupe, and Martinique.³⁴ In addition, French and English interests, centered on the Caribbean colonies, started a struggle for the world sugar market. As a result Caribbean agriculture changed from diversified small-scale cropping production to specialized large scale operations oriented to sugar cane, and the process of rapid consolidation of small farms into sugar plantations accelerated.³⁵ Production of minor staples and provisions diminished and the region became dependent on imports. Foodstuffs, livestock, and building materials were imported from the North American seaboard colonies closer to the centre of sugar production. For example, Sheridan³⁶ reports that in 1770 6,700 horses were exported from North America to the West Indies.

In the early stages of sugar production land was cheap compared with other factors of production. However, as agriculture became specialized the supply of good cane land approached exhaustion. Land prices rose to such heights that intensive cultivation was introduced. Cane had to be planted every year and to maintain soil fertility a large amount of manure was used.

Among the English colonies Barbados was the largest sugar producer in the seventeenth century. But in 1769, the problem of soil exhaustion was so serious that an attempt was made to import some of the rich soil of Surinam.³⁷ In 1736 Barbados produced 22,769 hogsheads of sugar but by

1784 production dropped to an annual average of 9,554 hogsheads, i.e. 40% of the 1736 output.³⁸ During the eighteenth century Jamaica led the English sugar producers, followed by Antigua. In 1768 the former island had 648 plantations of which 369 were equipped with cattle mills, 235 with water mills, and 44 with windmills. The total production was 68,160 hogsheads or approximately 100 hogsheads (80 tons) per mill.³⁹ According to Williams, at that time not a single innovation had been adopted either in technology or cultivation, when compared with the preceding century. Antigua in 1764 had 300 plantations producing 16,000 hogsheads or 50 hogsheads per plantation. Adam Smith, quoted by Williams, stated in 1776 that "the profits of a sugar plantation in any of our West India Colonies are generally much greater than those of any other cultivation that is known either in Europe or America".⁴⁰ In spite of the prosperity of the British West Indies, the sugar produced there was basically brown (muscovado) and, therefore, of inferior quality.

The French West Indies experienced the same change in agriculture as the British colonies. In spite of the introduction of sugar plantations in the second half of the seventeenth century, prosperity in Martinique and Guadeloupe started only in the eighteenth century and was linked to the introduction of the manufacture of clayed sugar. The number of mills operating in Martinique increased from 14 in 1671 to 286 in 1769 (184 were ox-driven, 114 water-driven, and 12 driven by windmills) whereas the total production increased from 120 metric tons to 9,146 metric tons.⁴¹ In Guadeloupe the number of mills also increased from 65 in 1667 to 415 in 1767, of which 263 were animal-driven, 144 water-driven, and 11 driven by windmills.⁴² Total production in 1767 was evaluated at 7,898 tons. In French Guiana sugar plantations did not expand to the extent of those in

Martinique and Guadeloupe. In San Domingo and Haiti (Hispaniola) the sugar industry started in the end of the seventeenth century but the progress was rapid. In 1701 there were 35 mills at work and by 1767 they were 599. However, the prosperity of the island did not last long. The sugar production decreased from 62,640 metric tons in 1767 to 1,825 metric tons in 1819.⁴³

The Dutch arrived in Guiana in 1658 when a cargo of slaves was introduced. Among the first colonists were a number of Jewish refugees from Brazil, expert in sugar cultivation and processing. However, little progress was made until 1713. During the eighteenth century Surinam production was almost always less than 11,000 metric tons.

The Spanish colonies in the Caribbean did not show much progress until the second half of the eighteenth century. Puerto Rico in 1776 produced only 1,222 metric tons increasing to 5,559 metric tons in 1827. In Cuba the sugar industry started at the end of the sixteenth century but progress was slow until 1772. In 1763 there were 70 factories, increasing to 480 in 1806; production rose from 2,600 metric tons to 31,302 metric tons.⁴⁴

The expansion of sugar plantations in the New World, mainly in the English and French colonies may be evaluated from the scattered records presented in Table 14. The records for Brazil although based on rough estimations and on the amount exported (1796, 1806, and 1809), show that sugar cycle did not finish abruptly in 1650. It seems that Brazil continued to be the world's largest producer until the last decade of the seventeenth century. Barbados the most important English colony in the seventeenth century produced 6,950 metric tons in 1655. By 1698, Barbados and Jamaica already produced together 28,049 metric tons. The scarcity of

TABLE 14

SUGAR PRODUCTION OF AMERICAN COLONIES, 1560-1822

| YEAR | IN METRIC TONS | | | | |
|------|----------------|-------------------------------|------------------------------|-----------|-----------|
| | BRAZIL | ENGLISH COLONIES ^a | FRENCH COLONIES ^b | SURINAM | CUBA |
| 1560 | 2,470 | | | | |
| 1580 | 4,760 | | | | |
| 1600 | 16,300 | | | | |
| 1630 | 20,400 | | | | |
| 1640 | 24,500 | | | | |
| 1650 | 28,500 | | | | |
| 1670 | 27,200 | data n.a. | data n.a. | data n.a. | |
| 1710 | 21,800 | 23,383 | 2,920 | 6,100 | data n.a. |
| 1760 | 34,000 | 56,525 | data n.a. | 8,300 | 2,600 |
| 1776 | 20,400 | 57,907 | 89,553 | 6,820 | data n.a. |
| 1796 | 34,290 | 64,000 | data n.a. | data n.a. | 24,075 |
| 1806 | 35,463 | 97,100 | data n.a. | data n.a. | 31,302 |
| 1809 | 15,108 | 91,093 | data n.a. | data n.a. | 57,786 |
| 1812 | 6,200 | 62,100 | data n.a. | data n.a. | data n.a. |
| 1820 | 75,000 | 108,751 | 44,959 | 9,800 | 43,119 |
| 1821 | 83,000 | 109,563 | 45,387 | 10,600 | 47,333 |
| 1822 | 91,000 | 84,928 | 43,746 | 5,000 | 52,359 |

SOURCE: Noel Deerr, The History of Sugar, vol. 1 (Chapman & Hall Ltd., 1949), pp. 112, 131, 193-198, 212, 235-240 and Jose Jobson de Andrade Arruda, "O Brasil no Comercio Colonial (1796-1808), Contribuicao ao Estudo Quantitativo da Economia Colonial" (Tese de Doutorado, Universidade de Sao Paulo, 1972), pp. 328, 339.

^a Barbados, Nevis, Antigua, Jamaica, and Montserrat.

^b Martinique, Guadeloupe, St. Domingue, and Haiti.

data precludes a more accurate comparison. However, it is worthwhile to note that in spite of the strong external competition, Brazilian production was relatively stable during the eighteenth century, rather than exhibiting a sharp decline as might have been expected.

There were slack periods caused by price declines and aggravated by heavy duties levied on Brazilian sugar at Lisbon and/or high taxation in Brazil. However, the Brazilian sugar industry seemed always to have the capacity to recuperate. One such period occurred in 1691, but Boxer⁴⁵ reports that the Brazilian industry began to recover soon afterwards. He lists as factors involved in the recovery the increased demand in Europe, the exhaustion of stocks held at Lisbon, and the prestige of Brazilian sugar as being of better quality than the West Indian varieties. William Dampier who visited Salvador in 1699 is quoted by Boxer as follows:

It is a place of great trade ... The sugar of this country is much better than that which we bring home from our plantations, for all the sugar that is made here is clayed, which makes it whiter and finer than our Muscovado, as we call our refined sugar.⁴⁶

The sugar of the English colonies was not only of poorer quality but also more expensive than that produced in other colonies. Jamaica's planters for instance had a policy of not increasing the cultivated area in order to keep prices high.⁴⁷ Such a policy was not condoned by the British Government, refiners, and public. One complainant stated: "If the British plantations cannot, or will not afford sugar, ... plenty and cheap enough the French, Dutch and Portuguese do, and will".⁴⁸

Brazilian historians often report that the colonial plantation were also strongly affected by the gold rush (1694-1760) which caused an accelerated internal migration to Minas Gerais and rapid increase in the

price for slaves and cattle, and therefore gave rise to a serious crisis in the sugar economy.⁴⁹ This period is identified as "the gold cycle". Other writers, Simonsen⁵⁰ for instance, do not agree that the gold rush had much effect on the plantations. He believes that the colonial policy developed by Colbert (France) and Cromwell (England) was the major cause of the sugar crisis in Brazil. Furtado⁵¹ on the other hand states that gold and diamond mining did not mobilize large amounts of capital nor did slaves constitute a large proportion of the population in the mining region. It was an adventurous activity of short duration which generated less profit than sugar to Portugal. Simonsen⁵² estimates that Portugal's total revenue derived from the Brazilian colonial exports (1500-1822) amounted to £536,000,000. Of that sugar accounted for 56% (£300,000,000), gold and diamonds 32% (£170,000,000), hides 3% (£15,000,000), brazilwood 3% (£15,000,000), tobacco 2% (£12,000,000), cotton 2% (£12,000,000) and others 2% (£12,000,000). Further, even during the mining peak (1700-1760), sugar continued as the major export. Buescu⁵³ states that gold and diamond revenues exceeded that of sugar in only a few years.

The lack of adequate record of export revenue from economic activity, capital investments, total production by economic sector, etc. precludes a thorough analysis of the plantation situation. However, despite fluctuating economic fortunes there is an important spatial aspect of Brazilian sugar economy so far not satisfactorily explained, i.e. the continuing expansion of sugar mills after 1650.

6.4 Expansion of Sugar Mills

The number of sugar mills in operation over time in Brazil and Bahia reveals another aspect of the sugar economy. Brazil had 60 mills

in 1570, increasing to 350 mills in 1650, 500 mills in 1670, and 650 mills in 1710. This is a peculiar response by the Brazilian sugar industry to the so-called severe impact of external competition. According to Buescu⁵⁴ the explanation is a proliferation of mills operating at low productive capacity. The evidence for this contention is based on the average production per mill. Such production is probably estimated, however, because the sources are not provided.

Normally in a competitive situation uneconomic enterprises tend to be eliminated. Even accepting an imperfect knowledge of the market, Brazilian entrepreneurs had had long experience in the sugar affairs. The high investments required to operate a mill indicate that from an economic standpoint it would not make sense to increase the number of enterprises under condition of low capacity. Rather, the reduction of number of mills through the concentration of production in few larger enterprises would be expected.

Taylor⁵⁵ on the other hand, constructed a model to explain the response of the Brazilian sugar industry (1570-1810) to price changes. This model consists of successive cycles of expansion-stagnation. Expansion occurred when a small increase in price stimulated a large increase in production. A small decrease in price, however, led the economy to stagnate but the reduction in output was relatively small. Taylor concludes that fluctuations in price over time led the industry to produce increasing quantities of sugar at correspondingly lower prices. Further, the continuing cycle of expansion-stagnation-expansion-stagnation, did not release land or labour during the stagnation phase causing sugar to dominate an entire regional economy. Taylor's analysis for this type of economic development lies in the economic advantage accruing to use of

the slave labour force which places the explanation for the Brazilian sugar economy entirely on one type of input, ignoring the fact that plantations used other costly inputs such as equipment, fuel, draft animal, and a wage labour force etc. Even the prices of slaves drastically increased during the eighteenth century. In addition, Taylor does not explain the fact of the expansion of the number of mills each of which required a high capital investment.

In Bahia the expansion of sugar mills followed the same pattern observed for Brazil. Records of the number of mills and their respective production according to the historical source (Table 15) suggest that the number of mills doubled during the second half of the sixteenth century and continued to expand until 1612. In the first decades of the seventeenth century the process of expansion stabilized, beginning again after 1627. This stable period coincides with the Dutch occupation of Bahia (1624-1625) when several mills were destroyed. From 1627 on there is another rapid expansion until 1711. Some sources do not discriminate between mills located in the Sergipe-de-El-Rei Captaincy from those located in the Recôncavo. This omission makes it impossible to judge whether the number of mills in Bahia declined between 1711 and 1759. This period is recognized as the most difficult of the sugar economy. It coincided with the rapid increase of the West Indies production (see Table 14) as well as with the peak of the gold rush. It is quite probable that some of the smallest mills stopped operating. However, apart from this relative short period, the general trend during the eighteenth and the beginning of the nineteenth centuries was a rapid expansion of mills.

Production of the mills is based on an estimation of a variety of sources. The lack of a long time series precludes an accurate judgement.

TABLE 15

EXPANSION OF SUGAR MILLS IN THE RECONCAVO, 1570-1817

| YEAR | NO. OF MILL | PRODUCTION IN ARROBA ¹ | PRODUCTION IN METRIC TONS | AVERAGE PRODUCTION IN METRIC TONS |
|---------------------|-------------|-----------------------------------|---------------------------|-----------------------------------|
| 1570 ^a | 18 | 54,000 | 796 | 44 |
| 1587 ^b | 36 | 120,000 | 1,770 | 49 |
| 1612 ^c | 50 | data n.a. | data n.a. | data n.a. |
| 1627 ^d | 50 | data n.a. | data n.a. | data n.a. |
| 1663 ^e | 69 | data n.a. | data n.a. | data n.a. |
| 1711 ^f | 146* | 507,500 | 7,486 | 51 |
| 1759 ^g | 126 | 255,685 | 3,771 | 30 |
| 1770 ^h | 150* | 525,000 | 7,744 | 52 |
| 1798 ⁱ | 260 | data n.a. | data n.a. | data n.a. |
| * 1817 ^j | 400 | 1,200,000 | 17,700 | 44 |

SOURCE: a) Pero de Magalhaes Gandavo, Tratado da Terra do Brasil (Rio de Janeiro: Anuario do Brasil, 1924), p. 29; b) Gabriel Soares de Souza, Tratado Descritivo do Brasil em 1587, 3a. ed. (Sao Paulo: Ed. Nacional, 1938), p. 173; c) Diogo de Campos Moreno, Livro que Da Razao do Estado do Brasil, 1612 (Recife: Arquivo Publico Estadual, 1955), p. 217; d) Frei Vicente do Salvador, Historia do Brasil, 1500-1627, 5a. ed. (Sao Paulo: Melhoramentos, 1965), p. 422; e) Padre Simao de Vasconcelos, cited by Mario Augusto dos Santos, "Formacao Economica da Bahia", Salvador, 1976, p. 3 (Mimeographed); f) Joao Antonio Andreoni [Andre Joao Antonil], Cultura e Opulencia do Brasil (Texto da edicao de 1711), introducao e vocabulario por A.P. Canabrava, 2a. ed. (Sao Paulo: Ed. Nacional, 1966), p. 228; g) Jose Antonio Caldas, Noticia Geral de Toda esta Capitania da Bahia desde o seu Descobrimto ate o Presente Ano de 1759, ed. fac-similar (Salvador: Tipografia Beneditina, 1951), pp. 429-438; h) Anais do Arquivo Publico da Bahia, "Senhores de Engenho", vol. XIV (Bahia: Imprensa Official, 1931), p. 155; i) Luis dos Santos Vilhena, A Bahia no Seculo XVIII, notas e comentarios de Braz do Amaral (Salvador: Itapoa, 1967), 1: 57; and j) J.B. von Spix and C.F.P. von Martius, Viagem pelo Brasil, trad. de Lucia Furquim Lahmeyer, rev. de B.F. Ramiz, anot. de Basilio de Magalhaes (Rio de Janeiro: Imprensa Nacional, 1938), 2: 307-309.

¹ 1 arroba = 14.75 kilograms.

* The mills of the Sergipe-de-El-Rei Captaincy are probably included.

of the capacity of the mills. Andreoni,⁵⁶ for instance, points out that Bahia's mills were larger than those located in Pernambuco. A small plantation in Jamaica produced from 24 to 40 metric tons of sugar a year.⁵⁷ By taking into consideration this information, the Bahian plantations had a somewhat larger average capacity. This fact seems to confirm, therefore, Andreoni's report. Another important aspect to emphasize is that the largest gross and average production occurred from 1711 on. Such evidence suggests that the Buescu's explanation for the expansion of Brazilian mills after 1650 does not apply to Bahia.

The rates of increase in mill numbers reveal that the response of Bahia's sugar industry to the external competition is the reverse of what might be expected. During the sugar cycle (1570-1663) the number of mills increased 283% whereas after that period (1663-1817) the total increased by 480%. Further, the latter period coincides with a rapid increase in the price of two basic inputs; the price of a slave started to rise in 1634, reaching the highest levels between 1705 and 1740 (Table 16) and that period is also marked by increased prices for oxen. Meanwhile the number of mills increased 112%. On the other hand, the prices of sugar during the cycle period were lower than after it (1651-1750). Taking into consideration that the prices of slaves and oxen increased relatively faster than sugar, how can one explain the rapid expansion of the mills after 1663? The viewpoint held here is that Bahia could face the external competition, expanding the number of mills because the total variable costs of plantations were lowered through the vertical integration of sugar, cattle, and tobacco production. Evidence for this explanation is presented in the following section.

TABLE 16

AVERAGE PRICES OF SUGAR, SLAVE, AND OXEN

| YEAR | SUGAR ^a REIS/ARROBA | INDEX 1690=100 | SLAVE REIS/UNIT | INDEX 1690=100 | OXEN REIS/UNIT | INDEX 1690=100 |
|------|-----------------------------------|-------------------|--------------------|-------------------|-------------------|-------------------|
| 1622 | 452 | 53 | 29,000 | 58 | data n.a. | data n.a. |
| 1623 | 421 | 50 | 35,000 | 70 | data n.a. | data n.a. |
| 1625 | 516 | 61 | 31,000 | 62 | data n.a. | data n.a. |
| 1628 | 684 | 80 | 30,000 | 60 | data n.a. | data n.a. |
| 1629 | 544 | 64 | 30,000 | 60 | data n.a. | data n.a. |
| 1632 | 583 | 68 | 30,000 | 60 | data n.a. | data n.a. |
| 1633 | 686 | 81 | 34,000 | 68 | data n.a. | data n.a. |
| 1634 | 658 | 77 | 42,000 | 84 | data n.a. | data n.a. |
| 1635 | 838 | 98 | 39,000 | 78 | data n.a. | data n.a. |
| 1636 | 1,082 | 127 | 50,000 | 100 | data n.a. | data n.a. |
| 1643 | 855 | 101 | 41,000 | 82 | data n.a. | data n.a. |
| 1644 | 824 | 97 | 41,000 | 82 | data n.a. | data n.a. |
| 1645 | 843 | 99 | 42,000 | 84 | data n.a. | data n.a. |
| 1646 | 938 | 110 | 52,000 | 104 | data n.a. | data n.a. |
| 1650 | 828 | 97 | 49,000 | 98 | data n.a. | data n.a. |
| 1651 | 962 | 113 | 55,000 | 110 | data n.a. | data n.a. |
| 1690 | 850 | 100 | 50,000 | 100 | 4,000 | 100 |
| 1705 | 1,600 | 188 | 200,000 | 400 | 4,500 | 112 |
| 1740 | 1,400 | 164 | 200,000 | 400 | 6,500 | 162 |
| 1750 | 1,650 | 194 | 120,000 | 240 | 10,000 | 250 |

SOURCE: Mircea Buescu, 300 Anos de Inflação (Rio de Janeiro: APEC, 1973); pp. 42, 44, 86.

^aWhite and brown sugar.

6.5 Economic Advantages Enjoyed by Bahia's Sugar Industry

So far, Bahian historians have not explained the striking expansion of sugar plantations despite the impact of external competition. References are often made to the crises faced by the sugar industry.⁵⁸ However, no attention has been paid to the fact that the crises were always overcome and the number of mills continued to increase in spite of the large production in the West Indies. The Caribbean region was closer to the European market, therefore, the costs of transportation were lower. Further, the price of slaves increased due to the high demand for this type of labour. In such a situation why did the Bahian plantations continue to operate competitively? It was pointed out in the Section 6.2.4 that the West Indies planters in 1671 sent a petition to the British Parliament claiming that the Brazilian planter produced sugar 30% more cheaply. Taking into consideration that the largest plantations of Brazil were located in Bahia, what advantages did the Bahian planters have over their competitors? Advantages may be recognized under two basic headings: the availability of land, and the reduction of variable costs through vertical integration of the sugar industry with cattle, and tobacco production.

6.5.1 The Availability of Land

The introduction of the plantation system in Bahia was preceded by the land grant system. The large area surrounding the Bay of All Saints and its suitable soil and climate more or less guaranteed successful operation of plantations. The input of land, was, therefore, free and plentiful. In addition, colonization began based on large estates and with specialized types of farming:

By comparison initial colonization of the West Indies was based on small properties. Agriculture was diversified to produce staples such as tobacco, indigo, cotton, cocoa, provisions and livestock and the agricultural tasks were carried out by the settlers rather than slaves.⁵⁹ The shift from a diversified agriculture to specialization in sugar cane, forced the consolidation of small units to achieve some economies of scale. However, as the process toward monoculture accelerated, the supply of good cane land became scarce. Prices rose to a level such that a fundamental change occurred in the relative value of the factors of production.

Williams⁶⁰ reports that a plantation of 500 acres which sold for £400 in 1640, fetched £7,000 for a half share in 1648. In the eighteenth century land cost three pounds an acre in Jamaica.⁶¹ Provisions and livestock were replaced by sugar cane leading the planters to import those intermediate goods from North America.

Land in Bahia never dominated the planters' capital investments. There was plenty to produce provisions inside and/or outside the plantations as well as to raise cattle at low costs. Nor was it necessary to increase the costs of producing the raw material by manuring the land.

According to Sheridan,⁶² in the West Indies the high land value encouraged the planters to keep their land under almost constant cultivation. It became necessary, therefore, to fertilize and cultivate the land more intensively.

As was previously pointed out, sugar cane could remain in the soil for more than six years in Bahia. The reduction of soil fertility was solved by the method of land rotation which decreased annual costs of production. Plentiful land in Bahia represented a major advantage over the Caribbean islands with their limited area.

6.5.2 Reduction of Variable Costs

6.5.2.1 Production of Raw Material. Bahia's plantations differed from those of their competitors vis a vis the system of production. As was described in Section 6.2.2 the mill owners had several suppliers of raw material (the lavradores) whose payment was based on a share of the sugar. This feudal type of payment represented an economic advantage for the mill owners in terms of the reduction of the total labour force required and the cost of maintenance. A large mill in Bahia needed an average of one hundred slaves to operate it, whereas a large sugar cane farm required from thirty to forty slaves. The distribution of risks among the planters, represented an economic advantage in terms of investments and variable costs for both enterprises, the mill and the sugar cane farm. More advantageous, however, was the system of sharing the sugar. The agreement involved only the share of clayed and brown sugar. The other varieties of sugar entirely belonged to the mill owner to whom they represented a net profit. In addition, the payment also varied according to the lavradores' situation. That is, the tenants paid lease in sugar from 12.5% to 16.6% over the grinding service. Although the mill owners also produced the raw material, over 50% of it was supplied by the sugar cane farmers. This system of production represented, therefore, an appreciable economic benefit for Bahian mill owners.

The plantations in the English and French colonies operated in a different manner. The functions of planter and of mill owner were united in the same enterprise.⁶³ There the risks of production were consequently larger. Williams⁶⁴ reports that in the eighteenth century a small plantation (300 acres) in Jamaica required an investment of £4,923. From this total amount 30% (£1,500) was spent in the purchase of thirty Negroes

costing fifty pounds each. To double production (from 40 to 80 metric tons of sugar a year) the same plantation required £14,029 investment and 100 Negroes equivalent to £5,000 (36%). A large plantation (900 acres) needed £39,270 investment and 300 Negroes (£15,000);⁶⁵ the labour force represented 38% of the total investment.

Comparison of the plantation system between Bahia and Jamaica leads to the conclusion that production of raw material was cheaper in the former area. The combination of feudal arrangements and the slave system in Bahia represented, therefore, an economic advantage.

6.5.2.2 Vertical Integration of Sugar, Cattle, and Tobacco.

The fact that the process of vertical integration is accepted as an industrial rather than an agricultural phenomenon and was chiefly recognized only after the industrial revolution, is one reason that Brazilian historians have missed the opportunity of reinterpreting the nature of the sugar economy. Actually, vertical integration may occur in both activities independent of the stage of development. Sjo's⁶⁶ viewpoint is that most farms originally were almost completely vertically integrated operations. That is, they produced raw food and fiber that were processed and consumed on the farm. In addition, most of the inputs used in production were also produced on those farms. There is no inconsistency in using the concept of vertical integration to explain the reduction of variable costs in the plantation economy, since it existed from the earliest stages. Beckford⁶⁷ recognizes that there is a relatively high degree of vertical integration in the plantation company. However, Beckford's analysis is concerned with plantations at present time.

This author's viewpoint is that the colonial plantations developed the process of vertical integration in commercial agriculture in the

sixteenth century and refined it over subsequent centuries. To discuss this viewpoint, vertical integration is here defined as a single unit of management controlling specialized agricultural enterprises—economically connected. That is, the output of one enterprise is directly or indirectly used as an input for the other enterprise. According to this definition, the colonial sugar plantations were vertically integrated with respect to the production of cattle and tobacco. This integration gave an economic advantage to the Bahian planters in reducing the costs of draft animals and slaves. The historical evidence is scarce but sufficient to support this viewpoint and to stimulate further research.

The process started in the sixteenth century through the integration between sugar plantations and cattle ranching. Souza⁶⁸ in 1587 informs us that among the mill owners, three of them (Joao de Barros Cardoso, the Count of Linhares, and Sebastiao da Ponte) raised cattle. More precise, however, is Pinho's statement:

... in the beginning of the nineteenth century the plantation owners used to replace the draft animals ... (by) buying cattle in the Capuame fair, when they were not supplied from the sertao where almost all of them owned ranches ...⁶⁹

The Capuame fair, functioned in the Recôncavo as an alternative source when the cattle driven from the farthest sertao of the Sao Francisco River, Sergipe, Piaui, Pernambuco, and Paraiba did not arrive on time. In 1676 Antônio Guedes de Brito who owned several ranches established a sugar plantation in Mata de Sao Joao (northern Recôncavo).⁷⁰ Andrade⁷¹ refers to the fact that in Pernambuco the plantation proprietors also owned ranches.

In Brazil, African slaves were bartered for trade goods. From the sixteenth century up to 1647, liquor was the commodity used by the

mill owners to barter for slaves. Later, however, twisted tobacco became the most acceptable item for trading. The historical sources do not state exactly when tobacco started to be grown in Bahia on a commercial scale, but by 1642 tobacco was already a Crown monopoly. However, the rapid expansion of the crop started in the 1650's when the Portuguese decree prohibiting liquor production was renewed (1650) and the plantations began to expand in the West Indies. In Bahia, Cachoeira and Santo Amaro (western Recôncavo), both famous plantation regions, became important also for growing tobacco.⁷² Further, many tobacco farmers were tenants. Although, the earliest contemporary sources do not reveal from whom the tenants leased the land, knowledge of the general structure of the farming system (above) led this author to infer that the plantation owners rented out their sesmarias to tenants to grow both sugar cane and tobacco. In both situations the lease was paid in kind and the land and the agricultural activities remained under the control of the landlords. There is also evidence that the mill owners were also tobacco growers. James referring to tobacco in Bahia states:

After African labor replaced the Indians, the planters found that growing tobacco was a good way to keep the slaves employed when they were not needed for the cane harvest.⁷³

The statement which most clearly supports this author's viewpoint is that given by Boxer who, discussing the heavy duties that Portugal levied on Brazilian goods, particularly sugar and the Bahian tobacco in 1687, reports:

Seven years earlier Peixoto Viegas, who was also a tobacco-grower and cattle-rancher as well as a sugar-planter, had complained that out of every hundred rolls of tobacco which he sent to Lisbon seventy-five went to defray the customs dues and freight charges.⁷⁴ (author's underlining).

The farming systems used in Bahia to grow tobacco and to raise cattle will be described in more detail in Chapter Seven. To reinforce the fact of integration among the three agricultural systems it must be stated in advance that cattle provided inputs for the sugar plantations (draft animal and food) and for the tobacco farms (hides to package the rolls and manure).

Tobacco was used as a trade good to barter for slaves (an average of three rolls per slave). According to Boxer⁷⁵ the African Negroes preferred the tobacco from Bahia to any other form of trade goods. This preference was related to the process used to prepare the twisted tobacco which was brushed with molasses. "This process was never effectively imitated by the English, Dutch or French traders, despite all the efforts they made to do so."⁷⁶ The sugar plantations, therefore, provided sugar and/or molasses used in the preparation of the rolls. In 1711 Andreoni⁷⁷ reports that 13,000 arrobas (192 metric tons) of tobacco were sent from Bahia to Africa.

The vertical integration of sugar, cattle, and tobacco production may be viewed as a factor of economic advantage in reducing the variable costs of the sugar industry. Such an advantage seems to better explain the expansion of Bahia's sugar mills than any other so far presented. In the West Indies the planters could not enjoy the same advantages because scarcity of land forced them to import draft animals and food from North America. Both goods were relatively expensive. In Jamaica in the eighteenth century a mule and a steer cost £30 and £14 respectively.⁷⁸ In 1750 an ox cost approximately £3 in Bahia. As for the cost of foodstuffs, in Barbados (1647) food was expensive as noted by a correspondent to Governor Winthrop of Massachusetts:

... that they the planters had rather buy food at very dear rates than produce it by labour, so infinite is the profit of sugar works after once accomplished.⁷⁹

In Bahia, food was not expensive. The slaves grew food crops for their own subsistence and for the landlords. Also rented land was used to grow food crops. In fact almost all requirements were produced in the colony.

Besides vertical integration there is also evidence of horizontal integration. That is, several mill owners operated more than one mill. Already by 1587 there were thirty-six mills but only thirty-two owners. The following planters owned two mills: Sebastiao da Ponte, Sebastiao Farias, Diogo Correa de Sande, and Gabriel Soares de Souza.⁸⁰ This process continued over subsequent centuries. Table 17 discriminates the senhores de engenho who operated more than one mill in the Recôncavo in 1870. The concentration of mill ownership was, therefore, a common event in the sugar industry.

The economic processes developed by the sugar economy acted on geographical space in two ways. The vertical integration promoted the expansion of the agricultural space through the specialization of supply areas in inputs and/or food, whereas the horizontal integration reinforced the specialization by the areal concentration of the sugar factories. Furthermore, the population grew, generating an additional expansion of settlement in the hinterland.

6.6 Spatial Implications of Price Fluctuations

In "The Isolated State" the effect of a change in prices due to a change in demand was held to cause agricultural space to undergo adjustments (see Chapter Two, Section 2.2.2). Price increases were related to

TABLE 17

RECONCAVO: CONCENTRATION OF MILL OWNERSHIP, 1870

| OWNER | NO. OF MILL | LOCATION |
|-----------------------------------|----------------|---|
| José Ferreira Bandeira | 2 | Candeias |
| Joao Teixeira Barbosa | 2 | Candeias |
| Antonio Frutuoso de Menezes Dores | 3 | Sao Francisco do Conde |
| Joao de Oliveira Carneiro | 3 | Sao Francisco do Conde |
| Gomes Ferrao Castelo Branco | 2 | Sao Francisco do Conde |
| Jeronimo Mainez F. Barreto | 2 | Sao Francisco do Conde |
| Antonio Feliciano S. Carneiro | 2 | Sao Francisco do Conde |
| Joaquim Ignacio Bulcao | 2 | Candeias & Sao Francisco do Conde |
| Manoel Lopes da Costa Pinto | 2 | Terra Nova |
| Alexandre Moreira de Pinho | 2 | Terra Nova |
| Domingos Borges de Barros | 3 | Terra Nova & Santo Amaro |
| Sancho de Bittencourt B. Cesar | 7 | Santo Amaro |
| Antonio Joaquim P. Carvalho | 2 | Santo Amaro & Sao Francisco do Conde |
| Pedro Rodrigues Bandeira | 3 | Cachoeira & Santo Amaro |
| Ana Joaquina de S. Jose | 2 | Cachoeira & Santo Amaro |

SOURCE: Lucia Maria T. Tavares et al., "Cana-de-Acucar" in A Insercao da Bahia na Evaluacao Nacional 1a. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), pp. 33-39.

the expansion of the margin of production farther from the market, whereas a drop in price led the agricultural system to undergo a spatial contraction (see Figure 3c). Such spatial effects linked to price change suggest an increase or decrease in demand for agricultural products. According to von Thünen there is a direct relationship between the size of the market (i.e. demand) and the area of cultivated land.⁸¹ This theoretical projection of demand and supply does not seem to hold true in the case of Bahia. The reason for this deviation lies in the consideration of demand and supply as a unique law, as well as in the assumption that the population in "The Isolated State" had the same income level and that, therefore, the price of grain determined the prices of the other residual purchased items. Actually there are two separate laws of demand and supply. These two components combine in different ways so that prices may also rise or fall due to an increase or decrease in supply.⁸² Equalization of income level does not exist in the real world, and in addition each agricultural product has its own curves of demand and supply which vary according to the factors working on both sides. Agricultural space may undergo adjustments in the long run due to competition, policy, a fall in prices, etc. However, when one particular crop is affected, it does not follow that the overall agricultural space contracts. Under the theoretical assumption of complete isolation there exists the possibility that a decrease in population (negative natural growth and/or outmigration), reduces the cultivated area. In the real world, however, the probability of such a phenomenon occurring is quite low. In addition, agriculture does not respond to price fluctuations in absolute terms, due to the practical difficulties of shifting from one product to another. The economic history of agriculture has shown that prices may fluctuate without affecting the

physical production of crops and livestock in the short run. This happens because agricultural production can be adjusted to price conditions in other ways. For instance the reduction of variable costs is one alternative as is also the reduction of output through a more extensive approach to cultivation.

The price fluctuations for sugar during the seventeenth and eighteenth centuries did not affect the expansion of the colonial plantations. On the contrary it stimulated the expansion of the overall agricultural space in Bahia as will be shown in Chapter Seven. This deviation between the theory and reality may be explained by the following factors:

First, Bahia was not a true isolated state. There were two markets involved, the metropolitan and the local, both increasing in population and potential demand, and therefore, requiring diversified agricultural products.

Second, the rapid increase of sugar supply from West Indies production, forced the prices downward and actually leading to an increase in consumption of sugar in Europe. During the so-called Brazilian sugar cycle not only prices fluctuated (see Table 16) but also the amount of sugar consumed in the external market was lower because not all social classes could afford to buy it. However, it is estimated for instance that sugar consumption in England increased about four-fold at the end of the seventeenth century. Other countries also started to expand their sugar consumption, therefore, increasing the demand to a level that more than compensated for a lower price.

Third, Bahia faced external competition by lowering the costs of production. The vertical integration among sugar, cattle, and tobacco contributed to reduce the variable costs of the sugar industry, thereby

stimulating the expansion of crops and livestock. Von Thünen did not take into consideration this economic alternative for agriculture. Had indeed the total costs of sugar production increased and the prices remained lower, the colonial plantations would have probably contracted and another crop expanded into the sugar cane space. The expansion of sugar mills suggests an inverse response.

Finally, the plantation is an agro-industry requiring a number of different types of input. It constitutes a market by itself either through its concentration of population or by the demand for intermediate goods. Its expansion and high level of specialization suggests the expansion of tributary areas and the entrepôt. If the plantations had declined, Salvador would not have achieved the position of being the largest city in South America during the eighteenth century. Nor would the Recôncavo have become one of the most urbanized areas of Brazil during the same time. As further evidence of expansion settlement spread along the coastline (Mata zone), into the hinterland (Agreste and Sertao zones). Price fluctuations for one agricultural output do not necessarily lead the contraction of agricultural space.

REFERENCES AND FOOTNOTES, CHAPTER 6

1. From 1500 to 1822, sugar shared 56% of Brazil's exports and gold and diamonds 31.7%. From 1823 to 1830 sugar exports reduced to 30.1% being followed by cotton 20.6% and coffee 18.4%. See Peter L. Eisenberg, The Sugar Industry in Pernambuco: Modernization without Change, 1840-1910 (Berkeley: University of California Press, 1974), p. 5 (hereafter cited as Eisenberg).
2. Joao Antonio Andreoni was a priest who lived in Brazil, particularly in Bahia for thirty-five years. His book Cultura e Opulência do Brazil presents detailed information on the structural, social, managerial and economic aspects of the sugar plantations. The famous Engenho Sergipe do Conde described by him was located on the Recôncavo's seashore and its first owner was the third governor of Bahia, Mem de Sa. Although Andreoni's survey were carried out in the end of the seventeenth century, his information can be generalized until 1888 when the slavery abolition and the industrial revolution gave way to substantial changes in the plantation economy. See pp. 133-234.
3. See Cardim, pp. 319-321 and Andreoni, p. 140.
4. Buescu, H.E.B., p. 128.
5. A.P. Canabrava, "Joao Antonio Andreoni e sua Obra", introducao a Cultura e Opulência do Brasil (texto da edicao de 1711) por Joao Antonio Andreoni [Andre Joao Antonil], 2a. ed. (São Paulo: Ed. Nacional, 1966), p. 49 (hereafter cited as Canabrava).
6. Andreoni, p. 162.
7. Ibid., p. 171.
8. Ibid., p. 171.
9. Ibid., p. 141.
10. 1 slave day cutting = 350 cane packages (each package = 12 canes) = 4,200 canes = 1 sugar loaf
 1 sugar loaf = 3.5 arrobes (each arrobe 14.75 Kg) = 52 Kg
 daily grinding = 1 tarefa (.44 hectare) = 25 cartloads of cane
 1 cartload = (150 sugar cane packages x 12 canes) = 1,800 canes
 25 cartloads x 1,800 = 45,000 canes
 45,000/4,200 = 11 sugar loaves x 52 Kg = 572 Kg
 1,000 sugar loaves = 3,500 arrobes = 51,625 Kg or 51.6 metric tons

If 572 Kg = .44 hectare then 51,625 Kg = 39.71 hectares
 Yield/hectare = 1,300 Kg or 1.3 metric tons/ha.
 If 1 slave produced 52 Kg (1 sugar loaf) then 1,300 Kg needed
 25 slaves.
 Ibid., p. 141, 180, 189, 209.

11. Ibid., p. 144.
12. Canabrava, p. 49.
13. Simonsen, pp. 102-103.
14. Andreoni, p. 181.
15. Schwartz, pp. 175-177.
16. Buescu, H.E.B., pp. 110-113.
17. Ibid., p. 117.
18. See Vilhena, 1: 177 and Koster, pp. 162-163.
19. See Andreoni, p. 177; Vilhena, 1: p. 176; and José Honorio Rodrigues, "O Acucar Segundo o Depoimento de Jose do Silva Lisboa", Brasil Acucareiro 25 (1945): 48 (hereafter J.H. Rodrigues, O Acucar ...).
20. G. Souza, p. 199.
21. Vilhena, 1: 174.
22. Joao Pandia Calogeras, A History of Brazil, trans. and ed. by Percy Alvin Martin (New York: Russell & Russell Inc., 1963), p. 26 (hereafter cited as Calogeras); Canabrava, p. 66; and Carmen Vargas, "A Historia do Acucar no Brasil (III)", Brasil Acucareiro 80 (1972): 47.
23. F. Salvador, pp. 420-427.
24. Frederic Mauro, Le Portugal et L'Atlantique au XVIIe Siècle (1570-1670), Etudes Economique (Paris: S.E.V.P.E.N., 1960), p. 205 (hereafter cited as Mauro).
25. G. Souza, p. 173.
26. Ibid., p. 173 and Andreoni, p. 228.
27. Courtenay, p. 18.
28. Buescu, H.E.B., pp. 124-126.
29. Ibid., pp. 125 and Mauro, p. 219.
30. K.S. Taylor, pp. 36-37.

31. J.H. Rodrigues, *O Acucar ...*, pp. 47-49.
32. Eric Williams, *From Columbus to Castro: The History of the Caribbean 1492-1969* (London: Andre Deutsch, 1970), p. 116 (hereafter cited as Williams).
33. See Rômulo Almeida, *Tracos da Historia Econômica da Bahia no Ultimo Seculo e Meio* (Salvador: Instituto de Economia e Financas da Bahia, 1951), pp. 3-4 (hereafter cited as R. Almeida); Furtado, pp. 28-29; Canabrava, pp. 36-39; and Buescu, E.E.B., pp. 62-63.
34. Williams, pp. 112-114.
35. Richard B. Sheridan, *Sugar and Slavery: An Economic History of the British West Indies, 1623-1775* (Barbados: Caribbean University Press, 1974), pp. 118-122 (hereafter cited as Sheridan).
36. Sheridan, p. 107.
37. Williams, p. 124.
38. Ibid.
39. Ibid., p. 123.
40. Ibid., p. 121.
41. Deerr, 1: 233.
42. Ibid., p. 234.
43. Ibid., p. 240.
44. Ibid., pp. 129-131.
45. Boxer, *The Portuguese Seaborne Empire*, pp. 154-155.
46. Ibid., p. 155.
47. See Williams, pp. 126-127.
48. Ibid., p. 128.
49. See Andreoni, pp. 303-304; Furtado, pp. 94-95; and Buescu, E.E.B., pp. 70-71.
50. Simonsen, pp. 116-117.
51. See Furtado, pp. 93-94.
52. Simonsen, p. 381.
53. Buescu, E.E.B., p. 87.

54. Ibid., p. 52.
55. K.S. Taylor, pp. 39-41.
56. Andreoni, p. 228.
57. Williams; p. 123.
58. See R. Almeida, pp. 3-6 and Anais do Arquivo Publico da Bahia, vol. XIV, "Do Discurso Preliminar, Historico e Introductivo com Natureza de Descripcao Economica da Comarca e Cidade da Bahia" (Bahia: Imprensa Official, 1931), pp. 153-154.
59. See Sheridan, p. 119 and Williams, p. 112.
60. Williams, p. 113.
61. Ibid., p. 123.
62. Sheridan, p. 121.
63. Deerr, 1: 108.
64. Williams, p. 123.
65. Ibid., p. 124.
66. John Sjo, Economics for Agriculturalists: A Beginning Text in Agricultural Economics (Columbus: Grid, Inc., 1976), pp. 18-19 (hereafter cited as Sjo).
67. Beckford, p. 8.
68. G. Souza, pp. 150, 159, 169.
69. W. Pinho, p. 228.
70. See "As Terras de Guedes de Brito", Revista do Instituto Geografico e Historico da Bahia 42 (1916): 69-74.
71. MCA, A Terra e o Homem ..., pp. 143-144.
72. See Viheña, 1: 199 and Spix & Martius, 2: 307.
73. Preston E. James, Latin America, 4th ed. (Indianapolis: Bobbs-Merrill Company, Inc., 1976), p. 730.
74. Boxer, The Portuguese Seaborne Empire, p. 151.
75. Ibid., p. 170.
76. Ibid., pp. 170-171.

77. Andreoni, p. 249.
78. Williams, p. 123.
79. Ibid., p. 118.
80. G. Souza, pp. 153-169.
81. VTIS, p. 219.
82. Sjo, pp. 134-136.

CHAPTER 7

GRADUAL EXPANSION OF AGRICULTURE: THE IMPACT OF THE COLONIAL PLANTATION ON BAHIAN LANDSCAPE, 1571-1822

7.1 Introduction

The increase in the number of sugar mills in Bahia had an expansionist effect on the landscape. Evidence of this is provided by the parallel growth of the population and the expansion of the overall agricultural space. Salvador became the largest city of South America by the beginning of the nineteenth century. Specialized areas grew up to supply the metropolitan and local markets. Cattle trails opened up linking Salvador to the hinterland and the coastal trade intensified. The number of towns, villages, and hamlets increased, particularly in the Recôncavo which became one of the most urbanized areas of Brazil already in the 1700's. This chapter deals with these spatial effects of the colonial plantation system. The last section of the chapter will be a comparative analysis of the two stages of agricultural evolution so far studied. These will be viewed in the light of the model proposed by von Thünen.

7.2 Population Growth

The record of Bahia's population during the first centuries of colonization is based on estimates. The censuses carried out in the eighteenth century each had different objectives and criteria. For instance

they excluded the children below seven years old, the pagans, and in some cases even the Indians living in the villages administered by the priests. Among these censuses it seems that the most complete and reliable is that carried out in 1775. Although these records represent an under-estimation they do reflect the prosperity of Bahia, particularly the Recôncavo, during the eighteenth century.

Scattered records of Bahia's population from the late sixteenth to the early nineteenth centuries are presented in Table 18 which suggests

TABLE 18

BAHIA: EVOLUTION OF POPULATION, 1570-1817

| REGION | 1570 ^a | 1587 ^b | 1660 ^c | 1757 ^d | 1759 ^e | 1775 ^d | 1817 ^f |
|-----------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Recôncavo | 5,500 | 14,000 | 40,000 | 53,416 | 114,879 | 128,805 | data n.a. |
| Others | 2,100 | data n.a. | data n.a. | data n.a. | 27,636 | 53,759 | data n.a. |
| Total | 7,600 | 14,000 | 40,000 | 53,416 | 142,515 | 182,564 | 494,072 |

- SOURCE: a) Pero de Magalhaes Gandavo, Tratado da Terra do Brasil (Rio de Janeiro: Anuario do Brasil, 1924), pp. 29-34;
 b) Gabriel Soares de Souza, Tratado Descritivo do Brasil em 1587, 3a. ed. (Sao Paulo: Ed. Nacional, 1938), p. 133;
 c) F. Contreiras Rodrigues, Tracos da Economia Social e Politica do Brasil Colonial (Rio de Janeiro: Ariel, 1935), p. 28;
 d) Thales de Azevedo, Povoamento da Cidade do Salvador (Salvador: Itapua, 1969), pp. 188-193;
 e) Jose Antonio Caldas, Noticia Geral de Toda esta Capitania da Bahia desde o seu Descobrimento ate o Presente Ano de 1759, ed. fac-similar (Salvador: Tipografia Beneditina, 1951), pp. 65-70; and
 f) J.B. von Spix and C.F.P. von Martius, Viagem pelo Brasil, trad. de Lucia Furquim Lahmeyer, rev. de B.F. Ramiz, anot. de Basilio de Magalhaes (Rio de Janeiro: Imprensa Nacional, 1938), 2: 307.

two basic demographic aspects, one, the relatively small increase in population until the mid-eighteenth century; two, the high concentration of

population in the Recôncavo. The two censuses carried out for the overall captaincy (1759 and 1775) reveal an increase over sixteen years of 28% (\bar{x} = 1.75% per year), whereas from 1775 to 1817 the population almost doubled with an increase of 171% (\bar{x} = 4.0% per year). With respect to growth in the Recôncavo, data available up to 1757 (incomplete census) indicate a steady increase. However, in 1759 it had already 114,879 inhabitants and this increased 12% by 1775. It grew latterly, therefore at a slower rate than the total population. This shows that in the second half of the eighteenth century rapid growth was being experienced by other regions of the captaincy.

Estimates for Salvador, suggest that it held the position of the largest city in Brazil for over two centuries. In 1587 it had 4,000 inhabitants increasing to 21,601 and 37,323 in 1706 and 1757 respectively.¹ The most rapid growth of the city and its metropolitan area, however, seems to have occurred from 1775 to 1820. Lindley² estimated that the population reached 100,000 inhabitants in 1803. Spix and Martius³ estimated the population in 1817 as 115,000 inhabitants. It is important to observe that the rapid expansion of the city is verified even after the change of Brazil's capital to Rio de Janeiro (1763). Aguiar⁴ states that by 1820 the population of Salvador (150,000) was closer to New York (200,000) and Philadelphia (160,000) than Rio de Janeiro which had only 110,000 inhabitants.

The above figures indirectly reinforced the basis for the spatial expansion of the plantations. They also suggest a significant increase in the total domestic demand for food and other agricultural output. As a result of this growth process both the established and the new types of agriculture expanded in areas not suitable for the growth of sugar cane.

7.3 The Food Crops

The published literature tends to consider the type of food crops supplying the Brazilian market during the colonial period as products of subsistence agriculture. Prado⁵ for instance, using the criterion of market orientation, classified the colonial agriculture in two types. The first type was large scale agriculture oriented toward the external market, including sugar plantations, tobacco, cotton, and coffee, and the second type was subsistence agriculture oriented to supply the domestic market. This classification does not seem consistent with the terms as defined by economists. The scale of production depends on the size of operating unit, type of production, number of workers per farm, value of output per farm, etc.⁶ rather than market orientation. Prado's criterion is not satisfactory, therefore, to classify Brazilian colonial agriculture. Actually this aspect of Brazil's economic history still lacks a thorough study. The omission is most serious with respect to the agricultural sector supplying the internal market, and erroneously considered in the literature as subsistence agriculture. For this reason, in this context, the term subsistence agriculture will only be used in a strict sense, i.e. an agriculture oriented exclusively to self-sufficiency. Such a distinction has the purpose of showing that in the case of Bahia the demand for food gave rise to the emergence of important supply areas in the Mata zone, particularly in the western and southern Recôncavo which cannot be considered as subsistence agriculture. In addition, these regions developed an active trade with Salvador and the plantation areas which resulted in a significant expansion of settlement.

To study this sector of agriculture two types of food crops will be distinguished: perishable and non-perishable.

7.3.1 The Perishable Food Crops

In this context the perishable food crops include production of fruits and vegetables. The literature dealing with this type of agriculture is scarce. However, the earliest chroniclers, often refer to the variety of fruits and vegetables growing in Bahia from the beginning of colonization.⁷ Souza's detailed descriptions of Salvador in 1587 specifies the presence of a mixed horticultural belt around the city as follows:

The land surrounding this city [Salvador] about one to two leagues is almost all occupied by small farms ... where food crops, fruits, and vegetables are grown to supply the city dwellers who do not grow their own provisions and the foodstuff is sold in the city market which is always well supplied ...⁸

Pyrard de Laval⁹ in his visit to Salvador in the beginning of the seventeenth century saw beautiful vegetable gardens in which grew lettuce, cabbage, cucumber, radishes, etc. Lindley¹⁰ in 1803 emphasized that the cropped area around Salvador contributed to the enlargement of the city area. Spix and Martius¹¹ were impressed by the evergreen appearance of the area surrounding Salvador and by the quantity of banana and orange trees. From 1625 fruits and vegetables had their prices regulated in the city market.¹²

In 1758 it was claimed that the orchards contributed to disorganize the urban space.¹³ According to Azevedo¹⁴, the high production of fruits gave rise to the development in Salvador of a domestic manufacture to produce dry fruits, candies, juices, etc. from which derived the prosperity of many artisans. In the seventeenth century the prices of these goods were also regulated.

The historical literature implicitly or explicitly provides qualitative evidence to prove that a zone of perishable food production

developed around Salvador from the earliest days of colonization. For this type of agriculture the site of the city was suitable. Deep narrow valleys provided fertile soils and plenty of water to grow vegetables whereas the slopes and the uplands were used to grow trees crops (banana, orange, lime, mango, etc.). Similar intensive agricultural land use could be observed in the outskirts of the city up to the present century. However, with respect to the farm size, system of production, and the land ownership there is no historical information.

7.3.2 The Non-perishable Food Crops

Included in this particular category of food crops are the production of starchy foodstuffs such as manioc, rice, corn, and beans. Actually manioc is a root which under natural conditions may not be classified as non-perishable crop. However, it cannot be consumed without processing it into different types of products, among them manioc flour (farinha-de-pau), a basic staple of the Northeast diet. This condition, therefore, justifies its classification. Further, the fact that manioc needs to be processed and that manioc flour can be more easily transported and stored means that it can be grown farther from the market.

During the colonial period foodstuffs were probably produced in Bahia by smallholders including owners, tenants, sharecroppers, and squatters. Their situation as a free labour force living in the rural areas differed, however, from the ranchers and mill owners. They belonged to a lower social stratum as well as lacking capital. Accessibility to the grant titles was thus difficult. Ethnically they might be either Portuguese, Indians or free Negroes, and their descendants. However, these general features are based on historical inference rather than on empirical data.

So far food production has not received much attention from the specialists who have classified this sector as subsistence agriculture and the generalization may be questioned on a number of points. Did the tillage methods of growing food crops differ from the plantations? To what extent could subsistence agriculture supply a large city, fleets, and to some extent the plantations? Were the food crop areas located randomly or were they located according to a general principle? An attempt to answer these questions will be made below.

7.3.2.1 Technology and Scale of Production. Insofar as the agricultural technology is concerned there were two methods of producing food crops in Bahia. One, traditional and extensive, adopted from the Indians called roca will be described here. The other, more advanced and intensive method consisted of a primitive crop rotation in which tobacco, manioc, and beans or corn completed a triennial or biennial cycle. This method will be described in Section 7.4.2, below.

The roca method was an annual practice in which fire, natural fertility of the soil, and primitive equipment were combined to support temporary crops. After some harvests, the field was abandoned and another one was opened up in the forest or in the bush or in previously abandoned plots. This method, as observed at the present time probably presented two variations, shifting cultivation and land rotation.¹⁵ The former, typically indigenous was practiced by the colonists on the agricultural frontiers where the low demographic density permitted long fallows. The latter, based on shorter (bush) fallow had to be used in the settled areas where the ownership rights and the property boundaries precluded a long rotation. Freire¹⁶ states that in the eighteenth century the intensive use of land to grow manioc caused the erosion from seven to eight leagues

(42 to 48 kilometers) of the Contas River banks (Ilheus Captaincy).

This environmental disequilibrium suggests, therefore, short fallows and small properties as well as high demand for manioc flour. From a technological viewpoint there was no difference between the method used to grow food crops oriented to supply the domestic market and that used to grow sugar cane. Both types of agriculture utilized land rotation and primitive equipment (hoe, axe, scythe, etc.).

With respect to the size of operating units there are indications that food crop production was carried out on a small scale. For instance the land as a factor of production was granted to colonists with social status derived through economic power, military and/or administrative position. Those landlords in search of high profits and social prestige preferred to invest in the plantations, and/or the livestock sector and to rent the land out rather than to grow food crops themselves. On the other hand the colonists without land and capital could not operate large units nor engage in the most profitable agricultural sectors. The food crop sector presented, therefore, an alternative occupation for these settlers. They could provide subsistence for the family as well as producing a surplus to sell. The historical literature also refers to the shortage of starchy food, in spite of plentiful land. The technological, social, and economic conditions prevailing in this agricultural sector lead one to infer that the operating units were small and oriented to supply the domestic market.

7.3.2.2 Demand for Starchy Food. In the first years of colonization Salvador's low demand and the plantations' own provision meant that the supply of food was satisfactory and easily achieved. However,

as the sugar industry expanded, the city population grew, and the metropolitan trade increased, food supply became a crucial problem. Land, capital, and labor in the Recôncavo were progressively allocated to export agriculture while the food crop sector became marginalized. Complaints of food shortages resulted in the establishment of laws and warrants forcing the tillage of manioc.

In 1635 the Senate forbade the cultivation of tobacco due to a shortage of manioc flour.¹⁷ This prohibition did not have any marked effect. A royal law of 1688 established that for a radius of ten leagues from the Bay of All Saints inland, all settlers, mainly the sugar cane planters and the tobacco growers, were obligated to plant 500 mounds of manioc per slave in service.¹⁸ Again this law was relaxed so that the export crops as well as livestock continued to attract the factors of production. Finally in 1701 another law extending from the Recôncavo to the southern capitaincies prohibited the raising of cattle in the same perimeter (ten leagues) as well as establishing possession of six slaves as the minimum required to allow the owners to grow sugar cane.¹⁹ It also reinforced the 1688 law, stipulating that one-third of manioc grown should be reserved to supply the farmers whereas two-thirds should be sold. The same law obligated the businessmen engaged in the slave trade to possess land sufficient to grow manioc to supply their crews and the slaves they transported. These laws were again confirmed by a royal provision of 1767. Later, a clause was inserted in the grant titles, requiring a guarantee that a certain number of mounds of manioc be tilled from the first year of the ownership.²⁰ These laws were not properly observed, in the Recôncavo. In 1807 the mill owners, represented by Manuel Ferreira Câmara reacted against the Crown's policies through the following statement:

I support more than 250 people; their sustenance costs me, according to present prices of manioc flour, between thirty-six and forty thousand reis each week; and I will not plant a single root of manioc, so as not to fall into the absurd situation of renouncing the best crop in this country for the worst that exists.²¹

This statement suggests that the plantation areas did not observe the laws. Conversely they became an important market for food. By 1781 Salvador alone, with a population estimated as 50,000 inhabitants annually consumed 13,000,000 liters of manioc flour.²² Also the fleets required a large amount of provisions. To supply the high food demand tributary areas emerged which may be partly related to the Crown's laws.

The amount of starchy foodstuff entering Salvador's market (Celeiro Publico) from 1785 to 1821 is shown in Figure 15. Although the supply pattern shows fluctuations over the period, the general trend indicates an increase in supply up to 1819. Considering each product per se, manioc flour has more steady output, distinguished from rice, corn, and beans by its increasing trend compared with the year base (1785). From this supply pattern two major conclusions may be drawn; one is that the Crown's laws had a spatial effect expressed in the increasing production; the other is that such an amount of foodstuff required production at more than a subsistence level. With respect to the records, one must bear in mind that only part of the total production is recorded. Significant quantities of food were sold directly to mills, towns, and villages in the Recôncavo. Vilhena²³ reports that loaded vessels and boats usually preferred to supply those markets directly because there the traders did not have to pay storage taxation as they did in the Celeiro Publico.

To reinforce the viewpoint that food crop production was market oriented, Figure 16 displays the prices of selected starches in the

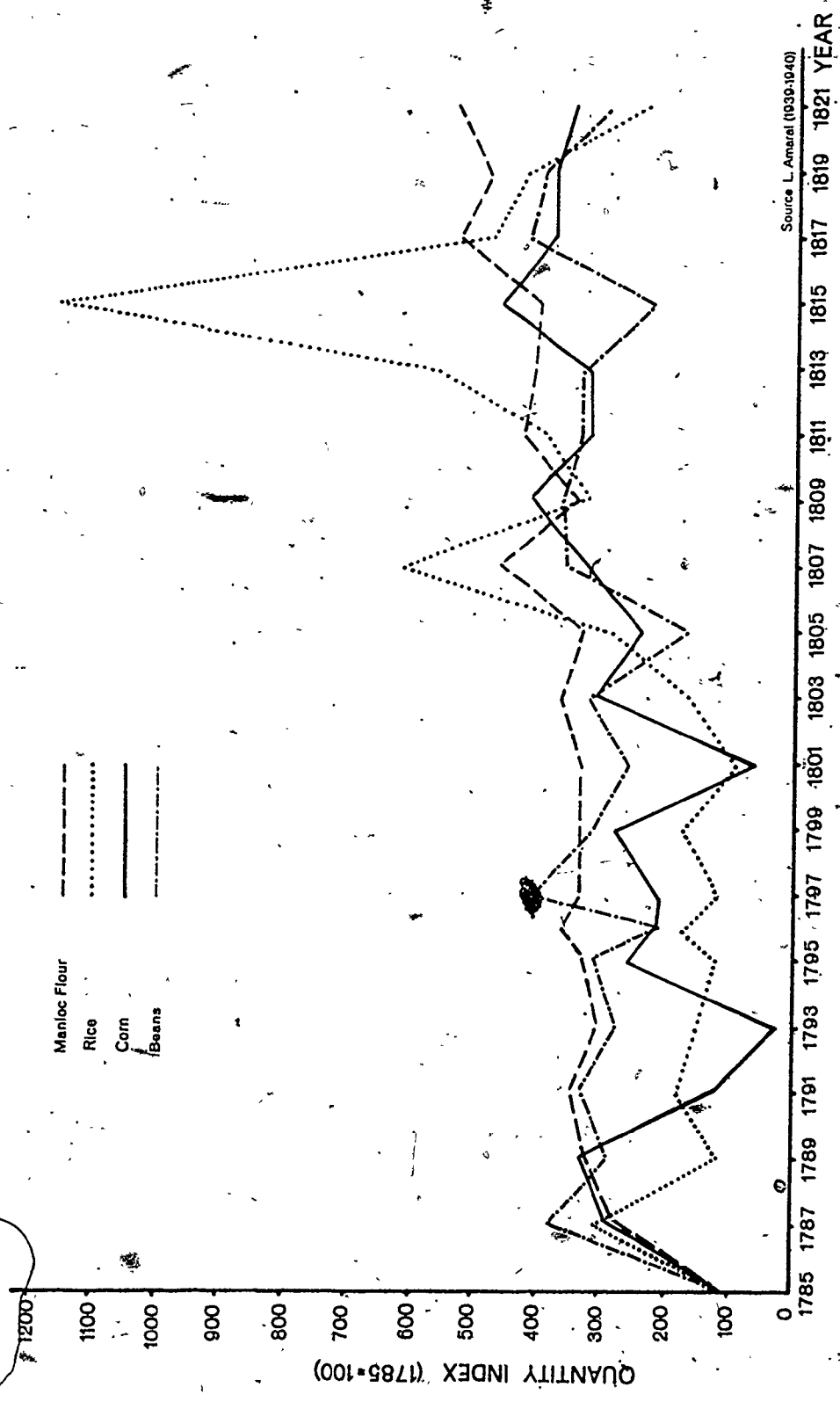


Figure 15 Amount of Starch Foodstuffs Entering Salvador's Celeiro Publico; 1785-1821

1327

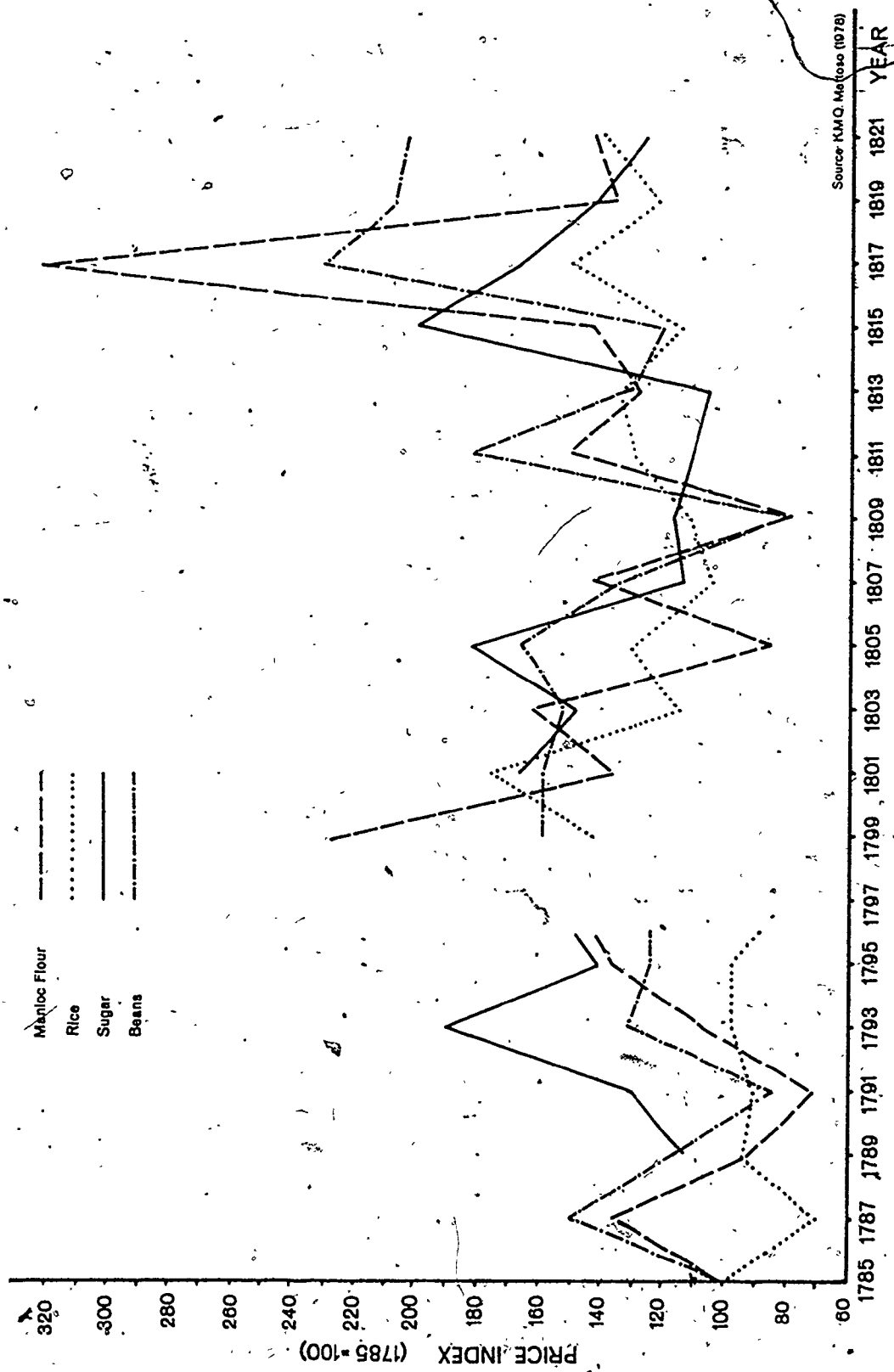


Figure 16 Prices of Selected Foodstuffs in the Salvador Market, 1785-1821

Salvador market (1785-1821). The price pattern fluctuated more than the supply pattern. Food prices for instance show a strong trend to follow sugar prices, indicating that this export product considerably influenced the cost of living in Salvador. However, there are some years in which food prices were relatively higher than sugar (1811-1821) particularly manioc flour and beans. This suggests that supply did not entirely satisfy demand. Another aspect to emphasize is the strong response to prices. It is noticeable that the positive relationship between upward prices and increase in the supply of starchy foodstuffs is evident after 1809. Despite the instability of price for manioc flour the output remained steady because it is a staple food item. In general the supply of beans and rice also tended to be related positively to price. By taking into account the imperfect knowledge of market at that time one may admit that food production operated strongly in relation to prices. Such a relationship leads to the conclusion that, in spite of the small operating units, the food crop sector was really market oriented. Subsistence agriculture would not respond to price nor could it supply a continuously expanding market.

7.3.2.3 Location of Food Crops. It was pointed out in Chapter Five that the production of food crops in 1570 (Figure 11) was basically concentrated around Salvador. The expansion of sugar plantations, ranches, and of tobacco areas displaced the food crops. The previously mentioned Crown laws did not much affect the expansion of these types of agriculture already established. On the other hand the dizimos paid by the Ilheus and Porto Seguro Captaincies to the Crown were still low up to 1745. The sugar industry started in these captaincies in 1536 but were

not successful at that time. However, the long coastline not only presented ecological conditions favorable to growing food crops but were also suitable from the point of view of transportation facilities. All these conditions favoured their becoming important food supply areas for Bahia. For instance, from 1648 the Ilheus Captaincy (Cairu, Camamu, and Boipeba) had to ship to Salvador 163,215 liters of manioc flour per year as taxation.²⁴ The Crown's policy, therefore, produced a spatial effect especially outside the Recôncavo.

From the maps of the supply areas for Salvador and the plantations, Figures 20 and 21, it can be observed that these areas were not randomly located. Their location in the Mata zone close to the coastline indicates that they reflected the influence of minimum costs of transportation. This fact justified the linear distribution of the supply areas stretching along the coast from the Recôncavo southward. This location also reinforces the viewpoint previously held that the production of food crops in Bahia was market oriented. A subsistence agriculture would not have located according to the transportation routes nor would it have presented such a regular pattern of distribution. Rather its location would be more random, determined by natural conditions and/or cultural and territorial limitations, as was the case with the Indian settlements.

7.4 The Cash Crops

To satisfy different types of demand a third group of crops expanded during the colonial period. These crops were cotton, which was grown from the earliest days of colonization, tobacco, and coffee. Their economic importance, however, was secondary compared with sugar. The reasons which account for this secondary position are evident from the study of each crop.

7.4.1 Cotton

It was pointed out in Chapter Five that cotton emerged in the Recôncavo close to the sugar plantations. But the expansion of the colonial plantations and tobacco displaced cotton from its earliest location.

The literature does not explain several aspects of cotton production. For instance while it is known that cotton spread relatively fast in the Agreste and the Sertao, there is no reference of when this diffusion took place nor in what areas it was grown in the seventeenth century. It seems that it followed expansion of the ranches.

Up to the eighteenth century cotton was grown to supply a very small domestic market constituted by the slaves and the poorest colonists. Although the external demand kept increasing, several reasons precluded a large production in Bahia; first, the metropolitan trade providing textiles to the colony created a barrier to the crop expansion; second, a law of 1785 prohibited local textile manufacturing and third, North American plantations competed with Bahia. In spite of these disadvantages, the gold rush and the consequent increase of the domestic market, and external demand favoured some expansion of cotton acreage during the eighteenth century.

It seems that the farming method to grow cotton was one of land rotation and few investments were needed. The scale of production is unknown. Also there is no information about the farmers, tenure, etc. During the first two centuries of colonization cotton was probably produced by smallholders and tenants. Scattered information specifies that in the southwestern Sertao (Caetite) and the central Agreste (Feira de Santana) cotton was produced on a large scale by the end of the eighteenth

century.²⁵ The importance of this crop, however, was short lived.

The crop ecology of cotton, which dislikes large amounts of precipitation, as well as its minor importance as an export crop, had a strong effect on its location. Figures 20 and 21 show that among the crops cotton was grown in areas where the transportation facilities were the poorest. This disadvantageous location may be viewed, however, as a result of its economic role. The rapid expansion of cotton in the second half of the eighteenth century led to the emergence of three major production areas (Figure 21). The first area was located in the northeastern Recôncavo (Camacari), where a good quality of cotton was grown which produced consecutive harvests from four to five years. The second area was located in the Agrêste (Santo Estevao, Feira de Santana, Inhambupe, and Itapicuru). A third area emerged in the Sertao (Jacobina, Caetite, Brumado and the Sao Francisco Valley). The first two areas sent cotton to Salvador, whereas the third area supplied Salvador and Minas Gerais where weaving developed from the time when the region became important for mining (1694-1760).²⁶ The most important area, however, was the southwestern Sertao, where the climatic conditions favoured the crop expansion. Its location farther from Salvador and the lack of transportation facilities made the product expensive. For this reason the area became tributary to Minas Gerais.

7.4.2. Tobacco

After sugar cane, tobacco was the second most important cash crop. The beginning of tobacco cultivation on a commercial scale is not precisely known but it probably started in the very early seventeenth century. Souza²⁷ reports that in 1587 tobacco was grown in the yards and

vegetable gardens for medicinal purposes. In Europe it had the same use, which meant that, there was no market to justify production on a commercial scale before 1600 when the habit of smoking was introduced. The first market for tobacco, however, was the slave trade (Chapter Six). Its expansion must be related to the African traffic and the prohibition against tobacco farming in Portugal (1649).

7.4.2.1 Tobacco Farmers and Scale of Production. As was discussed in Chapter Six, the historical literature does not clarify who were the tobacco growers. Andreoni compiled detailed information on the method of farming tobacco, but he did not refer to the farmers. Other writers followed the same line. Evidence has been presented to show that sugar, cattle, and tobacco were vertically integrated, and therefore, sugar cane planters, ranchers, and tobacco growers were united in the same enterprise. But it seems that smallholders and probably tenants were also involved in growing tobacco, considered one of the most profitable crops during the colonial period. Andreoni²⁸, referring to the labour force engaged in tobacco tillage mentioned the presence of old people and children, men and women, overseers and slaves. Information on a familiar labour force indicates the presence of smallholders and/or tenants. On the other hand overseers and slaves suggest larger holdings. Another source states that tobacco did not require a large property nor large amounts of investments, so that there were farmers whose production amounted to twenty rolls whereas others exceeded two hundred or more rolls per harvest.²⁹ Poppino³⁰ reports that in Feira de Santana (Agreste), tobacco growers leased small plots of land (less than 3 hectares) from the ranchers, paying the lease in kind (one-sixth or one-fifth). Vilhena³¹ estimated that there were 1,500 tobacco farmers, both large

and small, in Bahia. From their information one may conclude that tobacco was produced on both a small and a large scale; reinforcing, therefore, the vertical integration of sugar, cattle, and tobacco, and its thoroughly commercial nature.

7.4.2.2 Farming Method. Tobacco grew in the tabuleiro soils (sandy and porous) not suitable for growing sugar cane. The low fertility of these soils gave rise to the development of the most sophisticated agricultural technique in Bahia. Tobacco seeds were first planted in small manured areas called canteiros. When the plants grew they were transplanted to the fields which were called currais, also manured. Protection was afforded against the excessive heat, while the crop was regularly weeded, pruned, and the caterpillars and other pests removed. The processing stage consisted basically of curing and twisting into rolls and the overall procedure took about six to eight months. It seems that in the beginning of tobacco cultivation there was no crop rotation. However, the constant prohibitions and laws protecting the food crops must have produced a rotation system in which tobacco was replaced successively by corn and manioc or manioc and fallow. Tobacco required large numbers of workers as well as quantities of manure. It was estimated that a slave produced 98 arrobas (1.446 metric ton) a year.³² The tobacco farming system, therefore, was intensive with respect to the use of land and labour. However, the amount of capital invested was less than in the sugar plantations. Actually the equipment used to till and process tobacco was primitive, so that everyone possessing low amounts of capital could farm it. This fact had a particular influence in the location of the tobacco region.

The technology so far described was practiced in the Recôncavo. Tobacco also spread in the Agreste and the Sertao. The farming method used in these zones, however, was the roca system (land rotation).

Records on production are not available but according to Andreoni³³ Bahia exported an annual average of 25,000 rolls and the annual Crown revenue was estimated at £240,000 in the early 1700's. Bahia was the largest Brazilian producer.

7.4.2.3 Location of Tobacco Areas. Tobacco expansion was influenced by the sugar plantations. As was previously emphasized, the output was basically used to barter for slaves. During the eighteenth century, however, increasing quantities were also shipped to Portugal.

Although the methods of growing tobacco were intensive with respect to the use of land and labour, the producing areas were located farther from Salvador than the sugar plantations. The reason for this less advantageous location can be explained by the amount of capital invested and the costs of production involved in both types of agriculture, the plantations and the tobacco farms. Data on capital investment are not available for both crops, but considering the costs of production, Andreoni³⁴ evaluated that a chest of white sugar (35 arrobas) including all expenses cost 84,560 reis whereas a tobacco roll (8 arrobas) cost 12,124 reis. It must be emphasized that transportation was included in both evaluations. The location of tobacco area in the western Recôncavo (Figure 20 and 21) is, therefore, related to the lower investment of capital required to grow the crop.

Santo Amaro da Purificacao and Caehoeira were the first parishes in the Recôncavo to farm tobacco both were also important plantation areas. This geographical juxtaposition adds more evidence to their economic

integration. During the eighteenth century the crop started to expand to the Agrêste (Feira de Santana, Inhambupe, and Itapicuru).*

7.4.3 Coffee

Coffee was certainly introduced to Bahia after 1723 but the first area of growth is unknown. Taunay³⁵ states that in 1782 there were 400,000 coffee trees in the Ilheus Captaincy. In this captaincy, Camamu and Cairu shipped an increasing quantity of coffee to Salvador by the end of the eighteenth century.³⁶ The diffusion of the crop started, however, in the nineteenth century. In 1818 German and Swiss founded an agricultural colony in the Porto Seguro Captaincy to grow coffee in large scale. Spix and Martius³⁷ observed important coffee areas in the western Recôncavo (Muritiba) and in the Agrêste (Castro Alves). It seems, therefore, that coffee spread simultaneously southward in the Mata zone and Agrêste. But its rapid expansion occurred in the second half of the nineteenth century.

Coffee in Bahia never had the features of large scale agriculture nor did it require a large amount of capital investment. Literature on coffee production is scarce, so no information is given with respect to the coffee growers. In Bahia, however, coffee was a minor crop after sugar cane, and tobacco. This situation suggests that coffee was probably grown by small and medium-sized holders. An exception is the Leopoldina colony founded in 1818 in Caravelas (Porto Seguro Captaincy). There, European entrepreneurs (German and Swiss) established coffee plantations based on slave work. This colony had forty coffee farms employing 130 free workers and 1,267 slaves and in its earliest days production accounted for 60% of Bahia's total output.³⁸ By 1817 Spix and Martius³⁹ recorded a total

*The location of municípios indicated on Appendix map.

export of 10,000 arrobas (147.5 metric tons). But the largest production of Bahia occurred in the late nineteenth century.

As a perennial crop, coffee is intensive with respect to the land use but it requires less capital and labour than do the sugar plantations and the tobacco farms. For this reason it occupied a location farther from Salvador where the lower costs of production compensated the higher transportation costs (Figure 21).

7.5 Ranching and Subsistence Agriculture

After 1570 cattle ranching expanded rapidly into Bahia's hinterland. The reasons for such expansion are many.

First, there was a huge area available in the interior which had been granted since the beginning of colonization. Cattle were found to be better suited to occupy the land, while their presence confirmed ownership rights.

Second, the natural conditions of the Agreste and the Sertao favoured the expansion of ranches. The flat uplands (tabuleiros), covered by the caatinga and the cerrado offered sufficient natural pasture and salt soils. Perennial rivers such as the Paraguacu, Itapicuru, Inhambupe, Real, and Sao Francisco could supply sufficient water for the herds and the subsidiary subsistence agriculture.

Third, there was no need for a large qualified labour force. The Indians who did not adapt themselves to disciplined work in the plantations were found to be excellent supply of manpower for the ranches. Hence, the Portuguese with a small population could colonize a vast space and extend the political boundaries.

Fourth, exploration into the interior (searching for precious

metals and also capturing Indians) stimulated a fast expansion of agricultural frontier.

Fifth, cattle could be driven to the market at low costs, requiring few cattle drivers, and despite lack of roads.

Finally, there was a rapidly expanding domestic market. The plantations demanded large numbers of draught animals and beef. Salvador and the coastal villages also needed beef. Later the metropolitan market also offered an opportunity to export hides and leather.

In the late sixteenth century cattle spread inland from two foci. One emerged in the western Recôncavo, along the Paraguacu River. The other focus started from the Garcia d'Avila ranches in the northeastern Recôncavo. By the end of the seventeenth century large areas in the Agreste and the Sertao were already extensively occupied by cattle (Figure 20) and the Sao Francisco Valley became a major area of concentration:

The importance of livestock economy as well as the ranching system also contributed to the emergence and expansion of the subsistence agriculture in the hinterland.

7.5.1 The Factors of Production

The livestock economy did not face problems related to land, labour, and capital which were typical of the coastal areas of the colony.

The land was granted in the earliest days of colonization which resulted in the concentration of ownership. Andreoni⁴⁰ reports that by the beginning of the eighteenth century large areas of the Agreste and Sertao belonged to the Garcia d'Avila family, known as the Casa da Torre (the House of Tower) and the Antônio Guedes de Brito family. The former

owned 280 leagues on both banks of the Sao Francisco River whereas the latter owned 160 leagues ranging from the middle valley to its source in Minas Gerais. In spite of this land monopoly, the fragmentation of these huge sesmarias was inevitable. Actually the landlords could not occupy their estates being forced to rent part of them, whereby a more liberal tenure system emerged in the hinterland.

Cattle were raised on two types of ranch. The larger called fazendas (farms) occupied three leagues in length by one in width (13,068 hectares), located along a watercourse, extending a half league on each bank.⁴¹ The 'smaller' called sitio (small farm) measured one league in length by one in width (4,356 hectares).⁴² These sitios were leased at a yearly amount of 10,000 reis (approximately £3).⁴³ In 1815 the House of Tower had ninety-one sitios rented in the Sertao (Jeremoabo).⁴⁴ The ranches so structured formed huge open range on which six kilometers were left between the farms to prevent cattle straying into the neighbouring territory.⁴⁵ This space remained unoccupied and none of the ranchers were allowed to construct buildings or to undertake any type of work there. Land was, therefore, a cheap and plentiful factor of production so that cattle numbers could easily expand in the interior.

The tasks carried out on the ranches did not demand a large amount of labour. A manager and/or cowboy (vaqueiro) could manage a large estate with the aid of few workers i.e. less than four (Negroes and/or Indians). They also provided their own subsistence by cultivating small rocas on which grew the basic staples (manioc, beans, and corn). These workers, in general earned a monthly or yearly salary. But there were also peasant families (agregados) living on ranches, practicing subsistence agriculture and in return working free for the landlords once or twice a week. The

labour force employed in the ranches was cheap and the number of workers few.

The capital needed to establish a ranch was minimum. Cattle constituted the basic capital. They also furnished equipment such as rope, cloth, bedding, harness, bags etc. while the buildings (corral and houses) were constructed with inputs such as wood, stone etc. also provided on the farm itself. To install a corral a minimum of three heifers, one cow, and one bull were needed.⁴⁶ Usually, several corrals were established at once and close to each other. In short time the capital invested was doubled or trebled.

The low operating costs for a ranch account for the rapid expansion of livestock as well as for the stability of this agricultural economy.

7.5.2 Ranch Operation

Ranching was the most extensive type of agriculture developed in Bahia. According to Andreoni⁴⁸ Bahia's ranches raised on average from 6,000 to 20,000 head, that is, operating extensively.

Although a ranch operated extensively, a vaqueiro (cowboy) had several tasks to carry out. He had to take care of feeding the cattle. The natural vegetation provided the basic feed but annually before the rainy season, the pastures had to be alternately burned to ensure more succulent forage. This task was aided by the subsistence agricultural practices. Most of the staff's time was taken up supervising the animals because the ranches were large and unfenced. Domestication of the herds was also a hard task which demanded time and care. The cows about to calve had to be prevented from wandering off as they frequently did. Once a year the new calves had to be branded. To compensate for these hard

tasks the vaqueiro was paid in kind. That is, every five years he received one-fourth of the production. This type of payment also facilitated the social mobility in the hinterland so that a cowboy could easily become a rancher.

The economic focus of the operating units was to raise cattle which accounted for the largest revenue. However, the ranches also raised other animals such as horses, mules, and donkeys for transportation as well as goats and sheep for meat.

The ranches were self-sufficient in many aspects. The subsistence agriculture provided the starchy food and raw materials such as cotton and tobacco. Also the construction and provision of equipment was largely carried out using locally furnished materials.

7.5.3 Production and Supply

The natural, social, and economic conditions in which the ranching system was developed in the hinterland leads one to admit that the density of cattle, the productivity of herds and the yields per head were low. Records are not available but according to Andreoni⁴⁷ the number of head in a corral ranged from two hundred to one thousand. However, neither the area of a corral nor the number of corral per ranch are reported. The low density, for instance, may be inferred from the ranching features themselves. The natural pastures were poor and cattle ranged widely. Diseases, droughts, wild animals, poor quality breeds all affected productivity. Evaluation based on the colonial breeds raised in the traditional ranches (open range) still prevalent in the Northeast estimate an average of more than five hectares to feed one beef animal which yields between 135 and 150 kilograms live weight.⁴⁹

The byproducts such as milk and cheese were not market oriented. Milk, for instance, was used to meet the requirement of the ranches in the form of curd and cream cheese. Butter, on the other hand was not manufactured at all. These constraints were probably related to the Crown policy through which the colony was forced to import several food-stuffs, among them butter from the metropolitan market.

In spite of the limitations of the ranching system the overall herd steadily increased related to the demands of the coastal areas. The total production may be evaluated from the several sectors of the colony which the ranches had to supply. The sugar plantations demanded draught animals and beef. Salvador and the towns and villages had their basic nutrition centered on beef. Tobacco and cotton farms needed large quantities of hides to package their products. Also hides and different types of leather were increasingly exported to Portugal. Andreoni⁵⁰ calculated that in the beginning of the eighteenth century there were over five-hundred corrals, all located in the river valleys (Sao Francisco, Inhambupe, Itapicuru, Pojuca, Jacuibe, Real, etc.) and the total herd of Bahia was over 500,000 head. The supply of the Captaincy was also complemented by cattle driven from Piaui and Pernambuco (west bank of Sao Francisco), which were partially settled by Bahian ranchers.

Cattle were usually driven to the Capuame fair (Figures 20 and 21) close to Salvador in lots varying from one hundred to three hundred animals. There cattle were registered and sold to the butchers who controlled the city supply. Cattle were probably also driven directly to the plantations. As was pointed out in Chapter Six, the planters were also ranchers. The lots were driven by cattle drivers (whites, Negroes, Indians and their descendants) over long distances. Journeys could be

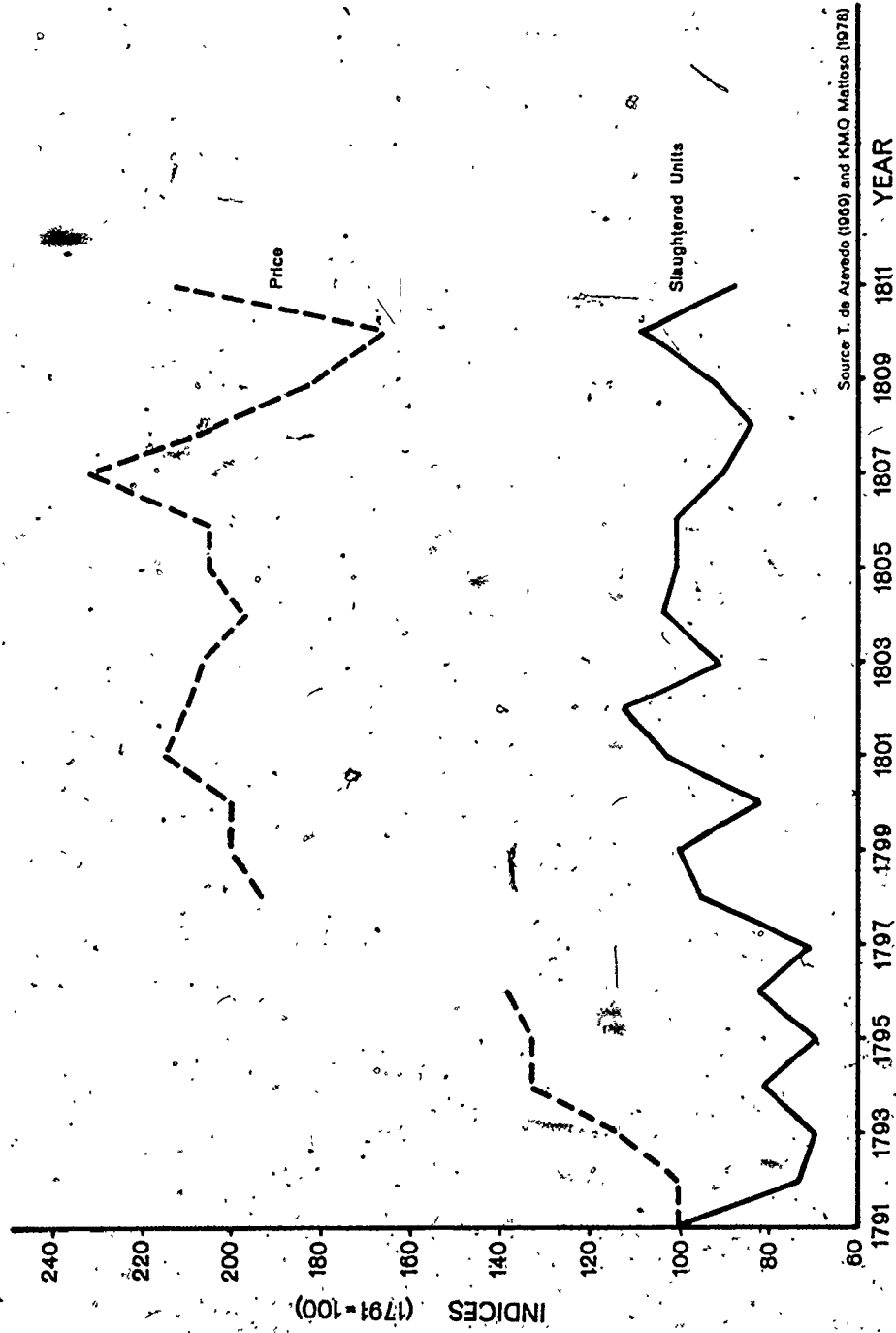
from twenty-four to one hundred and twenty kilometers according to the situation of the trails. The cattle drivers were paid per animal transported and according to the distance.⁵¹

Salvador's supply may be evaluated from the records presented in Appendix C. These records (slaughtered units) are associated to the price in reis (one kilogram of beef) in Figure 17. The pattern depicted indicates that the supply did not completely satisfy the demand. This inference is based on the relatively high prices that held over the period. The highest prices are associated with the lower number of slaughtered units and vice-versa. This association suggests that the cattle supply operated with some knowledge of the market. However, there is evidence that prices were rather controlled by the middlemen than by the ranchers.

Azevedo makes this point clear through the following statement:

In 1793 and 1794 the arroba of beef cost 600 reis; but the beef monopolists, dissatisfied, finally succeeded in raising that price to 800 reis. To achieve this advantage, they reduced the entrance of cattle so that in the weeks prior to the price increase sixty, fifty, thirty head were driven to the city and in some weeks none. However, in the week following the price increase, the butchers went to Jacobina ... and to Piani ... and in the same weeks they entered the city with over four hundred head of cattle.⁵²

The aforementioned statement indicates that the beef production was sufficient to supply the domestic market. The apparent shortage may be viewed as a market gamble in which the middlemen played an important role in price control.



Source: T. de Azevedo (1969) and K.M.O. Mattoso (1978)

Figure 17 Comparison of Beef Prices and Numbers Slaughtered in the Salvador Market, 1791 - 1811

7.5.4 The Impact of Ranching on the Settlement of the Hinterland

The expansion of the ranches in the Bahia's hinterland has been previously studied by others. Attention has been focused on the social and spatial effects of the plantations in the Recôncavo where the settlement has remained concentrated. Population dispersion and the prevalence of latifundia have been often considered as negative effects of ranching in the hinterland. Actually these effects should be analyzed in the light of the external forces acting on the overall economy which precluded the transformation of the traditional agriculture. The ranching system, when analyzed in its historical context, reveals a striking contribution to the social and spatial organization of the interior (Agraste and Sertao).

With respect to the social organization, ranching was indeed more liberal than the plantations. Figure 18a shows diagrammatically that the social hierarchy was simpler and the mobility easier than in the sugar plantations. The fact that to operate a ranch did not demand large amounts of capital nor a large labour force, contributed to cowboys and/or manager rapidly ascending to the position of rancher. The peasants (sharecroppers, agregados, etc.) had less opportunity to move upward as ranchers but they could eventually hope to become an independent farmer. The cattle economy also generated other types of independent employment such as cattle drivers, middlemen, artisans, etc.

The expansion of ranching on the other hand, had an outstanding influence on the spatial organization (Figure 18b). Cattle opened trails on which railroads and roads were later superimposed. These trails linking the coastal areas to the interior operated as the first economic

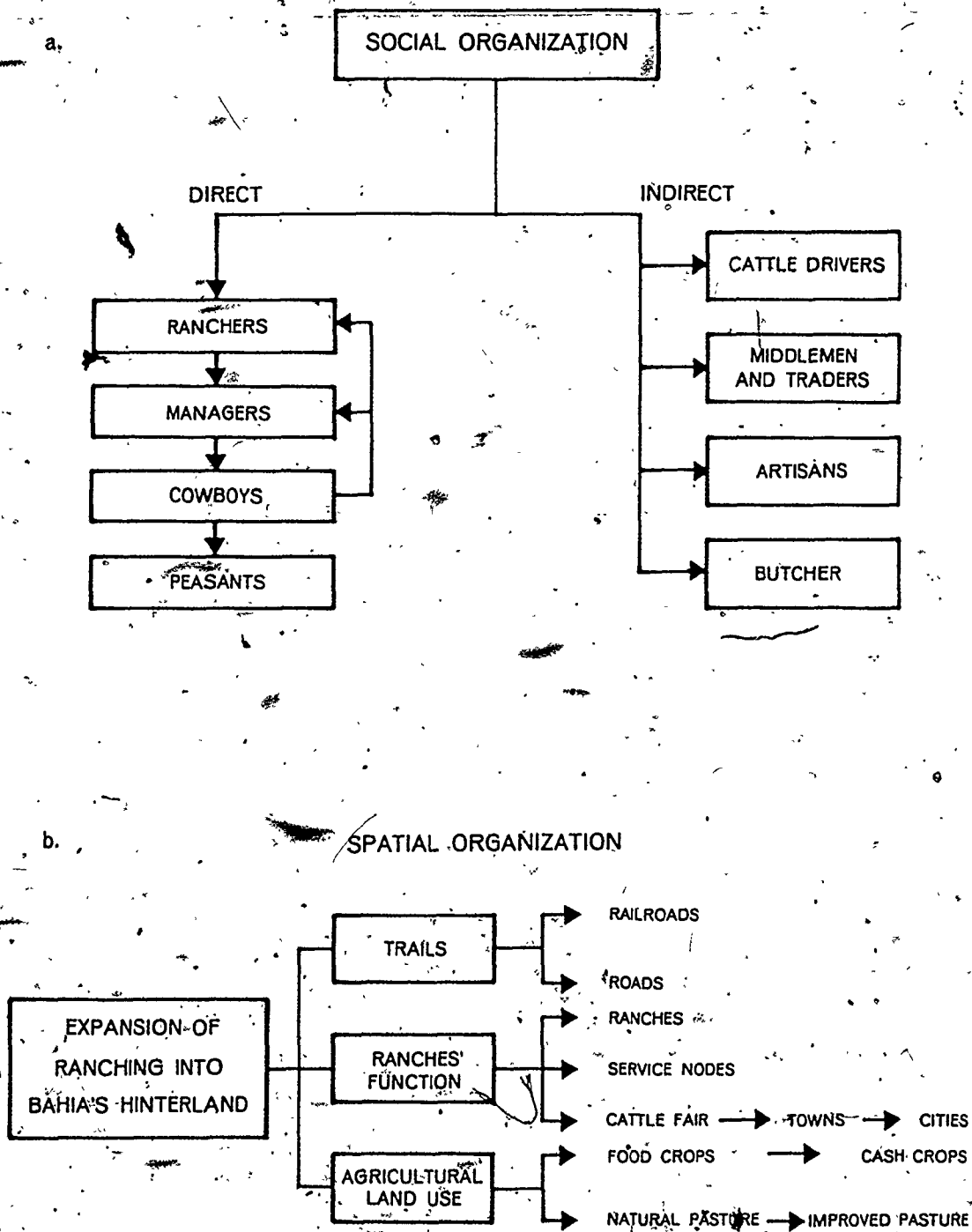


Figure 18 Impact of Ranching on the Development of Social and Spatial Organization in Bahia's Hinterland

corridors of the colony. Because of their favourable location alongside the trails some ranches developed into service nodes providing support to the cattle drivers and to other traders. Some also evolved into cattle fairs, towns and even cities. There are many examples of the latter function. Cities such as Feira de Santana, Senhor do Bonfim, Barreiras, Brumado, Xique-Xique, Castro Alves, Morro do Chapéu, Mundo Novo, Rui Barbos and others originated from ranches (see Appendix map). Feira de Santana located in the Agreste is a famous example of a city which originated from a ranch, which in the beginning of the nineteenth century evolved into the largest cattle fair of the Northeast and later the second largest city of Bahia.

The ranches had also an influence on the evolution of agricultural land use. They diffused the food and cash crops into the Agreste and Sertão as subsistence agriculture which eventually became market oriented. In the same zones natural pasture was also transformed into improved pasture.

7.5.5 Ranching Location

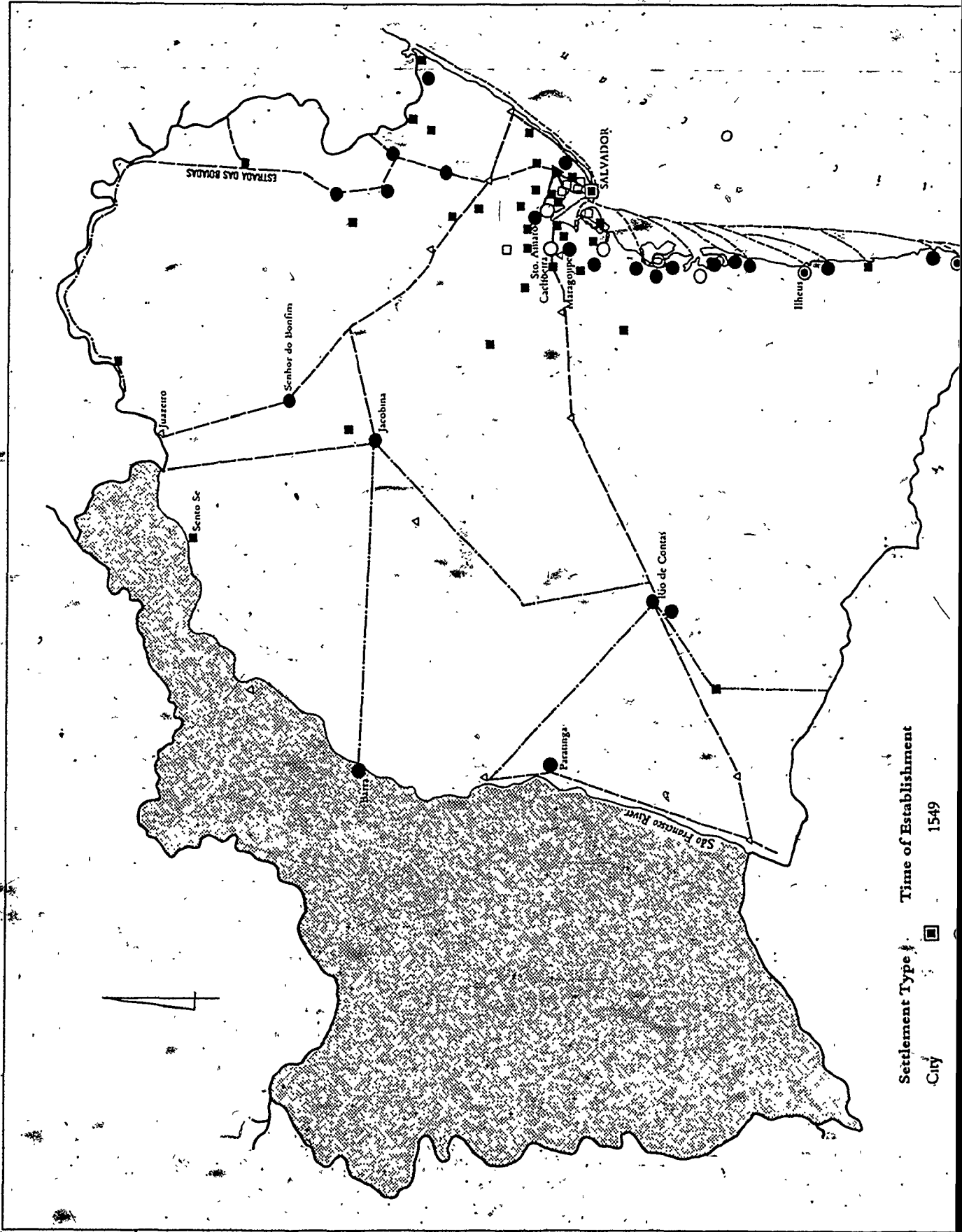
The ranches developed originally in the Recôncavo close to the plantations. By the end of the sixteenth century they started to migrate to the interior. Figures 20 and 21 show how quickly ranching dominated the hinterland. The natural conditions facilitated this rapid expansion of the ranches but their location is particularly related to the economic factors. That is, land was plentiful but the lack of transportation facilities precluded crop expansion into the interior. Also the amount of capital and labour required to operate the ranches had particular influence on their peripheral location.

7.6. Agricultural Expansion and Settlement

So far the study of the agricultural land use of Bahia seems to have demonstrated that the colonial plantation had indeed a positive effect on the expansion of agriculture. To reinforce this effect other aspects of the settlement may be taken into consideration as indirect indicators of the agricultural expansion. Actually the settlement of an area may be related to different types of economic activity. However, in Bahia the basic activity has always been agriculture. Under this condition, the emergence of settlement nodes and economic routes over the colonial period can be interpreted as a reliable manifestation of agricultural expansion. For this purpose Figure 19 represents urban nodes and cattle trails according to the time of their establishment.

From the observation of these types of settlement and the time of their establishment two basic aspects of Bahia's colonization can be emphasized. The first is that the rapid expansion of the settlement nodes occurred in the eighteenth century, therefore, after the sugar cycle. On the one hand, this acceleration reinforces the concept of the spatial expansion of the sugar mills. On the other hand, the external competition which forced the vertical integration of sugar, cattle, and tobacco also contributed to the emergence of specialized areas to supply the plantations and Salvador. In response to this economic process the number of nodes increased and expanded. The second aspect of colonization is the settlement pattern which reflects the types of agricultural land use and their location. Three types of pattern may be identified: clustered, linear, and dispersed.

The clustered pattern of settlement appears in the Recôncavo, where approximately 50% of the Bahia's population was distributed among



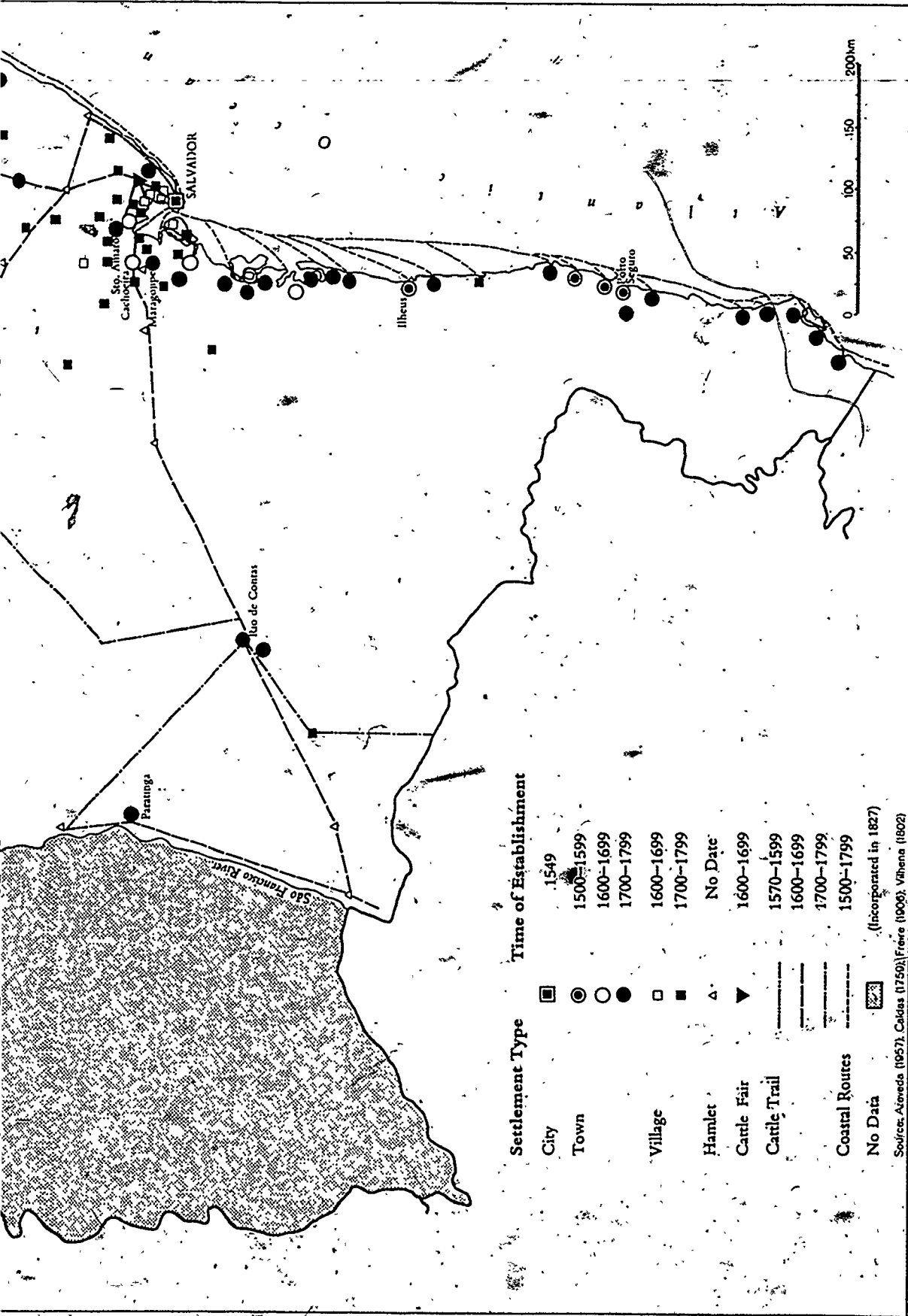


Figure 19 Evolution of Settlement in Bahia (1549-1799)

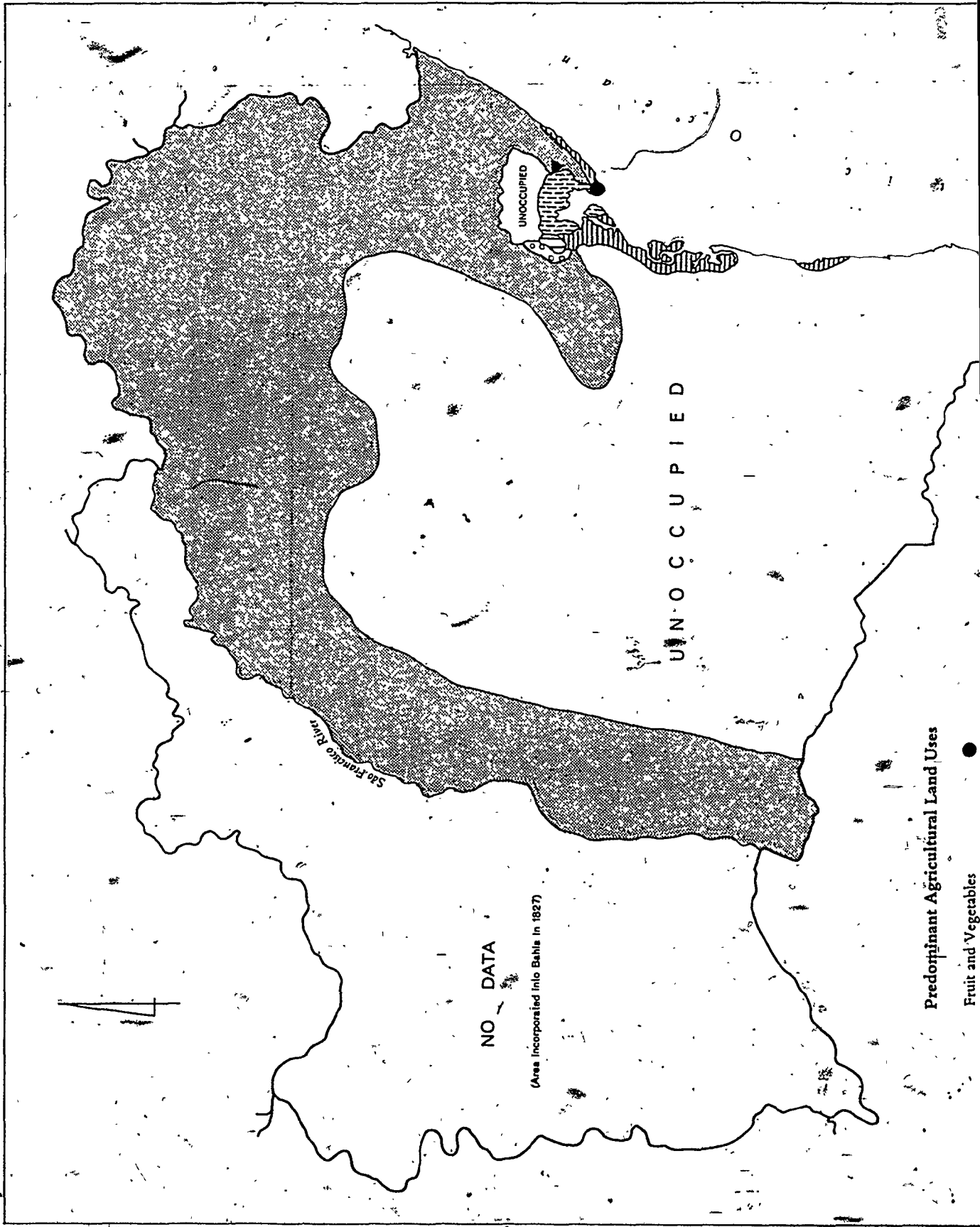
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Salvador, the towns, villages, and hamlets (the mills). (This last order of settlement node was omitted on Figure 19, however, to facilitate the representation of the other nodes). Association between location of the nodes and time of their official establishment indicate the expansion inland of the mills, of the tobacco and food crop farms (see Figures 20 and 21). The cattle trails and the coastal routes converging on the Recôncavo also show the economic importance of this region.

The linear pattern extends from the Recôncavo southward. This pattern corresponds to the food supply areas of Salvador and the plantations. The spatial organization of settlement indicates entire dependence on the transportation facilities. The number of towns (vilas) created during the eighteenth century seems to support the important argument, reinforcing the previous viewpoint, that the agriculture carried out in the region was market oriented.

The dispersed pattern corresponds to the ranching expansion in the Agreste and Sertao. It is interesting to note the role of cattle in the settlement of the hinterland. For instance the oldest cattle trail linking the Recôncavo to the interior is the Estrada das Boiadas. Along side this trail the settlement is less dispersed particularly in the north Agreste. The discovery of gold in Jacobina and Rio de Contas as well as the diffusion of cotton during the eighteenth century (Figure 21) also contributed to the expansion of settlement, while the mining rush in Minas Gerais may have had an influence on the linkages between scattered towns in the Sertao.

Evidence on the expansion of settlement seems to reinforce, therefore, the gradual expansion of agriculture over the period under consideration. Further, the concentration of the settlement in the Mata



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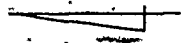
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Predominant Agricultural Land Uses

Fruit and Vegetables

San Francisco River



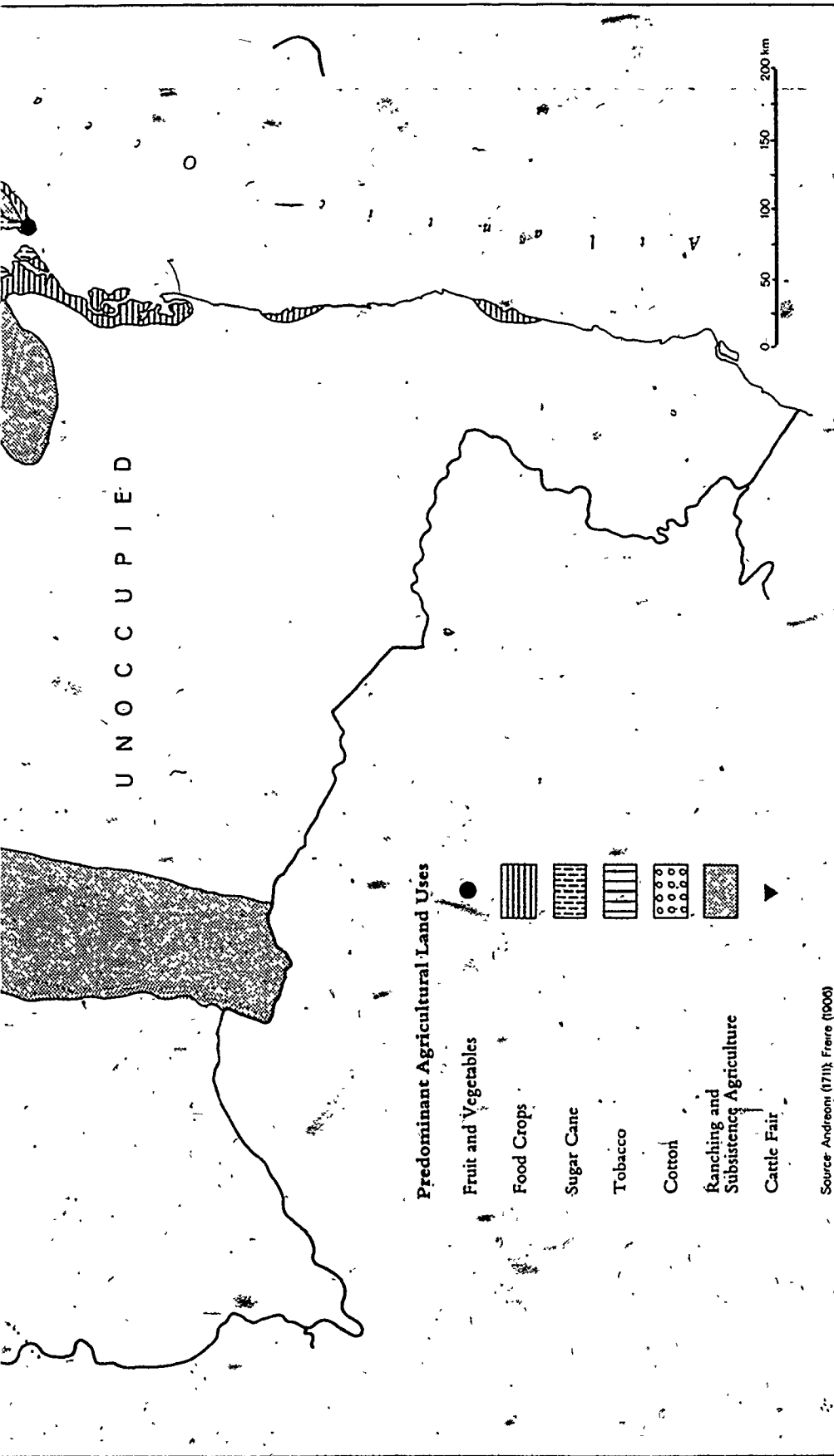
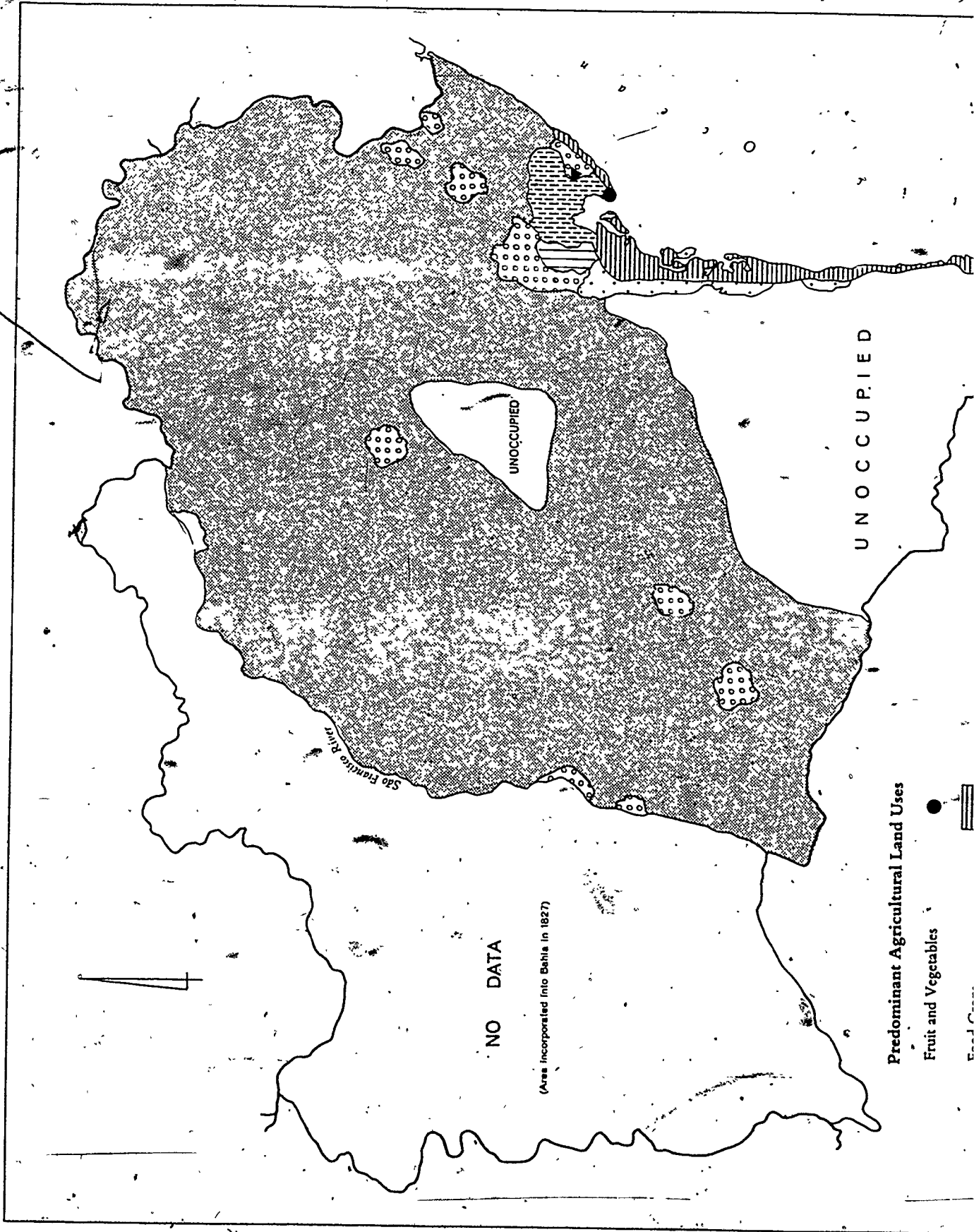


Figure 20 Land Use Pattern in Bahia ca. 1700

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Sao Francisco River

NO DATA

(Area incorporated into Bahia in 1827)

Predominant Agricultural Land Uses

Fruit and Vegetables

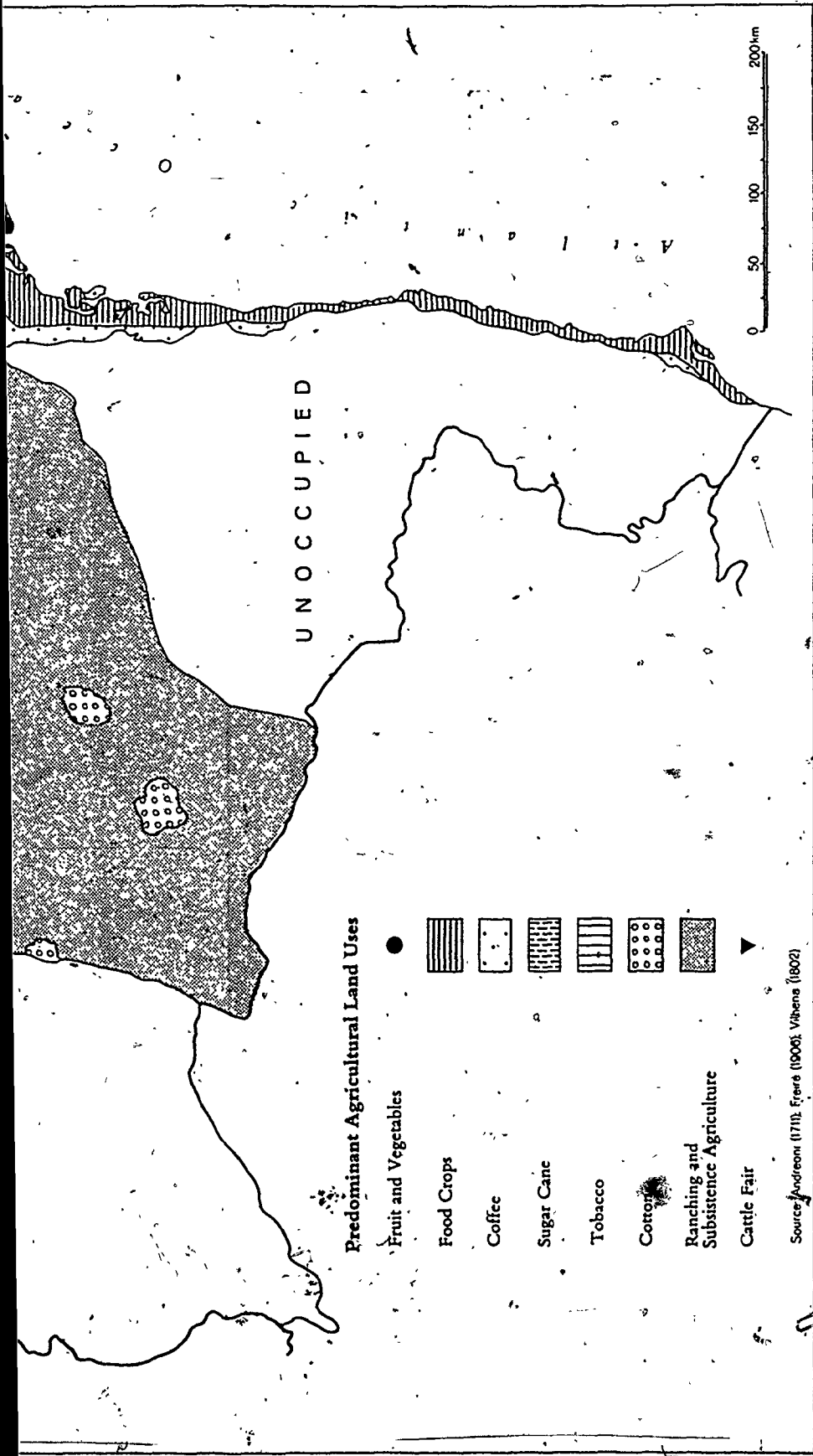


Figure 21 Land Use Pattern in Bahia ca. 1800

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zone indicates the competition of cash and food crops for the best location relative to the markets whereas the ranches spread in the Agreste and Sertao which were less advantageous locations for growing cash crops during the colonial period. A secondary consideration may be also inferred that settlement lagged behind ownership of the land. That is, by the end of the eighteenth century land was almost all granted (Figure 9) while the settlement remained highly concentrated in the coastal areas.

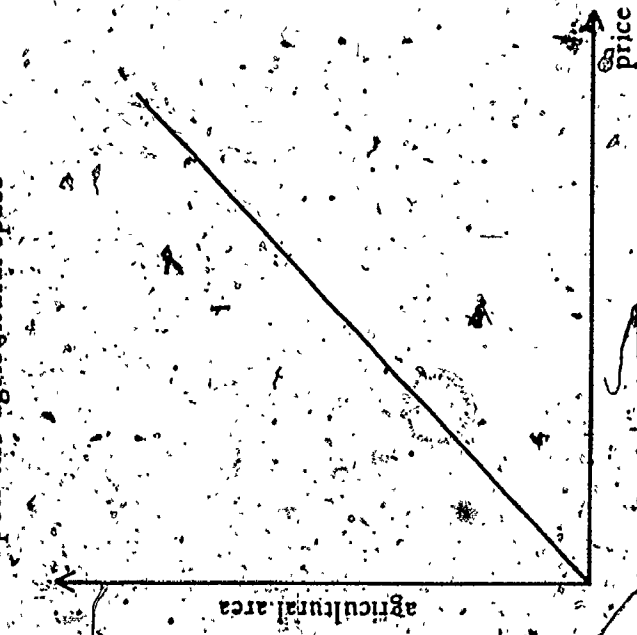
The increase of external and internal demand for different agricultural products led to the integration of peripheral zones into the Bahian system of supply areas. Cattle trails and coastal routes played an important role in this integration.

7.7 Spatial Dynamics of Agriculture Under the Effect of Prices Fluctuation

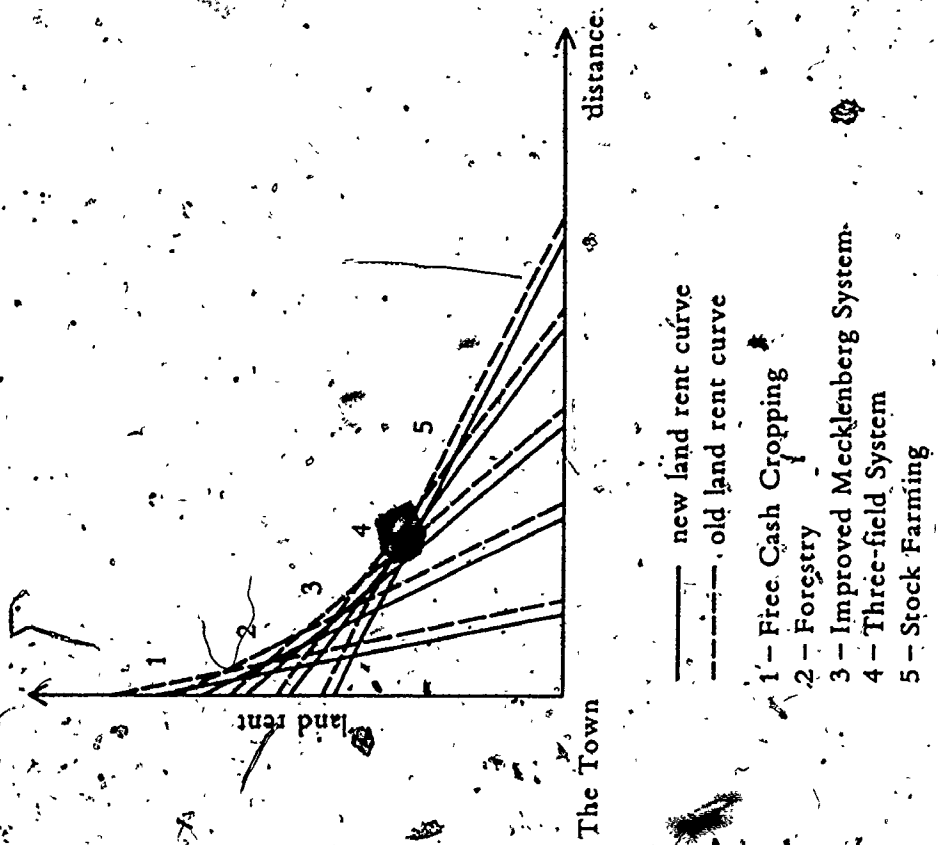
As was pointed out in Chapter Two (Section 2.2.2), according to von Thünen's prediction, all things remaining equal, a decrease in demand (lower price for grain) led the cropped area in "The Isolated State" to contract. As a result of this spatial adjustment of supply to demand the land rent for all farming systems not only became zero closer to the market but also extensive systems tended to prevail. This theoretical explanation for the spatial dynamics of agriculture is graphically represented in Figures 22a and 22b. The former shows the positive correlation found by von Thünen between prices (independent variable) and agricultural area (dependent variable). The latter figure attempts to interpret the impact of the spatial adjustment of supply to demand on the land rent. It can be observed that the prevalence of lower prices leads to the disappearance of the crop rotation system (Figure 3c).

Figure 22 The Von Thünen's Dynamic Model

a) Impact of change in demand upon the agricultural space



b) Contraction of agricultural space in "The Isolated State" under the effect of a lower grain price



Crop rotation is the most intensive system for grain production.

The study of the colonial plantations undertaken in Chapter Six has shown that the reality observed in Bahia deviates from the theoretical model based on von Thünen's ideas. As was pointed out, competition from the West Indies forced sugar prices lower in the long run. This expected reaction of the market related to an increase in sugar supply is widely documented by Brazilian literature. However, the same literature records a large increase in the number of mills in Bahia. Such an unexpected response by Bahian entrepreneurs to sugar prices led this author to propose not only a new explanation for the spatial and economic phenomena observed in Bahia but also to discuss the reasons for the disparity between reality and the theoretical model.

First, von Thünen considered that there was a fixed relationship between supply and demand. That is, he only took into account the price fluctuations determined by change in demand.

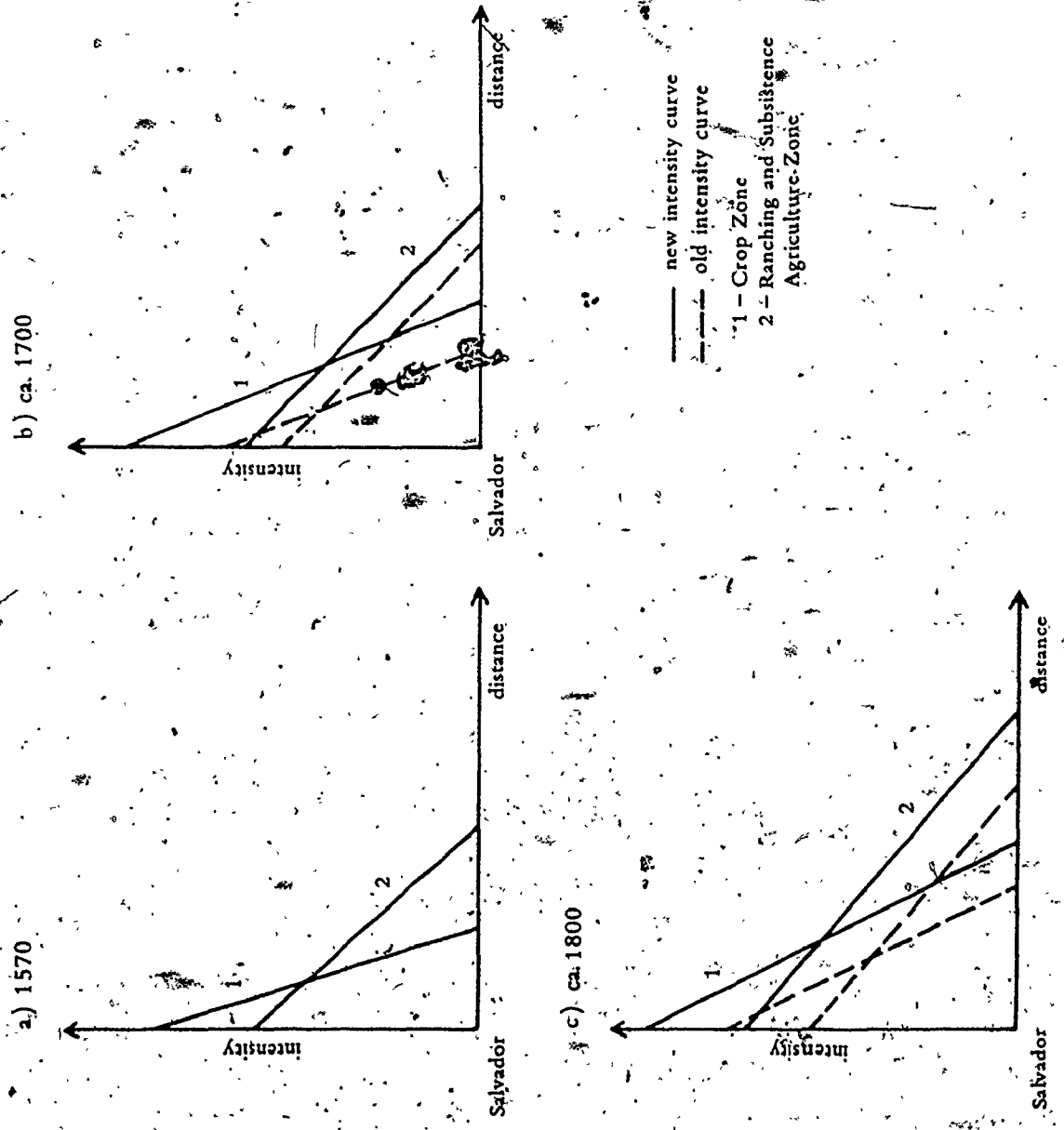
Second, low prices for a product are inversely related to the quantity purchased of the same product. That is, at lower price consumers are able to buy a larger amount of a given product because lower income groups can afford to purchase it. Hence, consumer behaviour does not mean change in demand but just a movement along the schedule curve of effective demand. To have a real change in demand it is necessary that at a given price a greater or lesser amount of the product be purchased. It is theoretically possible for a drastic adjustment of supply to demand. In reality, however, this adjustment does not easily occur because factors governing supply are different from those governing demand. An analysis of the world's sugar production in the 1700's and 1800's revealed that supply increased faster than demand. Such a situation led sugar prices

to decline even though the demand for sugar increased. Actually demand not only continuously increased but European income levels also increased.

Third, the decrease in price may influence the farmers to make decisions based on factors not considered by von Thünen such as the case of reducing the costs of production instead of reducing the cultivated area. This decision was made by the Bahian entrepreneurs, as was pointed out in Chapter Six. The vertical integration of sugar, cattle, and tobacco presents a good solution with which to face the sugar price crisis.

These three reasons seem to explain the disparity between von Thünen's dynamic model and the reality observed. From his prediction it was expected that lower prices of sugar would affect the agricultural expansion in Bahia. However, the comparison of Figures 11, 20, and 21 shows that not only did new types of agriculture emerge but also the agricultural frontier expanded in two basic directions. One was that directed by the spread of ranching inland and along the northeast coast. The other frontier was led by the expansion of crops along the southern coast. This displacement of the agricultural frontier is graphically represented in Figures 23a, 23b, and 23c in which the gradual expansion of the agricultural zones (Crop and Ranching) are shown by the distance of the intensity curves (dashed and solid lines) over time. As has been pointed out, sugar dominated Bahia's economy during the colonial period, and therefore, the other types of agriculture were directly or indirectly dependent on the plantations and the Salvador market. Had the sugar plantations declined cattle, tobacco, cotton, and the food crops would not have gradually expanded. Actually, there was the possibility of the metropolitan market absorbing part of the agricultural outputs such as

Figure 23 Observed Spatial Dynamics of Agriculture in Bahia 1570, 1700 and 1800



hide, tobacco, and cotton, however, this absorption started later. Further, this absorption alone would not justify a steady expansion of agriculture because the price of hides was relatively low while tobacco and cotton also faced competition. The gradual expansion of agriculture during the colonial period was, therefore, in large part determined by the expansion of the sugar industry and Bahia's population growth.

With respect to the negative relationship between distance from the market and agricultural intensity, evidence shows that the types of agriculture undergoing the largest proportional investment of capital as well as employing the largest amount of labour are those located closest to Salvador. Except for the perishable crops, the sugar plantations remain in the same location, followed successively by tobacco, food crops, coffee, cotton and ranching (see Figures 20 and 21). Von Thünen's prediction is, therefore, confirmed in Bahia. The poor condition of overland transportation as well as the high costs of the transoceanic freights favoured the concentration of crops in the coastal areas while ranching dispersed in the interior. The exception of the emergence of cotton pockets in the Sertao, farthest from Salvador may be explained by local demand and that of Minas Gerais as well as by the favourable natural conditions. The production of areas located in the northeastern Agreste was easily transported by river to the coast and along the coast to Salvador. Although cotton is a bulky product, the highest prices achieved during short periods, led to the shipping of cotton from Sertao to Salvador. However, by taking into account the criterion of the major agricultural land use, ranching prevailed both in the Agreste or Sertao.

REFERENCES AND FOOTNOTES, CHAPTER 7

1. See T. Azevedo, pp. 185, 188.
2. Lindley, p. 167.
3. Cited by Mattoço, p. 131.
4. Pinto de Aguiar, A Abertura dos Portos: Cairu e os Ingleses (Salvador: Livraria Progresso, 1960), p. 98.
5. Prado Jr., pp. 136-137.
6. See David Metcalf, The Economics of Agriculture (Middlesex, Eng.: Penguin Book, 1969), pp. 27-31 and R.L. Cohen, The Economics of Agriculture (London: James Nisbet & Co. Ltd., 1957), pp. 48-50 (hereafter cited as Cohen).
7. See Gandavo, T.T.B., pp. 44-46; Cardim, p. 289; G. Souza, pp. 181-182; and F. Salvador, pp. 29-36.
8. G. Souza, p. 140. Translated in part for this author by Roberto Aichinger.
9. Cited by T. Azevedo, p. 270.
10. Lindley, p. 160.
11. Cited by T. Azevedo, p. 268.
12. Ibid., p. 268n.
13. Ibid., p. 268.
14. Ibid., pp. 268-269.
15. See Nilo Bernardes, "Características Gerais da Agricultura Brasileira em Meados do Século XX", Revista Brasileira de Geografia 23 (1961): 388-391 (hereafter cited as Bernardes).
16. F. Freire, 1: 175.
17. T. Azevedo, p. 277.
18. Ibid., p. 277n.

19. Ibid., pp. 278n-279n.
20. Prado Jr., p. 158.
21. T. Azevedo, p. 297.
22. Ibid., p. 298.
23. Vilhena, 1: 71, 124.
24. F. Freire, 1: 198.
25. See Anais do Arquivo Publico da Bahia, "Algodao", vol. XIV (Bahia: Imprensa Official, 1931), pp. 201-202 and Poppino, p. 63.
26. See Maria Dundas Graham [Lady Maria Calcott], Journal of a Voyage to Brazil, and Residence There, During Part of the Years 1821, 1822, 1823 (New York: Frederick A. Praeger, 1969), p. 146.
27. G. Souza, pp. 232-235.
28. Andreoni, p. 243.
29. Anais do Arquivo Publico da Bahia, "Fumo", vol. XIV (Bahia: Imprensa Official, 1931), p. 185 (hereafter cited as AAPB, Fumo).
30. Poppino, pp. 62-63.
31. Vilhena, 1: 199.
32. AAPB, Fumo, p. 186.
33. Andreoni, pp. 249-251.
34. Ibid., pp. 230-250.
35. Affonso de E. Taunay, Pequena Historia do Cafe no Brasil (1727-1937) (Rio de Janeiro: Departamento Nacional do Cafe, 1945), p. 32 (hereafter cited as Taunay).
36. See Vilhena, 2: 497 and F. Freire, 1: 175.
37. Spix & Martius, 2: 255-280.
38. Luiz C.C. dos Santos and Hermano J.T. Dultra, "Cafe" in A Insercao da Bahia no Evolucao Nacional Ia. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), p. 136 (hereafter cited as Santos & Dultra).
39. Spix & Martius, 2: 309.
40. Andreoni, p. 309.

41. Prado Jr., p. 187.
42. Andreoni, p. 309.
43. Ibid., p. 309.
44. Borges de Barros, "Terras Patrimoniais da Casa da Torre", in Anais do Arquivo Público da Bahia, vol. XI (Bahia: Imprensa Oficial, n.d.), p. 87.
45. Prado Jr., p. 187.
46. See F. Contreiras Rodrigues, Tracos da Economia Social e Política do Brasil Colonial (Rio de Janeiro: Ariel, 1935), pp. 172-181.
47. Andreoni, p. 309.
48. Ibid., p. 309.
49. See Manuel Correia de Andrade, "Produção Animal e Derivados", in Recursos e Necessidades do Nordeste (Recife: ETENE, 1964), p. 353 (hereafter cited as MCA, Produção Animal e Derivados) and Banco do Nordeste do Brasil S.A., Pecuária Bovina de Corte (Fortaleza: ETENE, 1965), p. 19 (hereafter cited as BNB, Pecuária Bovina).
50. Andreoni, pp. 307-308.
51. Ibid., pp. 311-312.
52. T. Azevedo, p. 333.

CHAPTER 8

RAPID EXPANSION OF AGRICULTURE. SPATIAL EFFECTS OF ECONOMIC AND TECHNOLOGICAL CHANGES, 1823-1930

8.1 Introduction

The political independence of Brazil (1822) and the gradual displacement of the country's economic core to the Southeast did not lead to any fundamental change in the trade system of Bahia in the nineteenth century. Bahia remained economically isolated from the other states of Brazil and dependent upon the external market, which, however, expanded with political independence and the spread of industrial urbanization to include more of Western Europe and the United States. It was, rather, external changes which brought benefits to Bahia's agriculture. The lowering of transoceanic freight rates, the increase in number of industries requiring raw materials, faster population growth, and the mid-nineteenth century trend toward free trade, all increased the demand for Bahia's agricultural products. Internally these factors were complemented by the adoption of some technological innovations such as improvement of transportation facilities and processing plants stimulating a faster population growth and its areal expansion. As a result the agricultural pattern changed in two ways. On the one hand the traditional crops and livestock expanded into the interior. In the hinterland cattle ranchers, for example,

opened more lands in the centre, southern and western frontiers. On the other hand two new cash crops were introduced and diffused in direct response to external demand. Coffee expanded from the central coast westward into the interior uplands while cocoa plantations were developed throughout the coastal lowland to the south of Salvador. In the process cocoa became the leading export staple, followed by tobacco. Substantial transformations also occurred in the sugar plantations and ranching. In short, two major processes can be identified during this intermediate phase of Bahia's agricultural evolution. One process is related to the overall expansion of the agricultural space under the impact of external and internal factors. The other process refers to the intensification of agriculture in areas directly or indirectly affected by the technological changes.

These processes observed in Bahia, cannot be interpreted as unique phenomena. Actually, they represent manifestations of a general process which developed at the world scale as a result of the political, social, technological, and economic transformations that occurred mainly during the mid-nineteenth century in Europe. Research carried out by Schlebecker¹ in the United States and Peet's² study of change in the areas supplying Great Britain (1800-1914) has already confirmed the spatial effect of these transformations. The latter study for instance identifies a nineteenth century world economic core centered in Britain, Western Europe, and northeastern North America, Peet's so-called "Thünen World City", surrounded by a series of large concentric agricultural zones.³ With the increase in food and raw material demands in the "city" market, the zones were pushed outwards, causing the agricultural frontier to invade the vacant, or little-occupied, continental hinterlands.

The nineteenth century offers, therefore, all the necessary conditions to verify two of von Thünen's predictions. One is that all things being equal, an increase in demand tends to push prices upwards leading the overall agricultural space to expand⁴ (see Figure 22a). Another prediction is that, other things remaining unchanged, the improvement in transportation facilities causes a selective expansion of agriculture.⁵ That is, the cropped area presents a tendency to expand farther pushing outwards the stock farming system. In addition, a marked intensification of agriculture is also verified. In "The Isolated State", the lower water freight rate compared to the overland rate causes the crop rotation system (the most intensive system to produce grain) to expand along the river to the state frontier (see Figures 3a and 3b). In any of the above predictions, according to von Thünen, distance remains as the major variable causing the spatial differentiation.

The aim of this chapter is to describe the transformations in Bahia's agriculture and to verify to what extent these transformations conform to the aforementioned predictions. Assumptions held in the previous chapters remain the same, except for demand and transportation conditions.

To understand the processes accounting for this phase of agricultural evolution the following aspects will be studied: a) the impact of the European technological improvements on the expansion of international trade b) the diffusion of innovations into Bahia, especially railway transportation c) the population growth and its great expansion d) the expansion of agriculture and e) Bahia's agricultural exports. In the last section of the chapter a theoretical comparison between the reality of Bahia and von Thünen's predictions will again be undertaken.

8.2 Impact of Technological Improvements on the Expansion of the International Trade

In this context technological improvements refer to the set of innovations and applied processes which made it possible to speed up the production of goods and to develop the means of transportation and communication subsequent to the Industrial Revolution. The total list is very long but some had a major influence in changing the world economy and affected Bahia very directly. The textile processes were mechanized at various times between 1780 and 1860. The new machines not only increased the output per worker but also reduced the costs of production. Other industries also mechanized such as printing, papermaking and those producing building materials, equipment and chemical supplies, etc. The invention of the steam engine, the screw propeller, the telegraph and the use of electric power contributed not only to increase the efficiency of production, but also to reduce the absolute distance between regions and nations. The agricultural sector was widely benefited by the diffusion of livestock breeds, the selection of seeds and the use of early farm machinery. On account of the development and initial adoption of those and other improvements, Western Europe and later the United States became in a relatively short time, the most industrialized and urbanized areas of the world. The immediate effects of these striking changes were, among others, the increase in wages, the highest national standard of living, a growing desire for different kinds of goods, and therefore, a growing capacity to consume. Demand also increased in the peripheral areas.

The expansion of railways, the improvement of waterways, the construction of canals, and larger sizes of steamships made it possible to increase quantities transported over long distances, and to enlarge the

volume of world trade. From 1815 to 1913 the total value of the world's international trade grew from less than two to forty billion dollars, and by 1929 it had reached sixty-nine billion.⁶ For instance in 1840 the United Kingdom, France, and the United States shared 50% of world trade; this decreasing by 1913 to 35% and by 1929 to 34%.⁷ Germany's share increased from 9% in 1880 to 12% in 1913.

Besides its growth, the pattern of international trade also changed. The bilateral exchanges (trade between two countries) prevalent during commercial capitalism changed to include multilateral exchanges (trade among many countries). For many peripheral countries especially in Latin America this reflected the joint influence of their new political independence and the growth of industrial capitalism.

Brazil is one peripheral country in which multilateral trade anticipated its political independence. When Napoleon drove the Portuguese royal family from Portugal to Brazil in 1807, the King's first decree (1808) was to legalize direct trade. As a result a treaty signed between Portugal and England (1810) favoured the rapid establishment of over sixty British firms in Rio de Janeiro.⁸

Heaton⁹ represented Hilgerdt's model of the world's new trade pattern as taking the shape of a hexagon in which three of the angles were large industrial countries (United States, Germany, and United Kingdom), each flanked on both sides by predominantly agricultural regions (Temperate regions of recent settlement, Tropics, and Europe except the United Kingdom and Germany). The six points appear as directly connected one to another in addition to the routes around the hexagon. The goods which flowed along any one line did not cancel each other out by a bilateral balance of exports with imports. Brazil had come to hold a position in this structure.

The expansion of the world economy was further influenced by two basic factors. One was the emigration of Europeans to the New World, particularly to the temperate regions. The Bahian government attempted to introduce European immigrants (German, Spanish, Polish, etc.) to work in agricultural colonies founded in the southeastern and southern state. Lack of orientation and maladjustments of immigrants resulted in the failure of the colonies. The other factor was the export of capital to promote the development of infrastructures and industrialization of the supply areas of the world's economic core. From 1858 to 1883 Brazil borrowed a total amount of £26,986,800 whereas in the subsequent three years (1886, 1888, and 1889) that amount increased to £32,565,300. These capital movements influenced international trade in two ways. In the first place the capital was exported to its destination in the form of consumption and production of goods or services. In the second place the payment of interest might for a time be made out of new loans but had to be met by shipment of goods from the debtor country, which gave it a favourable balance and made the creditor country's balance unfavourable.

The international trade of Bahia from 1796 to 1929 (Table 19) illustrates these two basic aspects. First the records show the striking expansion of both the imports and exports after the colonial period. The latter is a particularly good indicator of the rapid expansion of agriculture during the period under consideration. The second aspect refers to the unfavourable balance prevailing from 1839 to 1894. This period coincides with the great investments in the modernization of the sugar industry and construction of other processing plants; as well as in the improvements of infrastructure; mainly transportation. On the other hand, the surplus observed after 1899 shows the impact of these innovations on

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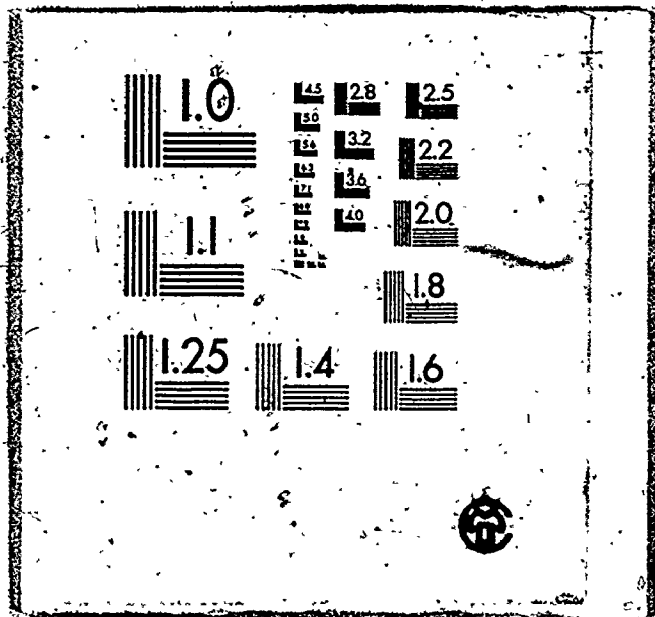


TABLE 19

INTERNATIONAL TRADE OF BAHIA, 1796-1929

| YEAR | IMPORTS (IN CONTOS)* | EXPORTS (IN CONTOS)* | NET BALANCE* (IN CONTOS) |
|-------------------|-------------------------|-------------------------|-----------------------------|
| 1796 ^a | 2,069 | 3,960 | + 1,891 |
| 1801 | 2,985 | 3,503 | + 518 |
| 1806 | 2,110 | 3,284 | + 1,174 |
| 1811 | 537 | 962 | + 425 |
| 1839 ^b | 7,710 | 5,982 | - 1,728 |
| 1844 | 9,744 | 8,469 | - 1,275 |
| 1849 | 9,744 | 9,033 | - 711 |
| 1854 | 12,690 | 11,783 | - 907 |
| 1859 | 16,206 | 10,823 | - 5,383 |
| 1864 | 16,893 | 14,184 | - 2,709 |
| 1869 | 20,277 | 19,763 | - 514 |
| 1874 | 19,154 | 15,743 | - 3,411 |
| 1879 | 20,204 | 16,452 | - 3,752 |
| 1884 | 18,880 | 13,951 | - 4,929 |
| 1889 | 18,360 | 9,794 | - 8,566 |
| 1894 | 33,030 | 27,022 | - 6,008 |
| 1899 | 36,130 | 47,094 | + 10,964 |
| 1904 | 30,259 | 57,193 | + 26,934 |
| 1909 | 29,228 | 65,420 | + 36,192 |
| 1914 | 28,642 | 64,578 | + 35,936 |
| 1919 | 59,828 | 216,932 | + 157,104 |
| 1924 | 90,351 | 255,978 | + 165,627 |
| 1929 ^c | 103,155 | 248,904 | + 145,749 |

SOURCE: a) Jose Jobson de Andrade Arruda, "O Brasil no Comercio Colonial (1796-1808), Contribuicao ao Estudo Quantitativo da Economia Colonial" (Tese de Doutorado, Universidade de Sao Paulo, 1972), p. 119; b) Bahia, Diretoria Geral de Estatistica do Estado, Anuario Estatistico da Bahia, 1926-1927, pp. 59-60; and c) Bahia, Diretoria Geral de Estatistica do Estado, Anuario Estatistico da Bahia, 1929-1930, p. 304.

* 1 conto = 1 million of reis.

the overall expansion of agriculture. Records also suggest that the First World War in which Brazil remained neutral stimulated demand for strategic goods. The period between 1914 and 1924 is marked by the largest increase in the net balance of trade.

8.3 Diffusion of Innovations Into Bahia

The beginning of the nineteenth century was marked by a general concern in Bahia to solve basic agricultural problems. In 1807 a survey of agriculture and trade was carried out by the colonial government. This survey resulted in several reports in which strategic aspects of agricultural production and trade were widely discussed. Brito,¹¹ one of the reporters, emphasized for example the farmers' lack of freedom to make decisions related to the choice of crops, the construction of buildings, or the sale of production. He also complained at the lack of facilities to improve agriculture, including poor transportation, credit, and lack of educational facilities. In short, the reports show strong resentment against the colonial policy which ruled agriculture, industry, and trade. In 1808 a decree on direct trade was signed in Salvador, but technological innovations affecting agriculture were introduced chiefly after political independence (1822).

8.3.1 Transforming the Colonial Plantations

It took many years for the colonial plantations to evolve from a mixed system of production (slave, feudal, and capitalistic) to capitalistic enterprises. Complete evolution occurred in the late 1800's when processing technology, the structure, and the spatial organization of the earliest enterprises finally changed.

8.3.1.1 Technological Changes. The first technological innovations introduced into the plantation environment were undertaken by entrepreneurs in the beginning of the nineteenth century. In this respect, Bahia is considered the pioneer captaincy. After 1804 a new type of furnace, reducing the consumption of firewood, was introduced in the Recôncavo. Otaiti cane was also introduced at this time.¹² Concern to improve the sugar industry led the plantation owners to found the Agriculture, Commerce, and Industry Society of the Province of Bahia (1832).¹³ In 1815 the first steam mill was brought into operation. By 1855 there were 1,651 mills in Bahia out of which 144 were operated by steam engines; by 1875 they had increased to 282.¹⁴

Official efforts were also made to accelerate modernization. By 1852 the governor of Bahia authorized an official investigation into the West Indies and North America plantations. This investigation resulted in a detailed report (Carson's Report) dealing with farming and the industrial aspects of plantations.¹⁵ It recommended, for example, the introduction of a free labour force, use of manure and plows, as well as changes in industrial equipment. In spite of these recommendations only the modernization of sugar processing was attempted.

In 1866 a pilot venture was undertaken by the provincial governor whereby a new mill, equipped with modern machines was constructed in the Recôncavo.¹⁶ Despite this undertaking, a traditional approach continued because most mill owners strongly resisted innovations. Substantial changes started to occur however with the construction of the first railways after 1858 and the threatened abolition of slavery.¹⁷ After 1879 the first central sugar factories started to be constructed. These new factories stressed the division of labour, i.e. the plantation

owners grew the sugar cane and, instead of processing it themselves, sent it to neighbouring central factories. The plan sought a more efficient use of productive factors. Each plantation could concentrate its resources solely to agriculture, facilitating improvements in the use of fertilizers, mechanization, etc. On the other hand, the factory owners could concentrate their resources on the industrial sector. During the 1870's the government began offering subsidies for the construction of central factories. Table 20 shows the original outlay needed to install a new factory as well as the revenue expected. Comparison between the investments

TABLE 20
ORIGINAL OUTLAY OF A CENTRAL SUGAR FACTORY,^a 1874

| ITEMS | IN CONTOS* | % |
|--------------------------------|----------------|--------------|
| Fixed Capital (Machines, etc.) | 400,000 | 80.00 |
| Floating Capital | <u>100,000</u> | <u>20.00</u> |
| (A) Original Outlay | 500,000 | 100.00 |
| Raw Material | 126,000 | 44.60 |
| Processing Costs | 30,000 | 10.62 |
| Fixed Costs | 43,494 | 15.40 |
| Freights | 42,000 | 14.87 |
| Sacks for Sugar | 21,000 | 7.43 |
| Wages | <u>20,000</u> | <u>7.08</u> |
| (B) Total Costs | 282,494 | 100.00 |
| (C) Gross Revenue | 499,800 | |
| Total Costs | <u>276,494</u> | |
| (D) Net Revenue | 223,306 | |
| % D of A | | 44.66 |
| % D of C | | 44.68 |

SOURCE: Lucia Maria T. Tavares et al., "Cana-de-Acucar", in A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPÉ, 1978), pp. 44-46.

^aDaily processing = 10 metric tons of sugar.

* 1 conto = 1,000,000 of reis.

in the old mills (Table 12) and the central factories indicates that the latter were indeed more profitable. Returns to capital and gross revenue are fifteen times greater than the old mills. Also the sugar yield per arroba (14.75 kilograms) of cane was twice that of the earlier mills.¹⁸

Capital borrowed from France permitted the operation of two central factories in the Recôncavo at Pojuca and Santo Amaro in 1880.¹⁹ From 1884 to 1889 four other factories were installed. However, the plan to modernize on the basis of Centrals failed. Paul Singer affirms that "the fundamental cause for the failure of the central mill is that it could not count on a sure supply of cane at prices which allowed it to make sugar at a competitive cost".²⁰ While Gileno De Carli also identifies "the instability of raw material supply"²¹ as the major cause. In addition, the entrepreneurs were supposed to construct railways to transport sugar. This additional investment during a period of high competition must have discouraged the undertaking. This author believes that the failure of Centrals resulted from the attempt to separate the productive process in the sugar plantations.

Complete modernization of sugar cane processing occurred in the late 1880's when the Centrals were transformed into the usinas (sugar factories). These processing plants differed from the central factories with respect to their economic aspect. That is, the central factories searched for the division of labour in which the economic process of production was separated. The Centrals were supposed to specialize in sugar manufacture buying cane from suppliers. The usinas not only bought cane from suppliers (the fornecedores) but also grew their own cane. In other words, attempts to break down vertical integration in the sugar plantations failed. In addition, the transportation infrastructure for

the usinas was provided by the government. By the end of the nineteenth century there were twenty-three usinas operating in Bahia, most of which were located in the Recôncavo (Table 21). These plants completed the elimination of the colonial mills from the Recôncavo.

The farming methods, however, did not change much. Land rotation remained as the basic method, but fallows became shorter through alternation of sugar cane and pasture. Fertilizers were not applied but the use of the plow became generalized. For example the 1920 census recorded 378 plows distributed among the municípios in which the sugar cane plantations prevailed, with particularly heavy concentrations found in Santo Amaro (233 plows) and Sao Francisco do Conde (101 plows)²² (see Appendix map).

8.3.1.2 Structural Changes. The usinas and the abolition of slavery changed the colonial structure of the plantations in the following aspects: tenurial, managerial, and economic.

It was pointed out in Chapter Three (Section 3.3.3) that in the mid-nineteenth century the fragmentation of the sesmarias in the Iguape Parish (sugar plantation area) was already underway. The transformation of the colonial plantations into larger capitalistic enterprises (the usinas) demanding larger quantities of cane, firewood, and draft animals gave rise to a new process of land consolidation in the municípios where the usinas were located. That is, the areas of the earlier plantations were absorbed by the new enterprises. Table 22 presents the ranked area of the usinas (1924-1925) with their respective cropped area. Records show the huge area of the new enterprises in which over 50% of land remains underutilized suggesting a widespread use of land rotation as well as the need for each holding to generate its own firewood requirements.

TABLE 21

USINAS OPERATING IN BAHIA, 1899

| USINAS | DAILY CAPACITY IN METRIC TONS | LOCATION |
|--------------|----------------------------------|------------------------|
| Terra Nova | 400 | Santo Amaro |
| Bom Sucesso | 250 | Santo Amaro |
| Sao Bento | 250 | Santo Amaro |
| Alianca | 250 | Santo Amaro |
| Sao Carlos | 240 | Santo Amaro |
| Itapetingui | 240 | Santo Amaro |
| Passagem | 100 | Santo Amaro |
| Malemba | 100 | Santo Amaro |
| Rio Fundo | 400 | Santo Amaro |
| Capimirim | 200 | Sao Sebastiao |
| Iguape | 400 | Cachoeira |
| Acutinga | 120 | Cachoeira |
| Colonia | 70 | Sao Francisco do Conde |
| D. Joao | 180 | Sao Francisco do Conde |
| Maracangalha | 80 | Sao Francisco do Conde |
| Sao Joao | 150 | Salvador |
| Aratu | 240 | Salvador |
| Cotegipe | 240 | Salvador |
| Pitanga | 240 | Mata de Sao Joao |
| Pojuca | 300 | Pojuca |
| Conde | 400 | Conde |
| Sao Miguel | 100 | data n.a. |
| Carapia | 70 | data n.a. |

SOURCE: Luis Amaral, Historia Geral da Agricultura Brasileira, 3 vols. (Sao Paulo: Ed. Nacional, 1939-1940), 2: 88-89.

TABLE 22

RANKED AREAS OF THE BAHIA'S USINAS, 1924-1925

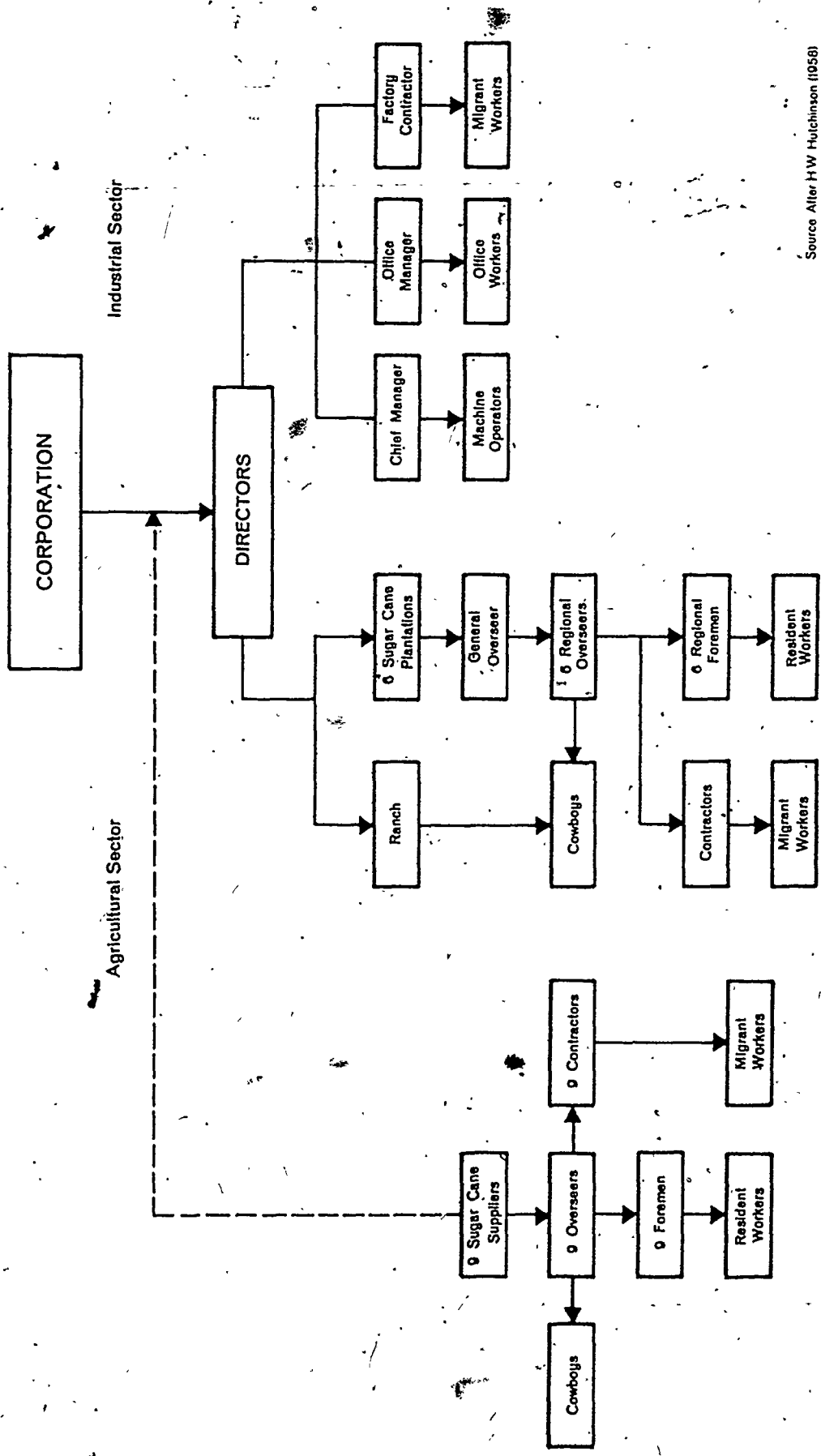
| | (A) TOTAL AREA IN HECTARES | (B) TOTAL CROPPED AREA IN HECTARES | B/A % | LOCATION |
|--------------|----------------------------------|--|----------|------------------------|
| Alianca | 9,147.6 | 2,613.6 | 28.50 | Santo Amaro |
| Pitanga | 7,405.2 | 1,132.5 | 15.20 | Mata de Sao Joao |
| Sao Carlos | 4,334.8 | 1,323.3 | 30.50 | Santo Amaro |
| Sao Lourenco | 4,138.2 | 784.0 | 18.90 | Sao Francisco do Conde |
| Passagem | 4,042.2 | 734.4 | 18.10 | Santo Amaro |
| Sao Bento | 3,919.4 | 1,524.6 | 38.80 | Santo Amaro |
| Terra Nova | 3,646.8 | 1,696.9 | 46.50 | Santo Amaro |
| Colonia | 3,484.8 | 1,089.0 | 31.20 | Sao Francisco do Conde |
| D. Joao | 3,484.8 | 1,219.6 | 34.90 | Sao Francisco do Conde |
| Sao Paulo | 3,267.0 | 914.7 | 27.90 | Santo Amaro |
| Cinco Rios | 2,178.0 | 774.0 | 35.50 | Santo Amaro |
| Itapetingui | 1,960.2 | 679.5 | 34.60 | Santo Amaro |
| Acutinga | 1,742.4 | 130.6 | 7.40 | Cachoeira |
| Vitoria | 1,698.8 | 108.9 | 6.40 | Santo Amaro |
| Capanema | 1,592.1 | 348.4 | 21.80 | Santo Amaro |
| Paranagua | 871.2 | 457.3 | 52.40 | Santo Amaro |
| Aratu | data n.a. | data n.a. | — | Salvador |
| Total | 56,913.5 | 15,531.3 | 27.29 | |

SOURCE: Bahia, Diretoria Geral de Estatistica do Estado, Anuario Estatistico da Bahia, 1924-1925, p. 44.

The land consolidation process resulted, therefore, from the persistence of vertical integration in the new sugar cane plantations.

Structural changes also occurred in the managerial and economic relationships. Information on these subjects is provided by Andrade²³ and Hutchinson.²⁴ The latter carried out research (1950-1951) in the Recôncavo in a factory which had been operating since 1900. Although the data come from the second half of this century, the general situation of the capitalistic plantations has remained virtually the same since the abolition of slavery (1888) and the last technological modernization (1880's). The Usina Sao Pedro resulted from the consolidation of six plantations with a contiguous total area of 1,620 hectares, a yearly capacity of 4,320 metric tons of sugar, and a permanent labour force of 1,350 workers.²⁵ It also processed cane from nine different fornecedores (cane suppliers). In addition, the usina owned a ranch (941.22 hectares) located in Irara município which supplied cattle and firewood to the factory.²⁶ The incorporation of six plantations into the Usina Sao Pedro illustrates, therefore, the process of land consolidation mentioned above.

Figure 24 is a reproduction of Hutchinson's diagrams in which basic structural aspects of the capitalistic plantations are shown.²⁷ Organized according to corporate principles, the new enterprises were controlled either by Bahian partners or traditional families, most of whom had previously been engaged in the sugar business. Vertically integrated backward through the production of basic inputs such as cattle, firewood, and sugar cane, the new enterprises differ little from the colonial plantations. On the contrary this contemporary evidence supports the descriptions in Chapter Six. The only difference lies in the discontinuance of tobacco as an integral part of the enterprise.



Source After H.W. Hutchinson (1958)

Figure 24 Usina of São Pedro: Structural and Economic Relationships (1951)

This is explicable by the abolition of slavery. Despite the lack of available information in published sources, this author believes that horizontal integration also continued to prevail.

The operational structure shows that the agricultural and industrial sectors are supervised by the directors of the corporation, a task carried out in the colonial mills by the manager.

Important change occurred, however, in the work relationship. Two basic types of relationships will be taken into account. One is the relationship between the cane suppliers and the corporation and secondly that between the workers and the corporation.

The fornecedores (cane suppliers) were successors of the mill owners but lack of capital precluded them from graduating to become usina owners or corporation partners. Their function in the new system resembles that carried out by the sugar cane growers (lavradores de cana). However, they owned the land, freed of agreements, had access to credit facilities, fought for their rights (prices and processing quota) and were paid in money. The suppliers' condition, dependent on the usina owner or corporation to process their cane, gave rise to the emergence of two groups, the usineiros (usina owners) and the fornecedores, each one fighting for its economic interests. The creation of the independent Institute of Sugar and Alcohol by the Brazilian government (1933) to protect sugar production, later became the body which determined sugar prices and related affairs.

Andrade states that in the Northeast there are also fornecedores who lease the land from the usinas.²⁸ These tenants were completely dependent on the usineiros to whom they paid from 15% to 20% of the cane production.

The second type of relationship deals with the workers (Figure 24).

Wages were paid according to the tasks carried out. They were divided into two categories, the permanent workers and the temporary workers.

The former lived on the usina or plantation in houses provided by the owners. Also provided were land plots to cultivate subsistence crops.

The temporary workers were immigrants from the Agreste and sometimes from the Sertao who left these areas during the driest season, which coincides with the sugar cane harvest (September to April). Up to 1963 minimum wages did not exist so that these workers earned symbolic salaries. The overseers had better conditions because, besides their wages, they also received annual extra compensation, proportional to the production of the area overseen.²⁹

8.3.1.3 Spatial Organization of Capitalistic Sugar Plantations.

The technological improvements introduced in the second half of the nineteenth century also affected the plantation landscape. The earliest mills, in the search for transportation facilities, concentrated on the seashore or close to it. Changes occurred in processing technology as well as in the transportation system which substantially altered the spatial organization of the new plantations. In the first place the new factories competing with the obsolete colonial mills absorbed them. The latter disappeared from the landscape and were replaced by cane fields and/or new factory buildings. Increases in economy of scale gave rise, therefore, to land consolidation. In the second place the size of the usinas also differed from the earliest mills. The average daily capacity of some new factories was ten times the average annual capacity of the oldest mills. On account of this transformation in scale and the construction

of railways the usinas became dispersed while the earliest mills had tended to encourage their spatial concentration around the Bay of All Saints.

8.3.2 Industrialization of Agricultural Raw Materials

Modernization of the sugar industry and the expansion of agriculture gave rise to the emergence of other industries. For instance a metallurgical industry was established to provide equipment for agriculture, transportation, and the sugar industry. By the end of the nineteenth century there were fourteen metallurgical factories operating in Bahia of which 10 were located in Salvador, 3 in Santo Amaro (plantation area) and 1 in Valença.³⁰ The role of agriculture in an expanding industrial sector was, however, more important in the realm of the textile and tobacco industries.

8.3.2.1 Textile Industry. The development achieved by this industrial sector after 1843, is directly related to the expansion of agricultural exports which required inputs such as sacks to export sugar, coffee, cocoa, and cotton, as well as to the demand for clothes by the lower income group of the population. Raw material was supplied either by domestic production or by other provinces (Alagoas, Sergipe, Pernambuco, and Minas Gerais).³¹ In the 1860's Bahia became the largest textile centre of Brazil. In 1866 there were, in Brazil, 10 textile factories of which 6 were located in Bahia.³² In 1875, the province continued to lead the textile industry with 10 factories operating, whereas Rio de Janeiro had 5, Sao Paulo 6, and Minas Gerais 5, out of a total of 29 in the whole country. By 1885, however, Bahia occupied the third place after Minas Gerais and Rio de Janeiro. Production was basically to

supply the domestic market (regional and national).

Table 23 shows the situation of the textile sector between 1872 and 1893. The foundation of operating units suggests that the textile industry preceded the mechanization of the sugar industry. It also employed a large number of workers per factory, most of whom were free workers. Information on the labour force in Table 24 seems to be an underestimation. The 1872 census recorded a total of 6,471 workers employed in the textile industry of which 14% were slaves.³³ The number of looms and spools indicate that the largest factories were located in the southern Recôncavo in Valença. However, the largest number of individual factories was concentrated in Salvador.

Insofar as the investment of capital is concerned there are indications that investors were businessmen, mainly traders, settled in Salvador. This suggests that the agricultural sector, through exports, provided the major source of capital to the textile sector. However, Sampaio's³⁴ viewpoint is that the trade sector providing capital was that related to imports.

Technological improvement in the production of cotton did not occur. The supply areas were located in the Sertao far from the factories. Transportation was costly because railway projects gave first priority to the construction of routes which reached areas producing major exports (sugar, tobacco, coffee, and cocoa). Cotton was basically transported by trails, so that factories imported the raw material from areas which could be shipped by coastal steam ships. The production of the Sertao remained a tributary of Minas Gerais, although part of it was also sent to the coastal areas either to supply the factories or for export.

TABLE 23

BAHIA'S TEXTILE INDUSTRY, 1872-1893

| FOUNDATION ^a | FACTORIES ^b | NO. OF WORKERS 1893 ^b | LOOMS 1893 ^b | SPOOLS 1893 ^b | CONSUMPTION OF COTTON 1872/76 IN METRIC TONS | PRODUCTION, 1893 ^b CLOTH IN M. | THREAD IN KG. | LOCATION ^a |
|-------------------------|------------------------|----------------------------------|-------------------------|--------------------------|--|---|---------------|-----------------------|
| 1834 | Queimado | 110 | 30 | 1,921 | data n.a. | 229,651 | 21,275 | Salvador |
| 1835 | Conceicao | 116 | 60 | 2,160 | 74 | 638,789 | data n.a. | Salvador |
| 1844 | Todos Os Santos | 300 | 135 | 5,184 | 300 | 1,000,000 | data n.a. | Valenca |
| 1857 | S. Carlos | 125 | 53 | 2,636 | data n.a. | 485,301 | 5,997 | Cachoeira |
| 1858 | Modelo | 161 | 70 | 3,348 | 80 | 530,139 | 39,885 | Salvador |
| 1860 | N.S. Do Amparo | 320 | 145 | 5,568 | 42 | 1,200,000 | data n.a. | Valenca |
| 1870 | S. Salvador | 132 | 85 | 3,264 | data n.a. | 720,360 | data n.a. | Salvador |
| 1873 | Bonfim | 160 | 54 | 2,077 | 90 | data n.a. | data n.a. | Salvador |
| 1873 | N.S. Da Penha | 161 | 60 | 2,520 | 43 | 571,560 | 375 | Salvador |
| 1875 | S. Braz | 340 | 151 | 5,920 | data n.a. | data n.a. | data n.a. | Salvador |
| Total | 10 | 1,925 | 843 | 34,598 | 629 | 5,375,800 | 67,532 | |

SOURCE: a) Jose Luis Pamponet Sampaio, et al., "Algodao e Textil na Bahia", in A Insercao da Bahia na Evolucao Nacional da. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), p. 203 and b) Francisco Vicente Vianna, Memoria sobre e Estado da Bahia (Bahia: Typographia e Encadernacao do Biario da Bahia, 1893), pp. 272-274.

8.3.2.2 Tobacco Manufacture. After 1822 tobacco production faced several crises due to the loss of the metropolitan market and the abolition of the slave trade in 1850. The situation was resolved with German investments in the tobacco market and the establishment of local processing plants for the raw material.

The first tobacco factory established in the Recôncavo (1819) produced snuff.³⁵ From 1850-1889 10 factories were constructed to manufacture snuff, cigars, and cigarettes. In 1893 Vianna³⁶ records a total of 17 tobacco manufacturers of which 12 produced cigars (4 in Salvador, 6 in Sao Felix, and 2 in Maragogipe); 4 produced cigarettes; and 1 made snuff. Detailed records on the manufacturers are not available, but they employed a large labour force, increasing the opportunities for the population of the tobacco growing areas as well as Salvador. In 1882 the Fragância and Juventude factories employed 70 and 130 workers respectively and they did not use machines. The Dannemann and Suerdieck concerns both founded in the late nineteenth century, became famous cigar manufacturers. The latter alone employed 900 workers in 1921.

Capital to establish factories was provided by the expansion of the export trade generally and in particular the tobacco trade, held by German and Portuguese firms.³⁷

Although manufacturing absorbed large amounts of tobacco, Bahia continued exporting tobacco in leaf to external markets. The tobacco area thus expanded due to new market possibilities. However, agricultural technology remained basically the same as that used during the colonial period. By the second half of the eighteenth century new varieties of tobacco (Nicotinas glutinosas and fructicosas de Linei) from Virginia were introduced into the Recôncavo as well as improvements in the method

of tillage and equipment to process the tobacco leaves.³⁸ Several attempts to improve tobacco cultivation were also undertaken during the nineteenth century but no positive effect was observed.³⁹

8.3.3 Ranching Improvements

The development of the ranching system was related to two basic factors: the expansion of the domestic market for beef and the improvement of transportation.

Although the system remained extensive, the introduction of innovations such as new breeds and types of forage and fencing, all contributed to an increase in production from the new agricultural frontiers. These frontiers were in areas previously covered by forest... (Foothills of Diamantine Ridge and Southern Agreste).

Precise data on the introduction of ranching innovations are not available. There is information for example that Caldeira Brant Pontes (mill owner) in 1814 became interested in introducing varieties of African grass into the Recôncavo. He had heard from friends living in Europe that the Guineagrass (Panicum maximum Jacq.) already growing in Puerto Rico and Jamaica was excellent cattle feed. After importing several varieties of grass from Africa, Caldeira Brant Pontes wrote in a letter to a friend in 1821 that the Guineagrass was growing satisfactorily in his garden, from where he planned to diffuse it among the mill owners.⁴⁰ These types of forage diffused from the Recôncavo to the Agreste and the Sertao, transforming large areas of these zones into improved pasture.

New European and American breeds of cattle were introduced into the Reconcavo e.g. Turina and Short Horn.⁴¹ The latter, however, did not

adapt to the ecological conditions of the tropical areas. On account of this maladjustment, Bahia began to import Indian breeds (Gir, Nelore, and Guzera) locally called Zébu. These breeds were introduced in the end of the nineteenth century into Brazil mainly in Minas Gerais. It is probable that they diffused from there into Bahia.

Both improved pasture and new breeds required the use of fences. Wire fences became widespread in ranching areas, mainly in the Recôncavo, Agreste, and Foothills of the Diamantina Ridge by the late 1800's. These innovations resulted in the change of the open range system, the most extensive method of raising cattle, to a more specialized system of pasture rotation for fattening beef.

By taking into consideration the agricultural innovation of the nineteenth century, ranching seemed to have been the system which experienced the most striking improvement. As was previously pointed out the export agriculture (plantations, tobacco, and cotton) according to the literature adopted very few technological innovations. Improvements were found in the industrial sector but rarely in tillage methods. The ranches although located farther from Salvador, adopted, therefore, more innovations than the agricultural systems of the coastal zone. Capitalization of the livestock sector, transportation facilities, and the striking expansion of the internal market for beef may have stimulated investments, and therefore, the evolution of the ranching system.

8.3.4 The Emergence of Cocoa Plantations

The increase and diversification of the external demand as well the improvement in transportation had also influence in the emergence and diffusion of new types of agriculture. Such was the case of the cocoa plantations in Bahia.

The first attempt to introduce the cocoa crop to Bahia was in 1746 when seeds brought from Para were planted in the município of Canavieiras (right bank of Pardo River).⁴² However, the market price for cocoa in the eighteenth century did not cover investments nor the transportation costs despite the cost of production being lower than those for sugar production.⁴³ Price and demand improved gradually by 1825 when Bahia exported 26 metric tons of cocoa at a price of £100 per sack (60 kilograms).⁴⁴ But it was only in 1852 that cocoa crops started to spread alongside the major rivers of the southeastern Mata zone (Cachoeira, Contas, and Pardo). Further diffusion resulted in the extension of the crop southward (Belmonte) and northward (Camamu, Itubera, Valenca, etc.).⁴⁵ By 1887 the president of the province had already emphasized the rapid expansion of coffee and cocoa growing on a large scale which, in face of market advantages and fewer external competitors, required less financial aid than sugar.⁴⁶ Between 1840 and 1890 exports of cocoa rose from 103 to 3,502 metric tons. By the end of the nineteenth century the cocoa areas were attracting immigrants from the Northeast and other regions of the state and the flow continued until the 1930's.⁴⁷ However, it was the transportation improvements (coastal shipping and railway) which influenced further cocoa expansion.

8.3.4.1. Factors of Production. The cocoa plantations in Bahia is a type of agriculture that operates on a large scale, requiring large amounts of land. To achieve an average production of 1,500 arrobas (22 metric tons) per harvest, a farmer must plant approximately 55,000 cocoa trees. Assuming an average yield of 400 kilograms per 1,000 trees (1 hectare) a farmer must have, therefore, a minimum of 55 hectares in trees, to attain that production.⁴⁸

In contrast to sugar plantations, however, the first cocoa farmers were smallholders rather than landlords. These farmers, considered pioneers, were immigrant posseiros (squatters) from the Northeast and other regions of Bahia. Public lands and/or unoccupied sesmarias located in dense forest were opened up in the mid-nineteenth century to grow first, subsistence crops and later cocoa. However, German and Spanish immigrants (160 people) also were brought into the region to grow coffee in 1822. This venture failed and many people died or left the area. The German survivors founded the Sao Jorge Colony to grow cocoa.⁴⁹ But it was only in the beginning of this century that large plantations emerged through consolidation of small farms and/or foundation of large farms in unoccupied lands.

The labour force which worked in the cocoa plantations was made up of free workers such as squatters, contratistas, and wage earners. The squatters, as previously pointed out, were the pioneers of the region who became smallholders or simple workers during the "cocoa boom". The contratistas were a special type of tenant who emerged in the cocoa area. They were hired by the landlords for a period of time to plant cocoa trees. For five or six years the harvest was shared half and half and then they were dismissed, leaving the land planted. Their rights consisted of being able to build a house and till subsistence crops. At the end of the agreement, the contratistas received a certain payment per tree planted and then they moved to other farms. When the immigration flow stopped the wage earners became prevalent in the region.⁵⁰ Diegues⁵¹ states that tenants are also found in the cocoa plantations whose payment is made in kind (half of the harvest). A large plantation may employ from 30 to 40 wage earners during the periods of planting and

harvesting.⁵² Most of these workers are hired temporarily so that spatial mobility is a common social phenomenon in the cocoa region.

Capital investment in the cocoa plantations was comprised of the purchase of land, buildings (house, storage, etc.), trees, primitive equipment (sword, ax, scythe, hoe, pick ax, and pruning hook), wages and mules for transportation. Because the operational costs of a plantation were low, cocoa was called "the crop of indolents".⁵³

Bondar⁵⁴ estimated that in 1938 a farm valued at 100 contos, producing 489 metric tons a year, with a cost of production of 158,000 contos, could give in ten years a net return of 242,192 contos or 24% on the fixed capital per year.

8.3.4.2 Operation of Cocoa Plantations. A common feature of cocoa plantations is absentee ownership. Many owners live in the cities as businessmen or professionals, while the farm operations are carried out by managers. In some cases these more qualified workers become plantation owners.⁵⁵

The technology used is very simple; the initial task consists of clearing the forest and planting the cocoa trees. There are two methods of planting.⁵⁶ One is to seed cocoa into the lower stratum of forest previously cleared so that the highest stratum is left to shade cocoa. This method is often practiced on the cocoa frontiers. The second method is to plant cocoa associated with banana or another high tree. Shading is very important during the growth period. It takes approximately three years to reach the first harvest which occurs in two periods (March/July and September/November). According to the area, cocoa trees may give a good production for thirty years and yield varies from 400 to 700.

kilograms per hectare or 1,000 trees.⁵⁷ There were municípios, such as Canavieiras, Belmonte, and Mucuri, where yields reached from 1,160 to 2,170 kilograms per hectare.⁵⁸ Old trees used to be replaced by new ones planted in new soils, so that land constituted the major input. During the harvest period the major tasks consist of splitting the cocoa fruits and transporting the seeds to the plantation headquarter where they are fermented and dried on platforms or large trays called barcacas.⁵⁹

Cocoa plantations require a large amount of land to provide adequate production. It is an intensive form of agriculture with respect to the use of soil because cocoa is a perennial crop, however, it is less intensive with respect to the use of labour and capital. In addition, it is specialized agriculture, operating at a large scale and oriented toward the external market. Different from sugar plantations, the cocoa plantations emerged and expanded without economic linkages with other types of agriculture. The region imported almost all commodities it consumed but cocoa has promoted a rapid demographic and economic growth of southeastern Bahia.

The location of the cocoa region showed in Figures 31 and 32 is associated with ecological suitability and the economic locational advantages provided by the maritime transportation. Rapid expansion of crops in the late 1800's gave rise to the construction of the Ilheus-Vitoria da Conquista Railway initiated in the early 1900's. The economic importance of cocoa has contributed to the rapid growth of two major urban centres, Ilheus and Itabuna.

8.3.5 Evolution of Transportation System

Among the set of innovations introduced into Bahia, those dealing with the improvement of transportation facilities were the most important in terms of spatial effect. While the expansion of processing plants had a mainly local impact, the implementation of transportation affected a wider area. It reduced the absolute and relative distance between Salvador and a larger area of its hinterland and coastline. It also reduced the costs of overland and maritime transportation in specific directions. As a consequence of these improvements, both settlement and agriculture expanded into the interior. Evolution of the overall transportation system (shipping, railways, and roads), however, was not initially rapid. Shipping in coastal waters was the first mode of transportation to be modernized.

8.3.5.1 Coastal Shipping. Among the Brazilian provinces, Bahia was the first to introduce the steamship. In 1819, Caldeira Brant Pontes imported a steam engine from England and the first steamship was constructed in Salvador shipyard. This innovation represented a striking benefit in terms of time and cargo capacity. Evaluation made by the ship owner estimated that a trip which previously took five days, could be shortened to eighteen hours.⁶⁰ The same steamship had the capacity to transport a cargo which had previously required twelve vessels.

The first route to be established was that linking the ports of Salvador and Cachoeira (Western Recôncavo) the most important gateway to the hinterland. The undertaking did not last because there was a lack of technicians. In 1847 the Bonfim Company was created which operated the short routes linking Salvador to Santo Amaro, Cachoeira, Nazare, and

Valença.⁶¹ In 1851 the Santa Cruz Company established a route between Salvador and Maceio (state of Alagoas). Later these two companies were incorporated to form the Companhia Bahiana de Navegacão a Vapor (1858) which in 1862 was again incorporated to the Bahia Steam Navigation Company.⁶² This English company operated until 1880 when it became the property of the province. In 1891 it was incorporated to the Lloyd Brasileiro (national company) with the name of Navegação Bahiana.⁶³ This company in 1891 operated twelve steamships six of which had a cargo capacity ranging between 90 to 120 gross tons.⁶⁴ These steamships transported cargoes and passengers over shorter distances whereas the other six operated over longer distances with a larger capacity (200 to 580 gross tons).⁶⁵ In addition, the steamships linked the southern railways through shipping ports to Salvador.

8.3.5.2 Evolution and Connectivity of Railway Network. So far no thorough research has been carried out to analyze the evolution and impact of the Bahian railways on the economic development of the state. An attempt will be undertaken in this section to analyze both the expansion of the railway network and its structure. In the last sections of this chapter the impact of railways on the expansion of agriculture will be discussed.

To study the evolution and spatial properties of a network, the topological approach has been used because it offers the possibility to analyze both the expansion process and the spatial properties of the evolving system. To undertake this task six stages in the growth of the network were selected based on the period of most rapid diffusion of the tracks. To analyze the network structure the following criteria were

adopted: a) only the major nodes or stations on the railways and b) the terminals of the network were counted. With respect to the spatial properties of Bahia's railway network only the connectivity indices which measure the structural complexity and change over time were calculated. The formula to calculate these indices were already presented in Chapter Four (Section 4.4.3.1).

8.3.5.2.1 Evolution of Railways -- Projects to construct the railways in Bahia started in the second half of the nineteenth century, yet expansion was slow relative to population growth and economic necessities of the state.

Figure 25 shows the topological evolution of Bahia's railway network (1858-1930), in which six stages are represented; to orient the location of railways see Figure 26.

The first stage of expansion is characterized by the initiation of different projects in various regions and began in 1858 (Figure, 25a) when the project to link the Mata zone (Salvador) to the São Francisco River (Sao Francisco Railway) was initiated. After five years 123 kilometers (Salvador-Alagoinhas) were inaugurated. The second project began in 1875 (The Tramroad Nazare), linking Nazare (a river port in the southern Recôncavo) to the major producer areas of coffee and manioc flour. The third railway project (Central Bahia Railway) started in 1876 (linkage Cachoeira-Feira de Santana) and in 1881 (linkage Sao Felix-Santa Terezinha). This railway starting in Feira de Santana (ranching area) crossed the plantation and tobacco areas leading to the cotton region and finally reached the state of Minas Gerais. The fourth project began in 1878 with the construction of Santo Amaro Railway, to serve the

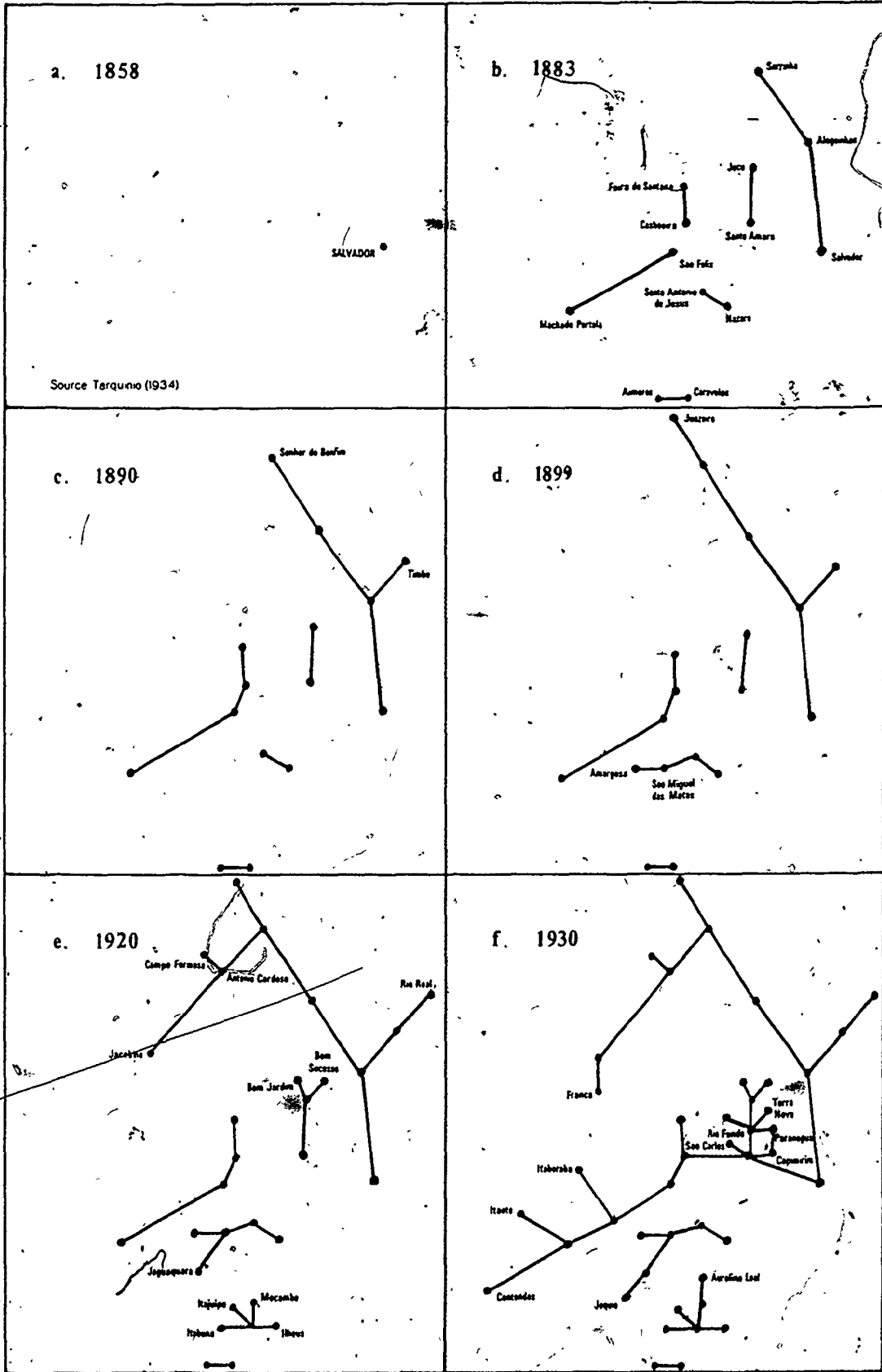


Figure 25 Topological Evolution of Bahia's Railway Network (1858-1930)

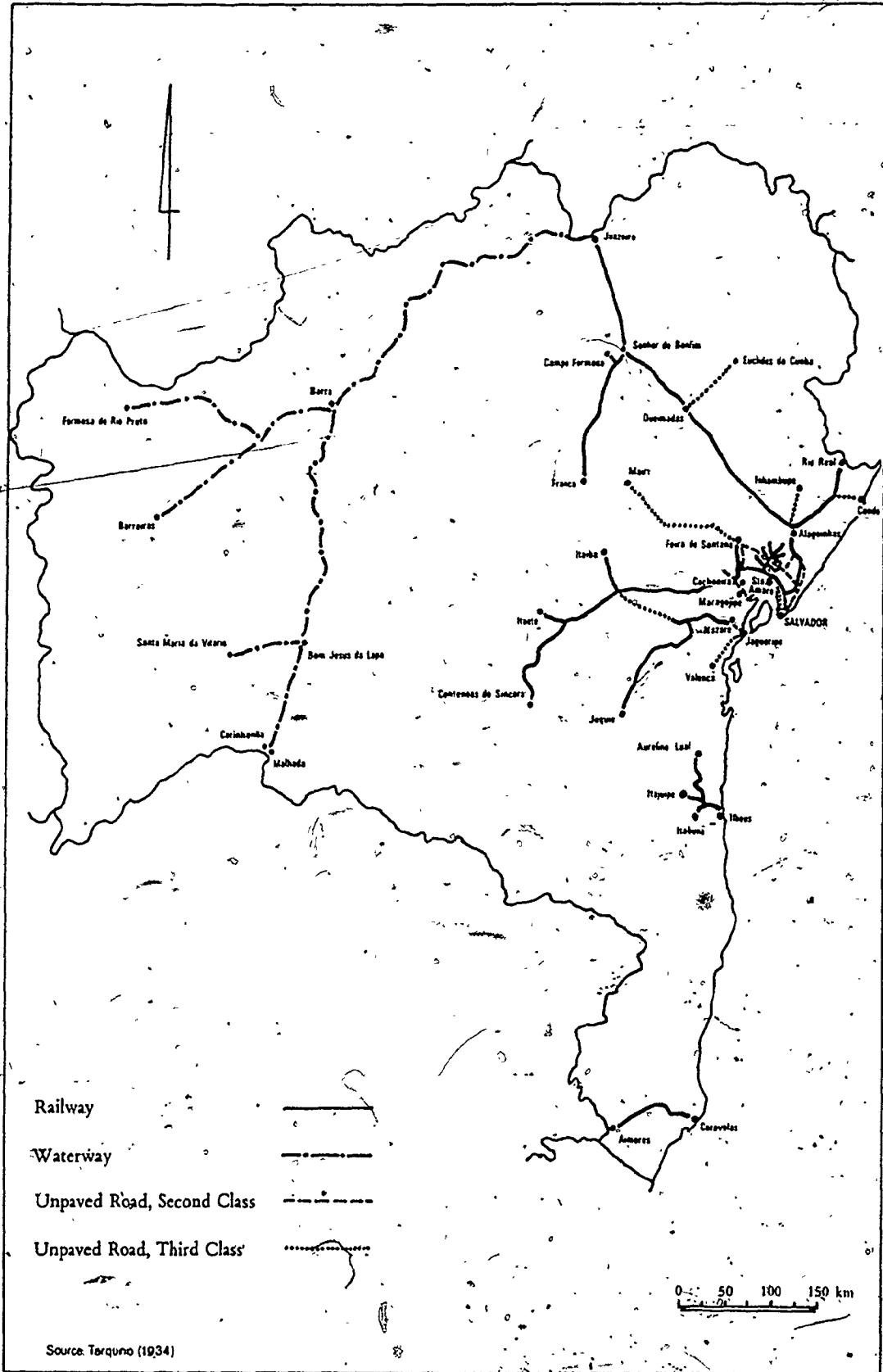


Figure 26 Transportation Network of Bahia (1930)

largest area of the plantations (Santô Amaro-Jacu). The last project of the nineteenth century was the Bahia-Minas Gerais Railway, initiated in 1879 (Caravelas-Aimore). This first stage was characterized by long delays in the approval and initiation of the projects.

The second stage (Figure 25b) is marked by the expansion of all projects. In 1883 the Sao Francisco Railway was extended to Serrinha (228 km.), the Bahia Central Railway expanded (255 km.) in the southwestern direction and the Bahia-Minas Gerais Railway (142 km.) was finished.

The third and fourth stages (Figures 25c and 25d) are marked by the expansion of the Sao Francisco Railway and the Tramroad Nazare, the former reaching Juazeiro on the right bank of the Sao Francisco River. Salvador thus became linked to a large area of its hinterland through the integration of the Mata, Agreste, and Sertao zones.

The fifth and sixth stages (Figures 25e and 25f) are characterized by the fastest growth of the number of feeders in the railway network as well as by the emergence of another railway, the Ilheus-Vitoria da Conquista Railway. During these stages not only did the overall system expand but it also became more connected.

The expansion of the railways over time may be also evaluated through the measures of route density. Table 24 presents several ratios which were calculated relating the total kilometers of railway to area, population, basic agricultural exports, and total exports. For example, the density of length of railway/100 square kilometers shows that the system continued expanding over time, in spite of low densities. The density of length of railway/10,000 people shows that the growth of network experienced a relative rapid increase until 1890. After this

TABLE 24

ROUTE DENSITY OF BAHIA'S RAILWAYS, 1860-1930

| YEAR | KM OF RAILWAY/ 100 KM ² | KM OF RAILWAY/ 10,000 PEOPLE | KM OF RAILWAY/ 100 METRIC TONS OF AGRICULTURAL EXPORTS* | KM OF RAILWAY/ £1,000 EXPORTED |
|------|---------------------------------------|---------------------------------|--|-----------------------------------|
| 1860 | 0.00 | data n.a. | 0.24 | 0.06 |
| 1865 | 0.02 | data n.a. | 0.17 | 0.06 |
| 1872 | 0.04 | 1.65 | 0.42 | 0.23 |
| 1875 | 0.05 | data n.a. | 0.54 | 0.38 |
| 1880 | 0.08 | data n.a. | data n.a. | 0.62 |
| 1883 | 0.15 | data n.a. | data n.a. | 1.21 |
| 1885 | 0.16 | data n.a. | data n.a. | 1.48 |
| 1890 | 0.19 | 5.47 | 3.12 | 0.98 |
| 1895 | 0.20 | data n.a. | 2.23 | 0.87 |
| 1899 | 0.22 | data n.a. | 2.93 | 0.90 |
| 1905 | 0.24 | 5.63 | 2.37 | 0.44 |
| 1910 | 0.26 | 5.38 | 1.79 | 0.34 |
| 1915 | 0.28 | 5.21 | 1.54 | 0.30 |
| 1920 | 0.31 | 5.16 | 1.77 | 0.20 |
| 1925 | 0.34 | 5.25 | 1.26 | 0.24 |
| 1930 | 0.37 | 5.30 | 2.34 | |

Sources on which author's calculations are based:

Mario Tarquínio "Vias de Comunicação e Meio de Transporte no Estado da Bahia", Revista do Instituto Geográfico e Histórico da Bahia 60 (1934): 325-444; Bahia, Diretoria Geral de Estatística do Estado, Anuário Estatístico da Bahia, 1924-1925, p. 234; Brasil, Instituto Nacional de Estatística, Sinopse Estatística do Estado da Bahia, 1936-1937, p. 38; M. István Jancsó, "As Exportações de Bahia Durante a República Velha (1889-1930)" in L'Histoire Quantitative du Brésil de 1800 a 1930 (Paris: Centre National de la Recherche Scientifique, 1973), pp. 345, 350, 352, 354, 356; and Ubiratan Castro Araujo and Vanda Sampaio de Sa Barreto "A Bahia Econômica e Social" in A Inserção da Bahia na Evolução Nacional 1a. Etapa: 1859-1889, vol. 1: A Bahia no Século XIX (Salvador: SEPLANTEC/CPE, 1978), pp. 54, 87.

* Includes sugar, tobacco, cocoa, and coffee.

date the demand for transportation facilities grew faster than the network. The same phenomenon occurred with respect to agricultural exports (sugar, tobacco, coffee, and cocoa) suggesting that there was a relative rapid diffusion of tracks up to 1890 which stimulated the expansion and intensification of some types of agriculture. However, in the following years the increase in production was larger than the increase of transportation facilities. By taking into account the density of length of railway/kl,000 exported, the peak of expansion was reached earlier (1885). This means that the total exports were positively affected by the innovations, but the expansion of the network did not respond fast to the economic development of the state. After 1920 there was a slight trend to a faster growth of the overland transportation but not as significant as in the earliest period of expansion.

Although no elaborate plan preceded the construction of railways in Brazil, particularly in Bahia, the network pattern showed in Figure 25 suggests two basic trends: the linkage of the total transportation system (coastal shipping-railways) through the shipping ports and the integration of the Brazilian regions, a goal of the national railways (Sao Francisco, Bahia Central, and Bahia-Minas Gerais).

8.3.5.2.2 Connectivity of Railways -- Connectivity may be defined as the degree to which the nodes of a network are directly connected to each other.⁶⁶ It is considered the most important structural property of a network particularly when growth is taken into account, as is the case of Bahia's railways. There is a direct relationship between the expansion or intensification of transport linkages and the increase in demand for transportation facilities to move people and goods. The degree of

connectivity of a transportation network is, therefore, indicative of the complexity of the spatial order that it imposes on the region it serves.

Figure 25 provided the basis for calculating the connectivity of Bahia's railways for which the indices are presented in Table 25.

TABLE 25
CONNECTIVITY OF BAHIA'S RAILWAY NETWORK, 1858-1930

| YEAR | EDGES | VERTICES | β | γ | α |
|------|-------|----------|---------|----------|----------|
| 1858 | 0 | 1 | 0.0 | 0 | 0 |
| 1883 | 7 | 13 | 0.54 | 0.21 | 0 |
| 1890 | 10 | 15 | 0.67 | 0.26 | 0 |
| 1899 | 13 | 18 | 0.72 | 0.27 | 0 |
| 1920 | 24 | 30 | 0.80 | 0.28 | 0 |
| 1930 | 40 | 43 | 0.93 | 0.32 | 0 |

Results of analysis (Table 25) show that the number of edges (lines) and vertices (stations) increased regularly according to the beta indices. For instance in 1883 there was 0.54 of a link for each vertex while in 1930 it had almost doubled. Indices through time indicate linkage intensity of the railway network, and improvement of transportation facilities. However, by taking into account the highest values which the beta indices can attain (the range varies from 0.5 to approximately 3.0) the linkage intensity of the Bahia's railway network was still low in 1930. Gamma indices also show some improvement in the relative connectivity of the railway system (from 21% in 1883 to 32% in 1930). But, a highly connected network may reach indices between 66%

and 100%, which are usually related to an advanced stage of economic development. Bahia's indices are further below that limit established, indicating a low connectivity of the railways, which is tied to underdevelopment. The alpha index measures the relative circuit connectivity, i.e. a ratio between the actual number of circuits in a network and the maximum possible number. The alpha values for Bahia's railway network is zero up to 1930. This means that there were no additional linkages in the network leaving the overall system overland unconnected.

From gamma and alpha indices it is possible to define the configuration of Bahia's railway network as having a spinal pattern which is characteristic of a minimally connected transportation system, probably related to underdevelopment. Theoretically the spinal pattern has a range of values as follows:

$$1/3 < \gamma < 1/2 \text{ where } v > 4$$

$$\alpha = 0 \text{ where } v = e + 1$$

Comparison between the actual situation of Bahia's railways with the original projects indicates that their execution was influenced extensively by administrative and political problems. Railways linking poorer and/or virtually unoccupied regions had priority over railways linking richer areas. The Sao Francisco Railway is an example of the former and the Bahia-Minas Gerais Railway is an example of the latter. On the other hand, the Bahia Central Railway which was projected to reach the most important cotton region of the state, had its construction delayed until the 1950's whereas the Ilheus-Vitoria da Conquista Railway was never completed. In addition, emphasis on isolated railways instead of lines linking the overall system contributed to economic inefficiency.

Connectivity indices and route density in this case should not be interpreted as a low effective demand for transportation facilities in Bahia. This is reinforced by the fact that the railway network was linked via shipping ports.

8.3.5.3 Waterways and Roads. The most important waterway of Bahia is the Sao Francisco River. Other rivers, including the Real, Subae, Paraguacu, Jaguaripe, and Jequitinhonha were navigable only for short distances in their lower courses.

In spite of its length the Sao Francisco River (3,161 kilometers) is navigable only in its middle section from Juazeiro to Pirapora in Minas Gerais (1,370 kilometers), from Barra to Barreiras (350 kilometers), from Barra to Formosa do Rio Preto (320 kilometers), from Bom Jesus da Lapa to Santa Maria da Vitoria (125 kilometers), and from Juazeiro to Boa Vista in Pernambuco (150 kilometers). Figure 26 shows the sections of river routes in Bahia. These routes were used during the colonial period by small vessels and canoes but there was no possibility of a river link between the Sertao and the Atlantic. Such a possibility came later when the Sao Francisco Railway reached Juazeiro in 1895. This connection favoured the improvement of transportation facilities through the introduction of a regular steamship service. In 1933 there were eleven units operating to transport cargoes and passengers.

The last transportation innovation introduced into Bahia was the construction of unpaved roads. In 1917 the government developed the first project to construct feeder lines connecting trunk rail lines. In addition, the project established the construction of trunk road lines linking supply areas to ports and/or demand areas. The execution of the

first projects resulted in the connection of Salvador to its hinterland through Feira de Santana. By 1930 the state had built 270 kilometers of new gravel roads. The earliest trails were also improved for truck and car traffic. Figure 26 shows the transportation network of Bahia in 1930 in which the prevalence of the railways can be observed. It also emphasizes the concentration of the transportation facilities in the Recôncavo and its periphery whereas the largest area of the state remained widely untouched by the technological improvements.

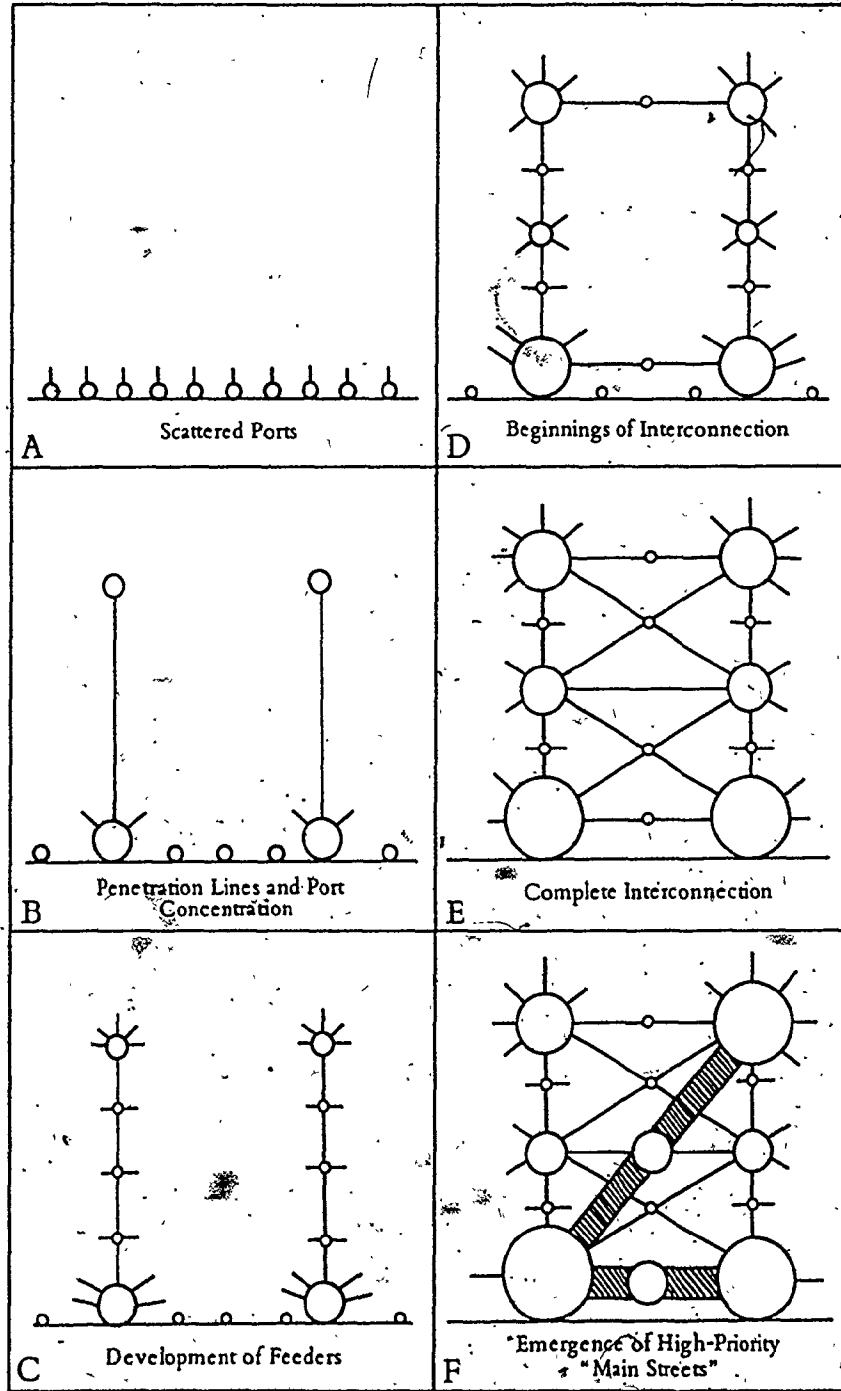
Taaffe et al.⁶⁷ developed a model to interpret the transportation expansion in underdeveloped countries which presents a strong analogy with the same phenomenon observed in Bahia. The authors studying the growth of the transportation network in Ghana and Nigeria idealized a typical sequence of transportation development in which the following phases were identified⁶⁸ (Figure 27).

Phase A consists of a scattering of small ports and trading posts along the seashore. There is little lateral interconnection and each port has an extremely limited hinterland.

Phase B involves the emergence of major lines of penetration into the hinterland whereby transportation costs are reduced for certain ports. Markets expand both at the port and at the nodes in the interior.

Phase C is characterized by the feeder routes which begin to focus on the major ports and centers located in the hinterland. These feeder routes give rise to a type of hinterland piracy that permits the major port to expand its tributary areas at the expense of adjacent small ports.

Figure 27. Ideal Typical Sequence of Transport Development



Source After Teaffe, Morrill and Gourd (1963)

Phase D, the previous process is accelerated through the development of small nodes along the main line of penetration as well as the feeder growth continues.

Phase E illustrates the further expansion of the feeder networks around the ports, centres in the hinterland, and main on-line nodes so that some of the larger feeders start to link up.

Phase F is characterized by a complete connection among ports, and nodes of different hierarchy, giving rise to the development of national trunk-line routes.

The process of economic development in Bahia until 1930 illustrates an analogy with some of the model phases described above. Phase A coincides with the largest part of the colonial period in which agricultural expansion concentrated around the major ports. Penetration in the hinterland was weakly developed through cattle trails so that no important nodes emerged. Transportation was based on maritime routes among the ports on the coastline which grew with the intensification of internal and external trade. In the late 1700's scattered nodes emerged in the interior giving rise to phase B. Trails remained as the major lines of penetration until 1858 when the first railway (Sao Francisco) began construction. In 1883 several railways started to operate linking the ports to their tributary areas (Figure 25b). Phase C started in 1890 when the feeder routes focused on the major ports and centres located in the hinterland started to emerge. In 1930 the transportation network of Bahia shows a tendency to reach phase D, particularly the tributary area of Salvador port. However, taking into account the total transport pattern of Bahia in 1930 (Figure 26) the overall preceding phases (A, B, and C) were still evident in most parts of the state.

8.4 Growth and Expansion of Population

Between 1817 and 1872, according to the census records, the population of Bahia had almost trebled. In the next eighteen years (1872-1890) the population grew at an average annual rate of 2% or a total increase of 39.15% (Table 26). From 1890 to 1900 the total population reached 2,117,956 while between 1900 and 1920 it climbed to 3,334,465 people representing periodic increases of 10.32% and 57.4% respectively.

Table 26 presents a picture of Brazil's population growth in which Bahia recorded the second largest population total between 1872 and 1890 and the largest in the Northeast. After 1900 it was surpassed by Sao Paulo but it remained until 1920 as the third most populous state of Brazil and the most important state of the Northeast. This demographic situation suggests that despite the "rubber and coffee booms" and the shift of Brazil's economic core toward the Southeast, Bahia continued to occupy an important position in the demographic and economic contexts. Such a position leads one to postulate a positive effect on the population growth of the technological innovations which marked the post-colonial period.

With respect to the rates of population increase, comparison among the states shows that Bahia did not experience the highest rates of growth. This reflects the fact that the economic development of Brazil, earlier concentrated in the Northeast and Minas Gerais (the mining region) became more diffused over the country. For instance the North (Amazonas and Para) attracted population from the Northeast (peripheral states) under the impact of rubber exploration, while coffee expansion in the Southeast stimulated outmigration from other states as well as European immigration. In fact, high demand in the southeastern coffee plantations

TABLE 26
POPULATION GROWTH OF BRAZIL, 1872-1920

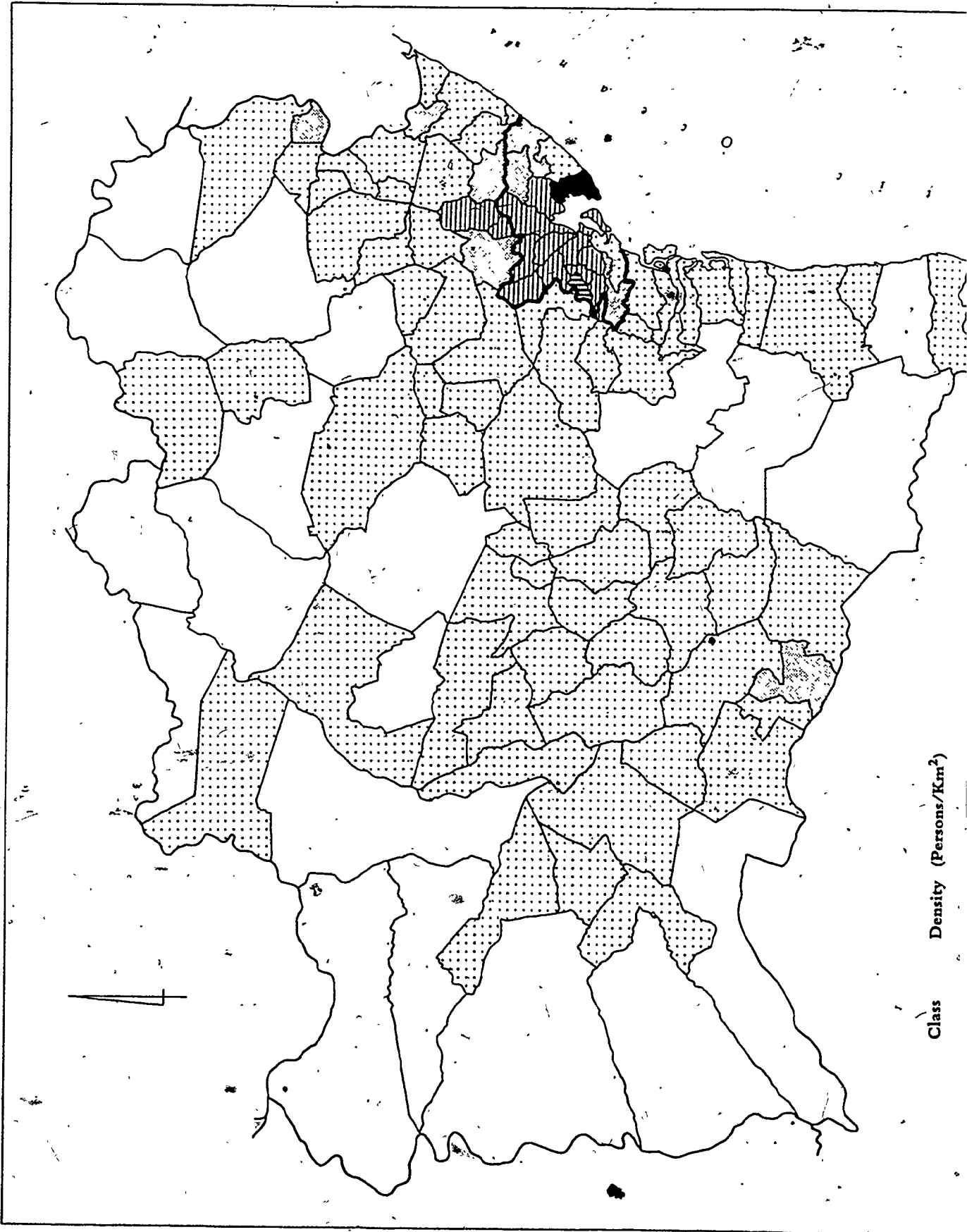
| | TOTAL POPULATION IN % | | | | INCREASE RATES IN % | | |
|---------------------|-----------------------|--------|--------|--------|---------------------|-----------|-----------|
| | 1872 | 1890 | 1900 | 1920 | 1872/1890 | 1890/1900 | 1900/1920 |
| Amazonas | 0.58 | 1.03 | 1.43 | 1.49 | 156.75 | 68.85 | 82.40 |
| Para | 2.77 | 2.29 | 2.56 | 3.21 | 19.34 | 35.59 | 120.84 |
| Maranhao | 3.62 | 3.01 | 2.86 | 2.85 | 20.00 | 15.89 | 75.10 |
| Piaui | 2.04 | 1.87 | 1.92 | 1.99 | 32.33 | 24.93 | 82.16 |
| Ceara | 7.26 | 5.62 | 4.87 | 4.31 | 11.64 | 5.39 | 55.36 |
| Rio Grande Do Norte | 2.36 | 1.87 | 1.57 | 1.75 | 14.66 | 2.25 | 95.81 |
| Paraiba | 3.79 | 3.19 | 2.81 | 3.14 | 21.53 | 7.34 | 95.83 |
| Pernambuco | 8.47 | 7.18 | 6.77 | 7.04 | 22.42 | 14.36 | 82.90 |
| Alagoas | 3.50 | 3.57 | 3.72 | 3.19 | 46.96 | 26.95 | 50.74 |
| Sergipe | 1.77 | 2.17 | 2.04 | 1.56 | 76.42 | 14.58 | 33.91 |
| Bahia | 13.89 | 13.39 | 12.15 | 10.87 | 39.15 | 10.32 | 57.44 |
| Minas Gerais | 20.55 | 22.21 | 20.61 | 19.22 | 56.10 | 12.89 | 63.81 |
| Espirito Santo | 0.83 | 0.95 | 1.20 | 1.49 | 65.57 | 54.26 | 118.00 |
| Rio de Janeiro | 10.65 | 9.77 | 9.96 | 8.87 | 32.32 | 24.15 | 56.39 |
| Sao Paulo | 8.43 | 9.66 | 13.08 | 15.00 | 65.37 | 64.81 | 101.21 |
| Parana | 1.28 | 1.74 | 1.88 | 2.24 | 96.88 | 31.12 | 109.61 |
| Santa Catarina | 1.61 | 1.98 | 1.84 | 2.18 | 77.58 | 12.87 | 108.79 |
| Rio Grande Do Sul | 4.38 | 6.26 | 6.59 | 7.12 | 106.40 | 28.04 | 89.95 |
| Mato Grosso | 0.61 | 0.65 | 0.68 | 0.80 | 53.64 | 27.14 | 108.95 |
| Goiias | 1.61 | 1.59 | 1.46 | 1.68 | 41.88 | 12.18 | 100.53 |
| Brasil | 100.00 | 100.00 | 100.00 | 100.00 | 44.34 | 21.66 | 75.68 |

SOURCE: Brasil, Fundacao IBGE, Sinopse Preliminar do Censo Demografico, Brasil, 1970 (Rio de Janeiro: DEGEN, 1971), p. 82.

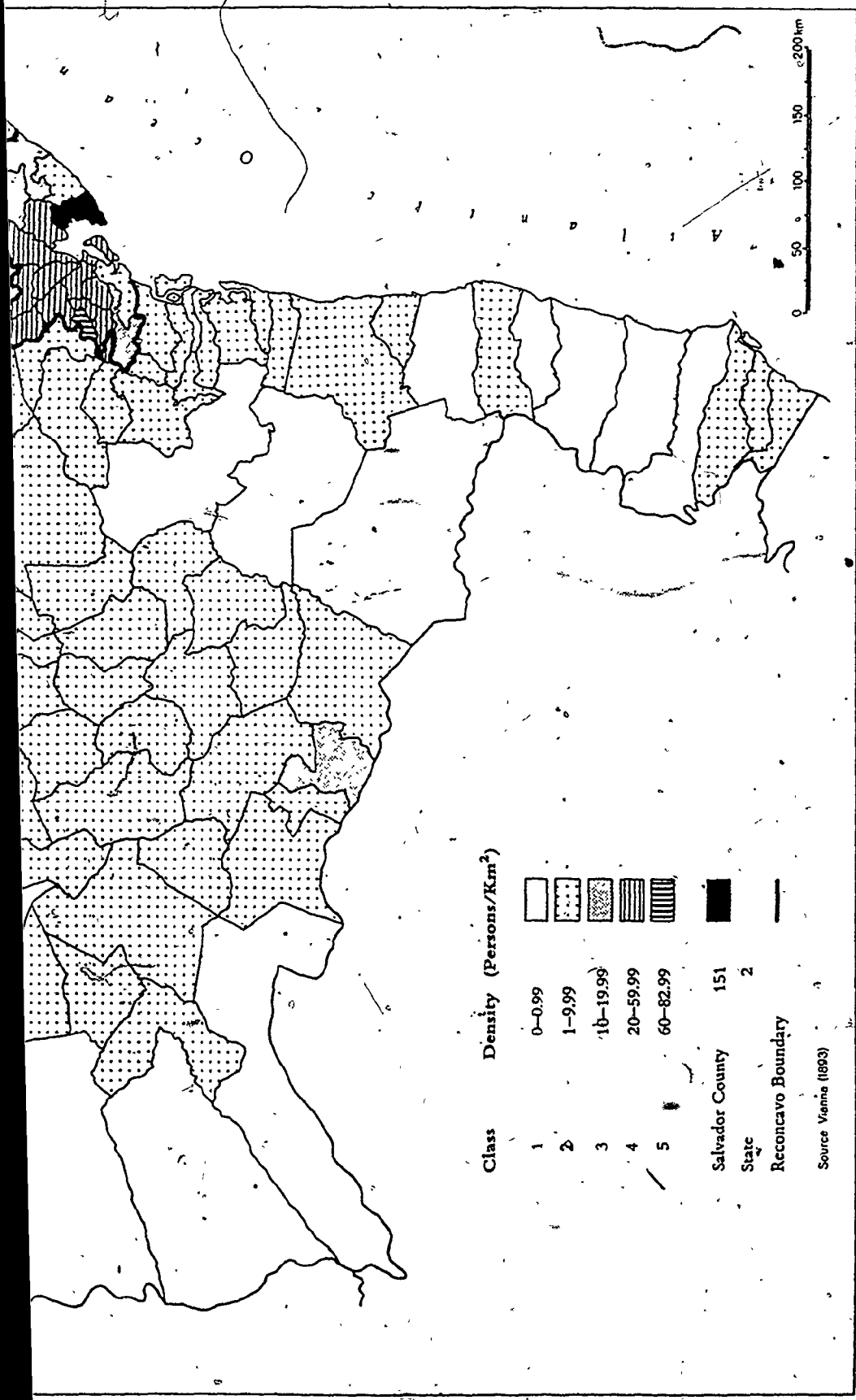
for a labour force coincided with the complete abolition of slavery in 1888. This event associated with successive drought periods which occurred in the Northeast (1877-1879, 1888-1889, 1898, 1900, 1903, 1907, 1915 and 1919)⁶⁹ stimulated outmigration to other regions. Bahia's demographic situation was particularly serious between 1890 and 1900 when the state experienced one of the lowest rates of growth in the country (10.32%). However, between 1900 and 1920 there was a striking change in the rate of increase as the state population experienced an annual average increase of 2.9%. This period matches the rapid expansion of cocoa plantations which attracted population from other states of the Northeast, particularly from Alagoas and Sergipe. Further expansion of railway tracks also occurred in the same period.

Overall, however, from 1872 to 1920 the population of Bahia not only grew faster than in the preceding centuries but its distribution pattern also changed. Such a change may be related to the movement of the agricultural frontier in several directions and/or the intensification of agriculture under the impact of a higher demand for agricultural products and the technological innovations.

Evidence for the change of spatial distribution of population is provided by a map series based on the available census records (1872, 1890, and 1920). The patterns of Bahia's population represented in Figures 28, 29, and 30 show that it is not distributed evenly. The Portuguese colonization gave rise to a type of territorial occupation in which two major areas can be identified. One area is focused on Salvador which presents the highest concentration of population in the state. The other area is occupied extensively and it comprises the largest part of Bahia. This general picture has tended, however, to change over time.

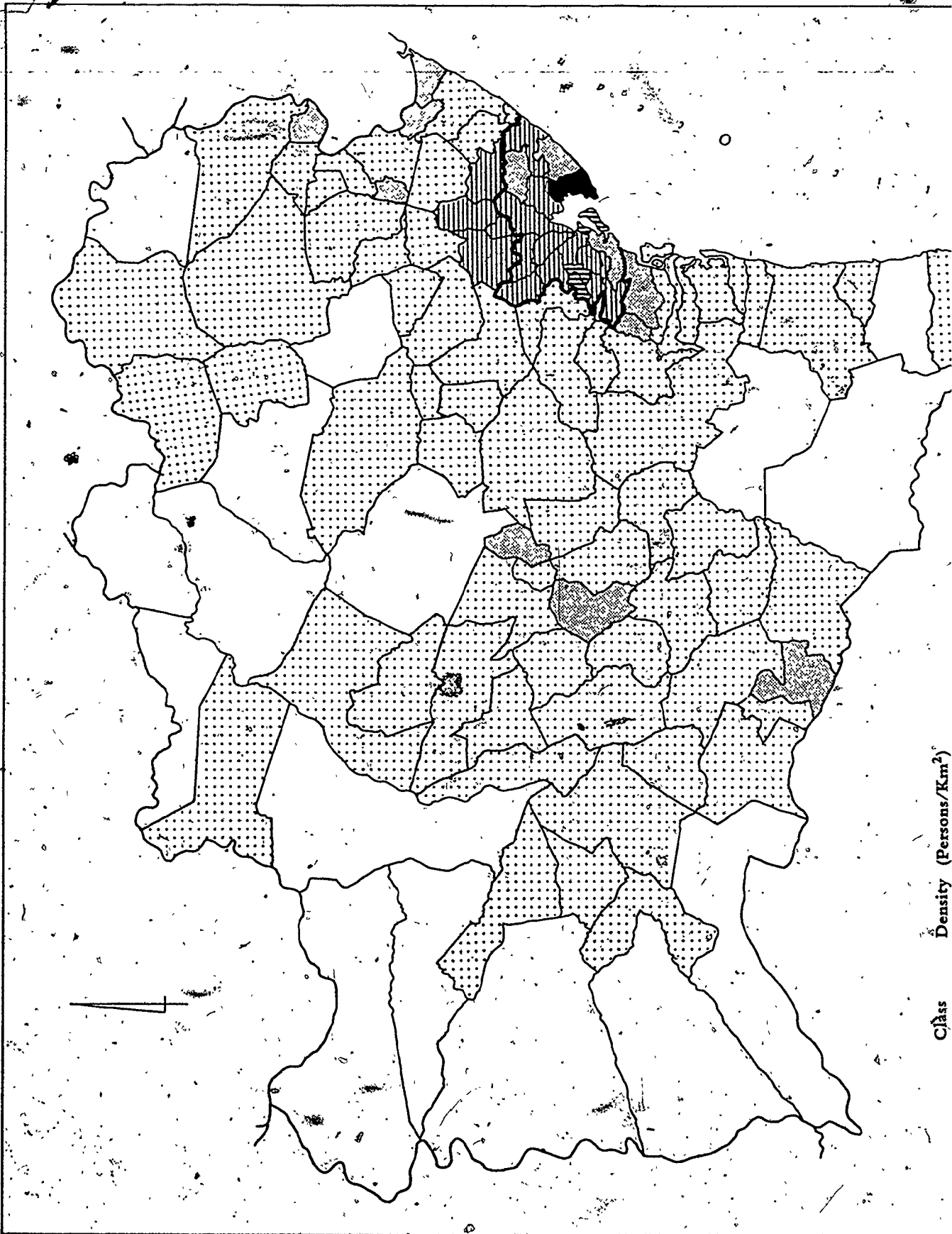


Class Density (Persons/Km²)



• Figure 28 Population Density of Bahia (1872)

20F 2



Class
Density (Persons/Km²)

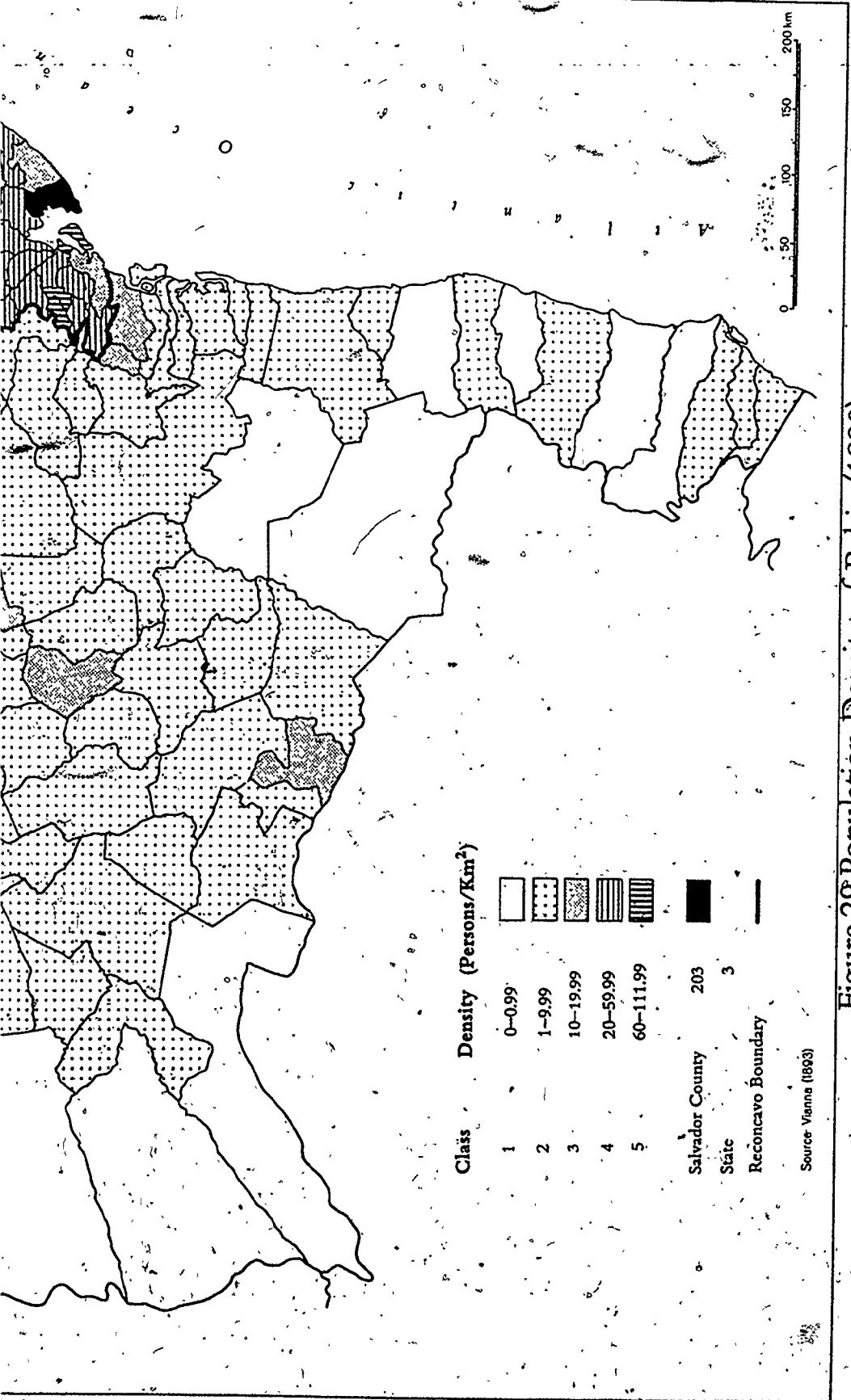
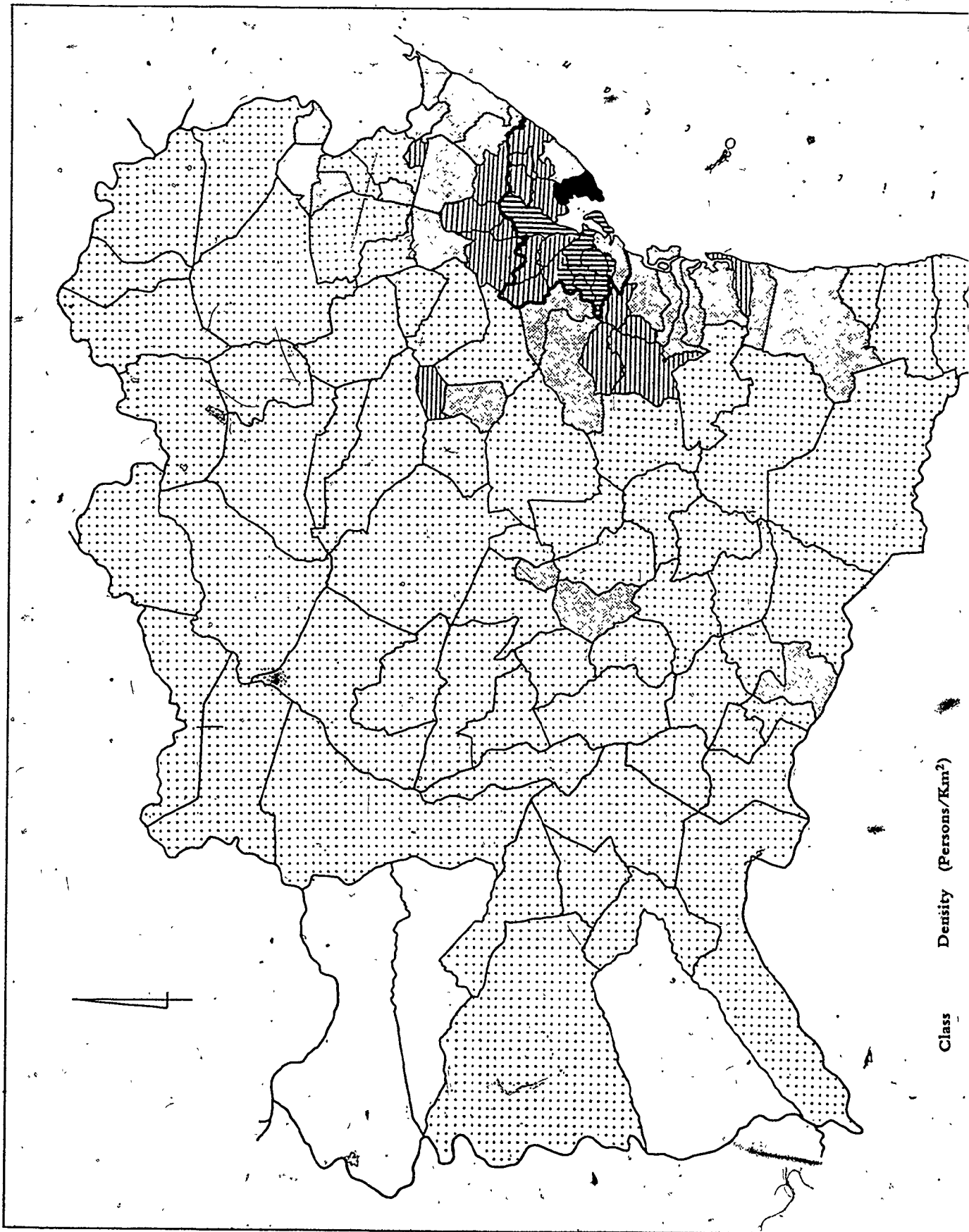


Figure 29 Population Density of Bahia (1890)

205 2



Class Density (Persons/Km²)

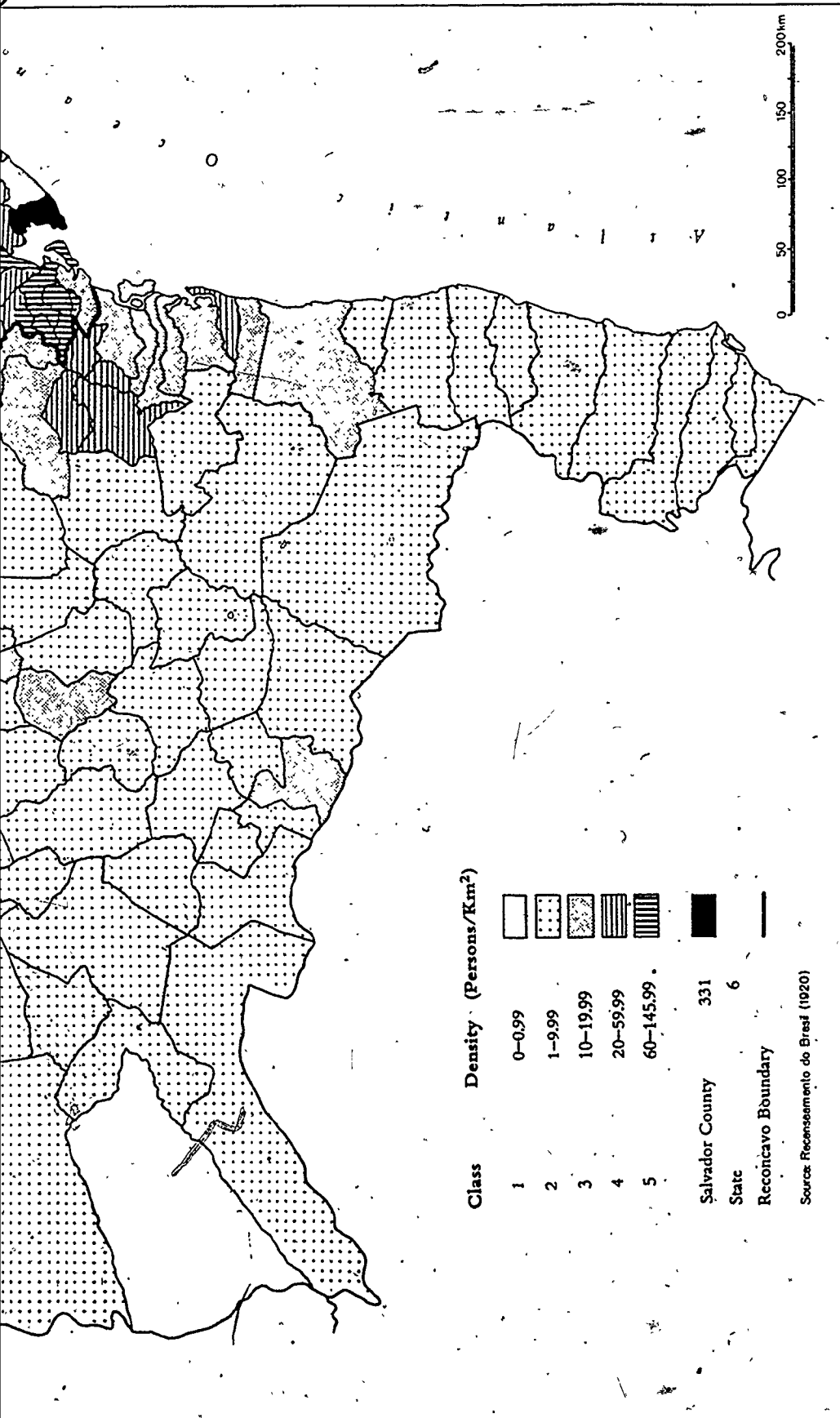


Figure 30 Population Density of Bahia (1920)

205-2

according to the geographic zones.

In the Mata zone; population remains highly concentrated in the Recôncavo, the traditional area of export crops (sugar cane, tobacco, and coffee) and food crops (vegetable, fruits, and manioc). This heartland of Bahia was the focus of technological transformations related to processing plants and transportation. Over the period 1872-1920 changes took place particularly in the northeastern and southern Recôncavo. In the former area density change was related to the expansion of the Sao Francisco Railway which stimulated the growth of towns and villages. In the former area, however, density change is definitely associated with both the transportation improvements (linkage of shipping ports to railways) and intensification of agriculture, particularly with respect to tobacco for which several processing plants were located in the area. The Recôncavo, therefore, not only experienced changes from 1872 to 1920 but population remained highly concentrated within the region (Figure 30).

Outside the Recôncavo, population expanded within the Mata zone northward and southward. In both directions density patterns changed between 1872 and 1920. Expansion northward may be related to the influence of Sao Francisco Railway (Timbo branch) and the prior expansion of sugar cane and food crops. Expansion southward is definitely associated with the relocation of agricultural frontier under the impact of the "cocoa boom". As was previously pointed out the cocoa expansion attracted immigrants of other regions. This event contributed to alter substantially the density picture of this area (Figures 28 and 30).

In the Agreste, density patterns also changed, particularly in the areas where the impact of the railways contributed to further intensification of agriculture (tobacco and coffee). Expansion of population in

the central and northern Agreste (Figure 30) matches agriculture intensification alongside the railways (see Figure 32). However, drastic changes occurred only in Alagoinhas, Feira de Santana, Amargosa, Jequirica, Laje, and Ubaira. Change is also observed in the southern Agreste but, sparse population remained the basic feature. This area corresponds to a new agricultural frontier, but opened up by cattle ranches in the earlier 1800's.

In the Sertao where physical conditions are more heterogeneous and the historical occupancy was based on ranching and subsistence agriculture, population remained highly dispersed. Despite the unfavourable factors density gradually increased, especially northward and westward (Figures 28, 29, and 30). The former direction coincides with the driest area of the state and earlier ranching expansion while the latter direction remained virtually unoccupied until the beginning of the nineteenth century. Both areas were located in the perimeter of the transportation improvements that occurred in the late 1800's (see Figure 26). The density patterns remained almost unchanged in the axis from the centre, southward. Only a few municípios (Mairi, Baixa Grande, Palmeiras, and Piata) underwent changes (Figure 30). Despite the linkage between ranching and lower population densities twenty-seven towns and cities out of one hundred and twenty-three urban nodes existing in Bahia in 1893 had originated from ranches.⁷⁰

Although the density patterns in Bahia revealed that population remained highly concentrated in the Recôncavo the settlement pattern in 1920 would reveal another picture of the state. That is, in each município, population nucleations had developed concentrated in small cities, towns, and villages surrounded by lower rural densities.

A fact which cannot be neglected, however, is the impact of technological innovations on the population growth and its areal distribution.

8.5 Expansion and Intensification of Agriculture

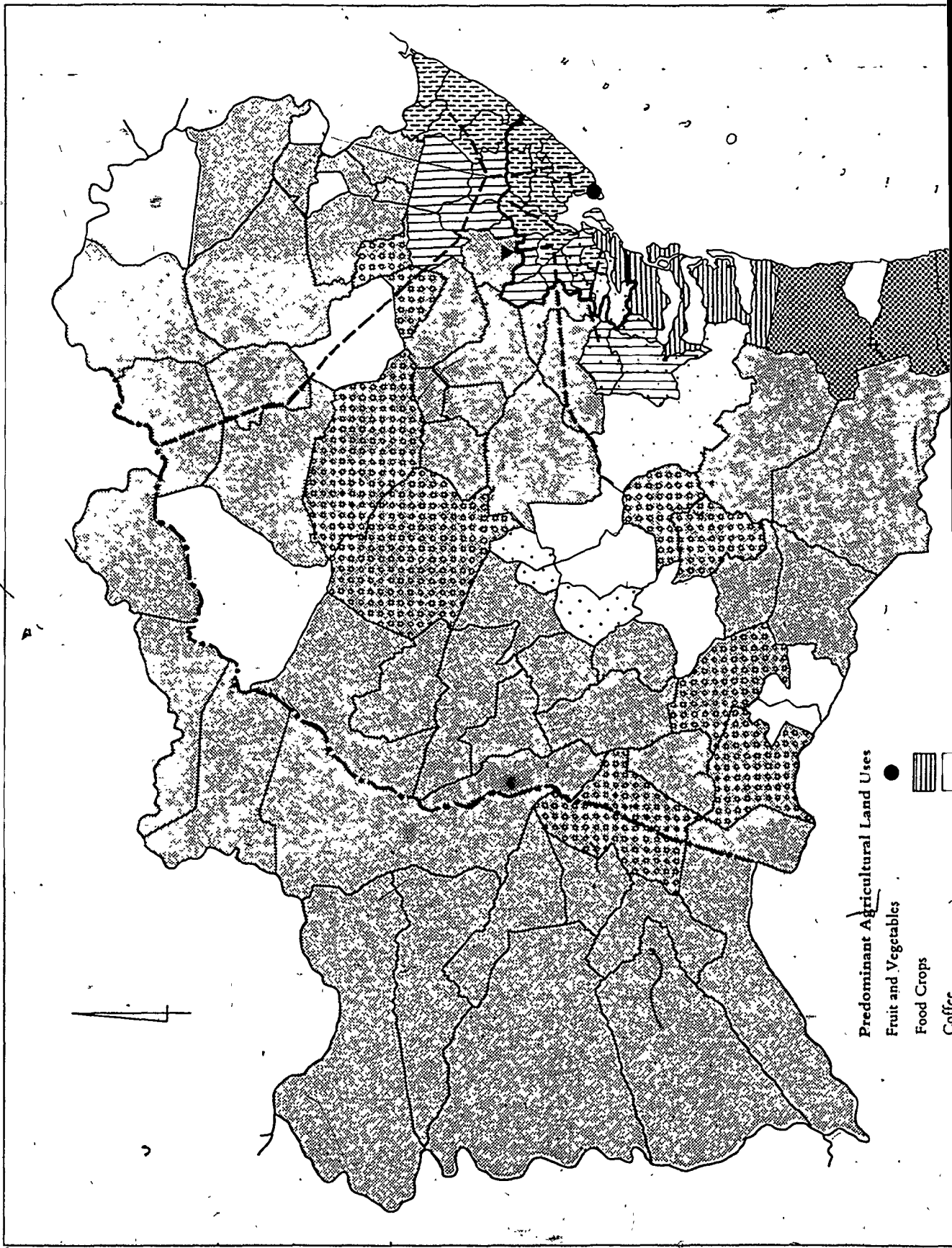
So far a set of transformations which occurred during the nineteenth century has been described. However, how these transformations influenced the agriculture in Bahia remains to be studied. In the first place the overall agricultural area experienced a relatively rapid expansion. During this expansion locational distinctions developed between types of agriculture; crops oriented toward the external market remained and/or expanded in areas better served by the transportation facilities or in virtually unoccupied areas with advantageous physical conditions. The prime example of the latter type of expansion is cocoa, which became the chief crop of the state. Crops oriented toward the internal market tended to occupy less advantageous locations while livestock not only became part of mixed system but also competed for better location, as the overall pattern evolved. As a result of expansion and intensification of agriculture, the external trade of Bahia experienced a substantial increase in both value and quantity. Evidence on these aspects of agriculture is provided below.

8.5.1 Agricultural Land Use Patterns, 1900-1920

To analyze the agricultural land use in the late nineteenth century only qualitative information is available. The first agricultural census in Brazil was carried out in 1920. However, there are problems with the reliability of information and data may reflect the influence

of the drought which occurred in 1919. In order to maximize use of the information recorded, a location quotient technique was applied and used to produce a map of land use (see Chapter Four, Section 4.4.3.2). The information used, included density of cattle and the total cropped area (perennial and temporary crops) at the município level which resulted in indices presented in Appendix E. These indices permitted the classification of the agricultural land use categories, which are labelled according to the prevalent types of agriculture (Figure 32). The search for a more objective classification, for the 1920 census, gives rise to maps which employ a different terminology from that used on the historical map series. This new terminology permits better comparison with the map series derived from the 1940, 1950, 1960 and 1970 censuses which are analyzed in Chapter Nine.

8:5:1.1 Changing the Colonial Agricultural Pattern. Figure 31 shows the prevalent agricultural land use in Bahia associated with the railway network ca. 1900. In the first place, comparison of the agricultural pattern with that previously observed ca. 1800 (Figure 21) suggests that agriculture (both crops and ranching) experienced striking expansion during the nineteenth century. This expansion process presents the following features. Areas previously occupied by cash crops (sugar cane, tobacco, and coffee) and food crops did not change except in a few counties located in the southeastern Mata zone (Belmonte, Canavieiras, and Ilheus). Areas previously occupied by ranching in the northern Mata zone (Entre Rios, Conde, etc.), the Agreste (Alagoinhas, Irara, Inhambupe, Serrinha, Amargosa, Ubaira, and Maracas), and the Sertao (Lencois, Palmeiras, and Piata) were invaded by sugar cane,



Predominant Agricultural Land Uses
● Fruit and Vegetables
▮ Food Crops
▣ Coffee

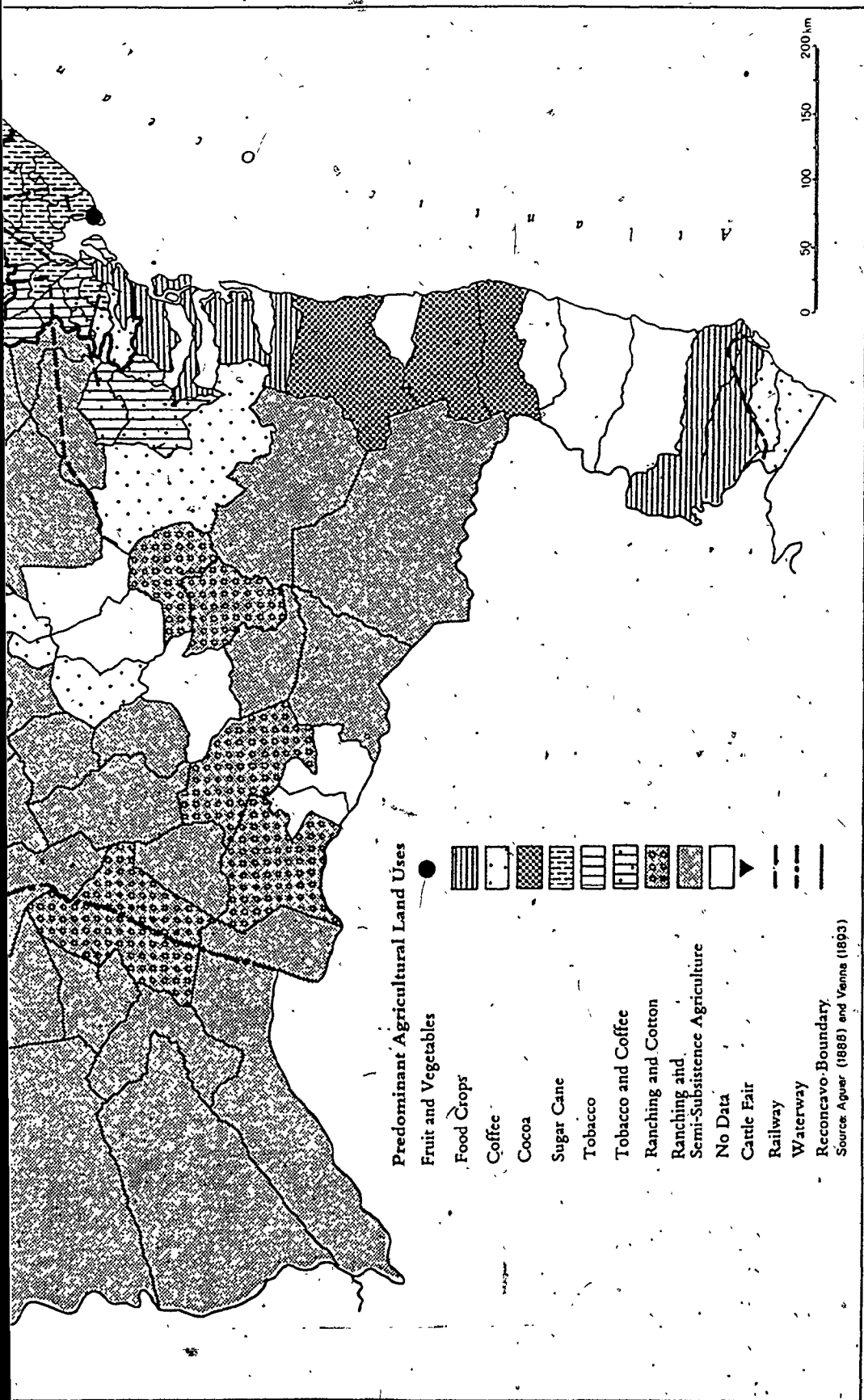


Figure 31 Land Use Patterns in Bahia ca. 1900

tobacco, and coffee. Areas virtually unoccupied in the Mata zone (Belmonte, Canavieiras, Ilheus, Alcobaca, Caravelas, and Vicosá), the Agreste (Pocoes and Vitoria da Conquista) and the Sertao (Foothills of Diamantina Ridge and the western bank of Sao Francisco River) were transformed into new agricultural frontiers. Finally, areas previously occupied by ranching in the Sertao (Jeremoabo, Tucano, Itapicuru, Ribeira do Pombal etc.) remained unchanged or evolved to a mixed agriculture (ranching and cotton) such as occurred in Jacobina, Morro do Chapéu, Caitite etc.

In the second place, areas affected by technological innovations, particularly the railways and transoceanic steamships expanded their cropped area. Ranching, therefore, became less important in areas closer to major ports (Salvador, Nazare, and Cachoeira). However, the relocation of the colonial cattle fair, Capuame from the northern Recôncavo to Feira de Santana in the Agreste, favoured ranching improvement on both sides of the larger railways, particularly in the Foothills of Diamantina Ridge (Mundo Novo, Mairi, Baixa Grande, Itaberaba, etc.). This region in the second half of the nineteenth century became specialized in fattening cattle driven from the Sao Francisco basin and western Brazil. The ranching improvements previously described (Section 8.3.3) diffused and consolidated in this area of commercial transhumance so-called invernadas. Intensification of agriculture seemed to have occurred on the Mata zone and alongside the railways in the interior. In both regions intensification is related to the expansion of external and internal markets.

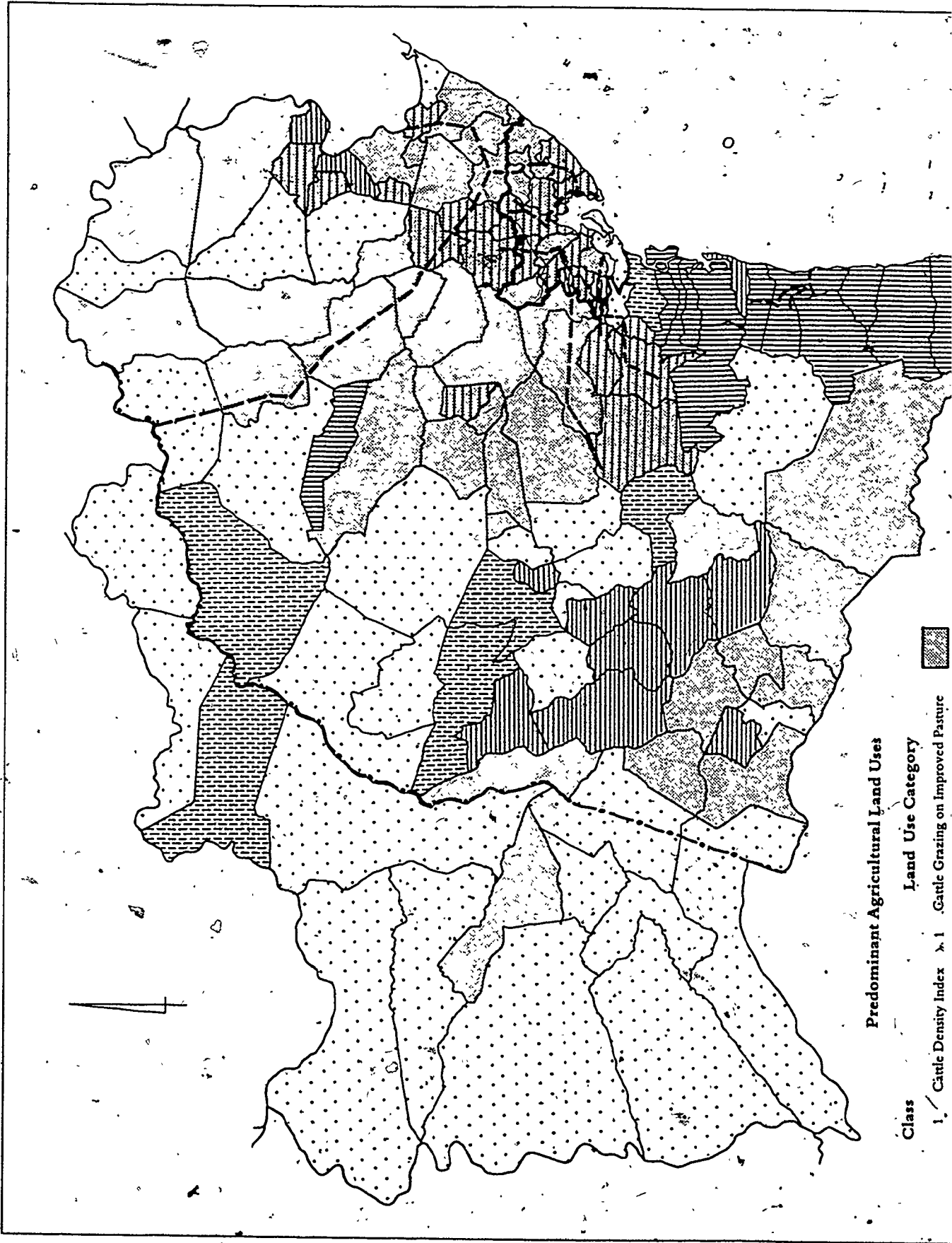
Finally, the 1900 agricultural pattern shows a striking concentration of crops in the Mata zone basically oriented toward the external

market. In this longitudinal zoning there also prevails the most intensive types of agriculture (sugar plantation and tobacco) remaining closer to Salvador. Between this narrow zone and the Sao Francisco River is a zone of considerable variety of farming types in the Agrete and the largest part of the Sertao. Here the intensity of agriculture varies according to the location of land use related to Salvador and physical conditions. However, the most extensive land use (ranching for raising cattle) dominates in the peripheral areas of the zone. A third zoning appears in the western Sertao (west bank of Sao Francisco River) in which ranching for raising cattle (open range) is the dominant type of agriculture. In these two zones, agriculture is oriented toward the internal market, although in specific areas of the Agrete and Sertao the production of tobacco and coffee supplies both internal and export markets.

8.5.1.2 Consolidation of Agricultural Land Use, 1920. Bahia in 1920 had 432,386 hectares in cropped area⁷¹ or 5% of total farmland (8,451,440 hectares) and a total of 2,698,136 head of cattle.⁷² The cropped area was distributed among the crops as follows: cocoa (45.59%), staple food crops (16.90%), coffee (16.45%), sugar cane (7.45%), tobacco (6.80%), cotton (4.28%), coconut (2.27%), and others (0.26%). These figures not only emphasize the overall expansion of the agricultural space which had occurred during the nineteenth century, but also that the expansion process was extremely selective. That is, the crops oriented to the external market, particularly cocoa and coffee together accounted for 62% of the total cropped area. On the other hand, the staple food crops (manioc, beans, corn, and rice) expanded relatively slower than the cash crops.

The agricultural pattern shown in Figure 32 suggests that, by and large, the trend observed in 1900 (Figure 31) remained the same but there were some noticeable changes.

In the northern Mata zone in several municípios sugar cane was replaced by pasture (Conde, Entre Rios, Mata de Sao Joao, Catu and Pojuca). Such a replacement may be related to the transformation which occurred in the sugar plantations as previously described (Section 8.3.1). That is, the land consolidation under the new usinas as well as their concentration in Santo Amaro, Sao Francisco do Conde, and Salvador made production of the raw material farther from the factories uneconomic. On the other hand, higher demand for beef and hides and the location of packing houses alongside the Sao Francisco Railway (Mata de Sao Joao) must have contributed to pasture expansion. In the Recôncavo, intensification of sugar cane production through improved land rotation (sugar cane versus pasture) gave rise to a mixed agriculture. However, in this new combination, sugar cane remained, economically, more important than cattle. A similar combination also occurred with tobacco. As already explained in Chapter Seven, tobacco's demand for manure was high, and therefore, expansion of the tobacco area encouraged cattle expansion. In the southeastern Mata zone a striking change is observed. Municípios earlier producing food crops (Cairu, Nilo Pecanha, Taperoa, Itubera, Camamu, and Itacare) changed over to perennial crops (cocoa, coffee, and coconut), particularly cocoa. This change must have contributed to the reduction of the total area in food crops. Changes also occurred on the south where forest areas were cleared to introduce cattle. Indices refer to cattle grazing on natural pasture in this area but it is probably more correct to interpret this as cattle grazing on improved pasture



Predominant Agricultural Land Uses

- Class
- | Class | Land Use Category |
|-------|------------------------------------|
| 1 | Cattle Grazing on Improved Pasture |

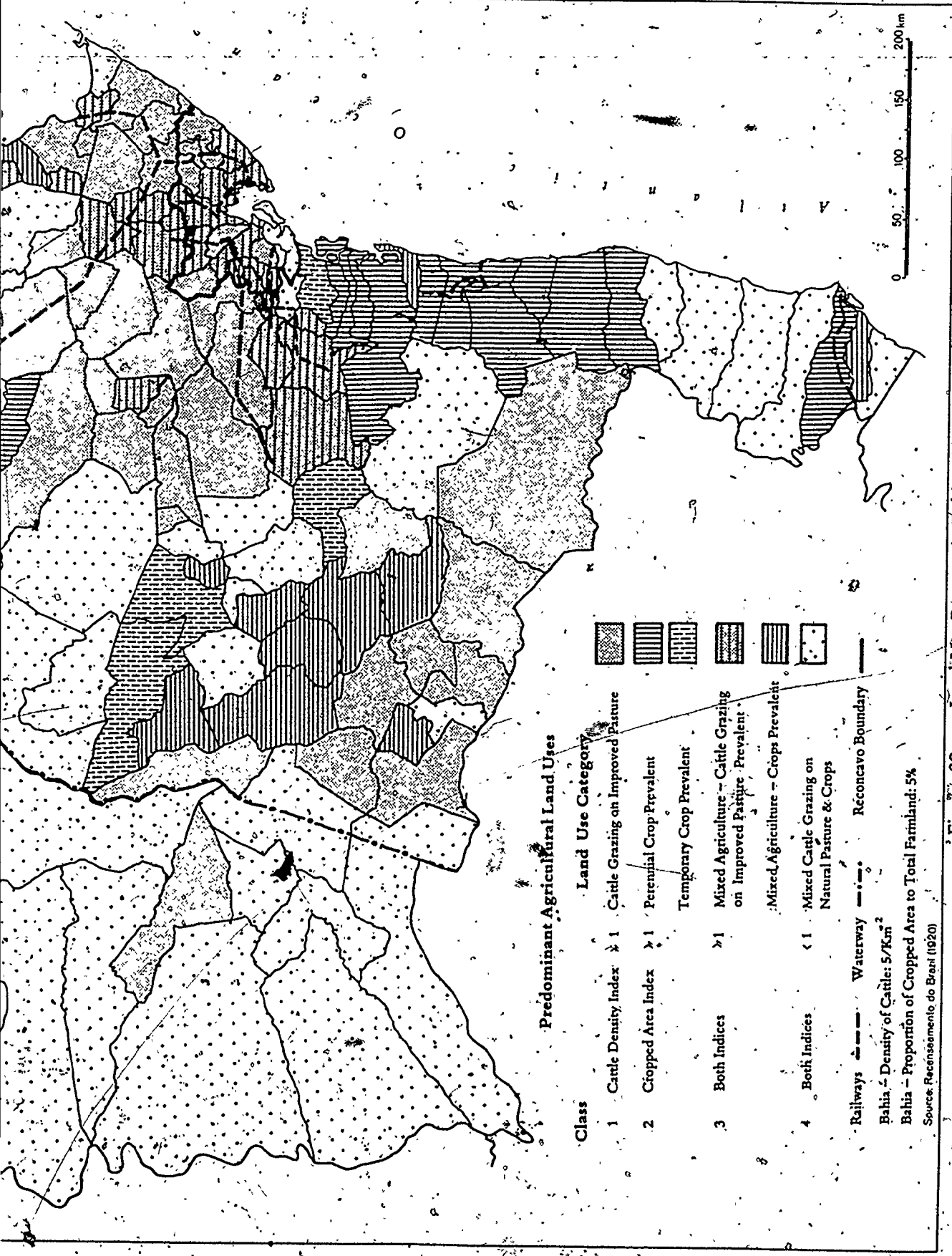


Figure 32 Land Use Pattern in Bahia 1920

which had been created by forest clearance. Earlier prevalent occupation of food crops and coffee in Alcobaca and Mucuri became less significant with the introduction of cattle.

In the Agreste slight changes occurred. Agriculture became diversified in municípios which had their economy based on cattle (Feira de Santana), tobacco (Serrinha and Irara), and coffee (Amargosa, Ubaira, and Maracas) while municípios previously engaged in the production of tobacco (Inhambupe and Alagoinhas) became important cattle producers. Intensification of cattle also started in the south of the zone, a factor of significance in later decades (see Chapter Nine).

Important changes occurred, however, in the Sertao. In the first place the replacement of food crops in the Mata zone by coffee and cocoa resulted in the relocation of these producer areas. That is, food production was displaced farther into the Sertao zone with two basic consequences. One was that the new areas of food production were located in the drought polygon (see Figure 5) and this resulted in frequent shortages. The other consequence, was the higher prices in the Salvador market due to the higher transportation costs. In the second place, food production in the interior had been ever carried out by smallholders. The traditional method of roca (land rotation) in smallholdings and drier areas results in soil exhaustion within a short period, and therefore, social problems. Finally, food production became definitely relegated to marginal lands giving rise to the proliferation of minifundia in the Sertão. In Figure 32, food crops and cattle appear side by side in the northern Sertao (Paripiranga, Ribeira do Pombal, Cícero Dantas, Ribeira do Amparo, and Nova Soure), in the Foothills of Diamantina Ridge (Baixa Grande) and on both banks of the Sao Francisco

River. The most important area occurs, however, in the Diamantina Ridge southwards, where climatic conditions are better (Brótas de Macaubas, Seabra, Palmeiras, Maçaubas, Paramirim, Piata, Rio de Contas, Brumado, and Barra da Estiva). Here, not only food crops were produced but also coffee, and cotton. Areas previously engaged in fattening cattle remained unchanged whereas the largest area of the Sertao changed from a complete prevalence of ranching to more diversified agriculture to supply small local markets.

The relationship between agriculture and the transportation facilities (railways) confirms the extreme selectivity. Cash crops oriented toward the external market continued to occupy locations closest to the railways except along the largest section of the Sao Francisco Railway where cattle grazing on improved pasture remained as the major type of land use. Actually, cattle represent a larger investment of capital in Bahia than do food crops. The beef price is also higher than for any type of food crop. From the economic viewpoint its location is, therefore, justifiable, but cattle also better survive a longer dry season. The long distance of the new food crop areas from the railways is noticeable. Some areas were, however, closer to the Sao Francisco River. It is quite possible that production was sent to Salvador via the River-railway, a fact that would increase the costs of transportation and/or sent via mule-railway. For instance, in 1925 the Central Bahia and Sao Francisco Railways together transported 25,888 metric tons of staples (beans, manioc flour, corn, and rice). The direction of shipment is not given, but it must have been sent to Salvador. Rice growing was relocated from the coastal area to the southern Diamantina Ridge. Production there used a primitive form of irrigation.

Any requirement for transportation increased prices in the major market thereby reinforcing the problem of food production.

Finally, the agricultural pattern in 1920 emphasizes the evolution and consolidation of the zoning identified in 1900 (Figure 31). The first zone where crops were always oriented toward the external market has extended farther north and west incorporating the cash and food crop areas located in the Agraste and Sertao. Despite cattle penetration in the north and south of this zone, crop production to supply the external and internal markets remains as the basic agricultural orientation. Investments of capital and labour are higher and the land is used more intensively. The second zone, incorporates parts of the Agraste (centre and south) and the largest area of the Sertao. Mixed agriculture, cattle specialization and food production appear located over the zone so that the intensity of agriculture gradually decreases from the railways westward. Although food crops in Bahia represent labour intensive agriculture, cattle represent higher investment of capital. Production in this zone is basically oriented toward the internal market but crop areas located in the Sertao (Diamantina Ridge) also supplied the external market with coffee and castor beans. The third zone is the most extensive, located in the western Sertao. Here the open range continued to prevail, although cattle and crops appear side by side. Production of food crops is basically oriented to the local markets, but cattle are raised for the invernadas.

8.5.2 Impact of Agricultural Expansion on Exports

To reinforce the effect of technological innovations on the expansion of agriculture, Table 27 shows the quantity of exports between 1860 and 1930. Records show a high increase in the exports after 1860,

TABLE 27

EXPORTS OF BAHIA TO EXTERNAL MARKET, 1860-1930

| YEAR | TOTAL IN L ^a | INDEX 1860 = 100 | TOTAL IN METRIC TONS ^b | INDEX 1860 = 100 |
|------|----------------------------|---------------------|--------------------------------------|---------------------|
| 1860 | 1,495,574 | 100 | 21,250 | 100 |
| 1865 | 1,778,226 | 119 | 71,403 | 336 |
| 1870 | 1,800,000 | 120 | 69,448 | 327 |
| 1875 | 2,171,040 | 145 | 54,933 | 259 |
| 1880 | 1,915,167 | 128 | 80,175 | 377 |
| 1885 | 1,698,029 | 114 | 12,225 | 58 |
| 1890 | 1,068,094 | 71 | 33,705 | 159 |
| 1895 | 1,279,245 | 86 | 50,042 | 235 |
| 1900 | 2,304,067 | 154 | 50,414 | 237 |
| 1905 | 3,014,138 | 202 | 56,429 | 265 |
| 1910 | 4,234,795 | 283 | 80,289 | 378 |
| 1915 | 5,280,282 | 353 | 101,363 | 477 |
| 1920 | 8,724,180 | 583 | 97,034 | 457 |
| 1925 | 7,729,837 | 517 | 150,985 | 710 |
| 1930 | 2,746,013 | 184 | 88,175 | 415 |

SOURCE: Associação Comercial da Bahia, Relatório da Junta Diretora, 1871, 1880, 1882, 1888; M. Istvan Jancso, "As Exportações da Bahia Durante a República Velha (1889-1930)", in L'Histoire Quantitative du Brésil de 1880 à 1930 (Paris: Centre National de la Recherche Scientifique, 1973), pp. 343, 350, 352, 354, 356; and Ubiratan Castro Araujo and Vanda Sampaio de Sa Barreto, "A Bahia Econômica e Social", in A Inserção da Bahia na Evolução Nacional 1a. Etapa: 1850-1889, vol. 1: A Bahia no Século XIX (Salvador: SEPLANTEC/CPE, 1978), pp. 60, 87.

^a Includes all exports.

^b Includes sugar, tobacco in leaf, coffee, and cocoa.

* Records refer to exports from October to December, 1885.

suggesting that production of major agricultural output was related to the expansion of railways and increase of external demand. Decrease in exports between 1880 and 1895 may be interpreted as a result of the abolition of slavery and the reduction of sugar exports. Actually the period coincides with the high increase in the production of beet sugar in Europe which accounted for three-fifths of the domestic European sugar supply.⁷³ However, this competition did not preclude modernization of the sugar industry because the domestic market could absorb some of the surplus. For instance, Bahia's sugar factories produced a total of 498,946 metric tons of sugar from 1902 to 1923.⁷⁴ But, sugar accounted for a lower percentage of the total exports than it had previously. Reduction of sugar exports had begun by 1887, whereafter tobacco and eventually coffee emerged as the major exports. This situation changed after 1906 when cocoa became the major agricultural export of Bahia and has remained so until the present time.

Evidence so far shown, seems to confirm that both increase in demand and technological innovations were the basic factors responsible for the rapid expansion of agriculture in Bahia in post-colonial era.

8.6 Spatial Dynamics of Agriculture Under the Effect of Change in Demand and Technology

It has been previously argued (Section 8.1) that political, social, technological and economic changes occurring during the nineteenth century, particularly in Europe led the world's economic core to expand pushing the agricultural frontier outward into the hinterland of the continents.

Empirical evidence in Bahia has shown that the increase of external and internal demand for agricultural products and the diffusion of

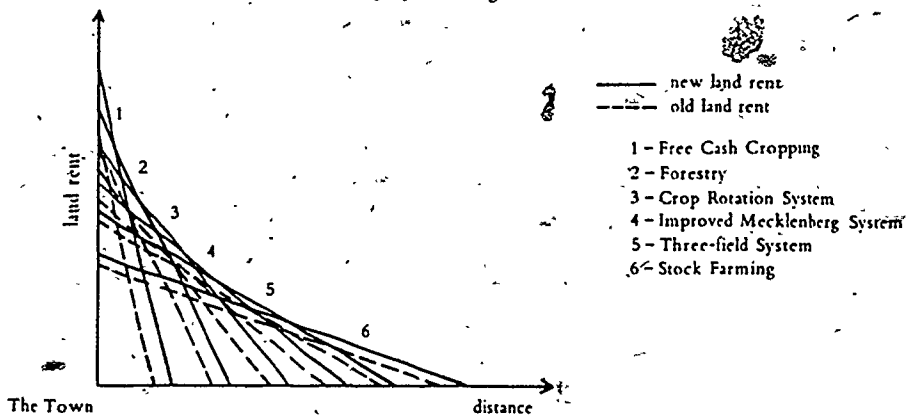
innovations, chiefly the transportation improvements, together contributed to the expansion of agriculture. In addition the cocoa plantations emerged while ranching and the sugar plantations underwent transformations.

The theoretical explanation provided by von Thünen's predictions that an increase in demand causes agricultural space to expand while transportation improvements provoke a selective expansion of agriculture, seem to be confirmed by events in Bahia from 1823 to 1930. To clarify the former prediction, Figure 33a shows graphically "The Isolated State" under the effect of a high price for grain as a consequence of an increase in demand. It can be observed that in this situation the increase in the value of land rent for each farming system advances the frontier. Graphical representation of Bahia's situation is shown in Figures 33b and 33c. Comparison between periods 1800 and 1920 shows two types of change. One type of change deals with the overall advance of the agricultural frontier outward into Bahia's hinterland. The other type of change refers to the transformation of the second zone prevailing in 1800. That is, the evolution of the ranching system as well as the expansion of crops (food and cash crops) within the earlier zone of Ranching and Subsistence Agriculture gave rise to a new Mixed Agriculture Zone in which intensity gradually decreases as distance from Salvador increases. On the other hand, the previous Ranching Zone is advanced westward, beyond the Sao Francisco River creating a third zone of lower intensity (Ranching and Semi-subsistence Agriculture).

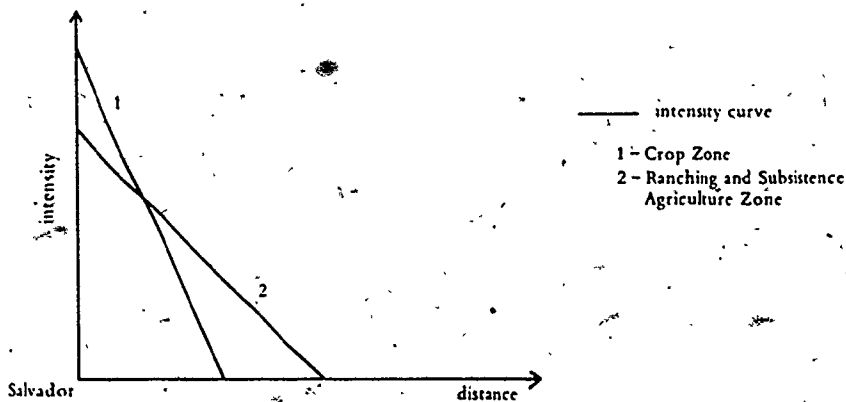
Prediction related to transportation improvements as illustrated in Figure 34a suggests a selective expansion of agriculture in "The Isolated State". The cropped area not only presents a tendency to expand

Figure. 33 Von Thünen's Predicted Model and the Observed Spatial Dynamics of Agriculture in Bahia 1800 and 1920

a) Expansion of agricultural space undergone by "The Isolated State" under the effect of high price for grain



b) Expansion of agriculture in Bahia ca. 1800



c) Effect of increase in demand on the Bahia's agricultural space, 1920

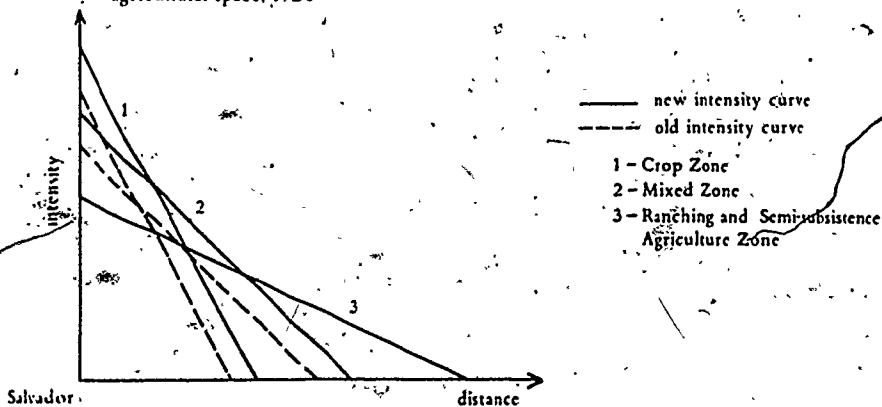
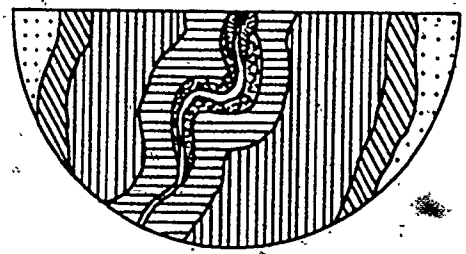


Figure 34 Spatial Dynamics of Agriculture Under the Impact of Transportation Facilities - Comparison of Von Thünen's Model and Bahia in ca. 1920

a.) "The Isolated State" under the impact of waterway



Free Cash Cropping

Forestry

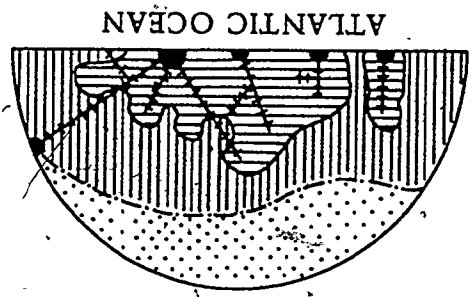
Crop Alternation System

Improved System

Three-field System

Stock Farming

b.) Bahia under the impact of improvement in overland and shipping transportation



ATLANTIC OCEAN

Shipping Port

Railway

Waterway

Crop Zone

Mixed Zone

Ranching and Semi-subsistence Agriculture Zone

Source After J.H.Von Thünen (1826)

farther away from the navigable river but a marked intensification of agriculture is also observed. That is, the crop rotation system extends on both sides of the river followed by the improved Mecklenburg system while the three-field system and stock farming are pushed outward into "The Isolated State's" hinterland. Figure 34b illustrates the spatial dynamics of agriculture in Bahia under the impact of improvement in overland (railways) and shipping transportation. It can be noted that the selectivity and intensification of agriculture are also observed in Bahia. That is, the Crop Zone oriented toward the external market (the most intensive zone) expands irregularly in the areas where the railways appear connected with the shipping ports. Areas still affected by the improvement in transportation but farther away from the shipping ports were transformed into a mixed agriculture (food-cash crops and livestock) basically oriented to supply the internal market. Deviation occurs, however, alongside the longer railways. The fact that the Sao Francisco and Central Bahia Railways lead to the driest areas of Bahia, meant that improved ranching instead of crops became prevalent alongside these railways. Cattle not only better resist a dry season, but also require larger investment of capital than food and secondary cash crops (cotton, coffee, etc.) in Bahia. Areas virtually untouched by the transportation improvement, eg. those beyond the Sao Francisco River became a ranching and semi-subsistence agriculture frontier.

Relationship between types of agriculture and distance from Salvador is still verified. Actually the location of major types of agriculture remain unchanged in the Mata zone. However, during the expansion process, the crops oriented toward the external market tended to be located in areas where good rainfall conditions were combined with

transportation access to coastal shipping (southeastern and southern Mata zone) rather than in areas with transportation improvement close to Salvador (northern Recôncavo). Areas affected by the transportation facilities but with a rainfall deficiency, even though close to Salvador, were occupied by cattle (central Agreste and northern Sertao). On the other hand, in areas with better rainfall conditions but not crossed by the railways, location of agriculture was determined by the investment of capital. Under this condition improved ranching tended to be located closer to Salvador (Foothills of Diamantina Ridge, southern and northern Agreste) than food crops, cotton, coffee, etc. (southern Diamantina Ridge). In addition, the breakdown of the colonial holding system must have begun to play an important role on the location of agriculture but this late development became most evident in the twentieth century (Chapter Nine). For instance, crop areas in the Agreste and Sertao are probably related to smallholding (minifundista) while cattle production in all zones (Mata, Agreste, and Sertao) is related to largeholding (latifundista).

Relationship between agricultural zones (crop, mixed, and ranching) and distance from Salvador suggests that intensity of agriculture gradually decreases as distance increases. This inverse relationship seems to conform, therefore, with von Thünen's prediction. Actually, the largest amount of capital (processing plants, value of land and buildings, agricultural equipment, etc.) and labour, remained concentrated in the Crop Zone. In the second zone dominated by improved ranching, food and secondary cash crops, intensity gradually decreases in terms of capital and labour. Finally, the third zone (Ranching and Semi-Subsistence Agriculture) is the most extensive with respect to all factors of production, capital, labour, and land; farther away from Salvador lacking

investment and virtually untouched by the transportation improvements. The shape of these zones are not concentric, however, as they appear in "The Isolated State". Their longitudinal conformation reflects the interference of geographical factors, but the basic principle of intensity in relation to the market remains valid.

Evidence from Bahia seems to confirm not only the von Thünen predictions but also Schlebecker and Peet's empirical findings.

REFERENCES AND FOOTNOTES, CHAPTER 8

1. Schlebecker, pp. 191-203.
2. Peet, pp. 290-301.
3. Peet, p. 283.
4. VTIS, pp. 217-220.
5. VTIS, pp. 214-216, 274-276.
6. Heafon, p. 623.
7. Ibid., p. 623.
8. Ibid., p. 629.
9. Ibid., p. 635.
10. Noya Pinto, p. 140.
11. Joao Rodrigues de Brito, A Economia Brasileira no Alvorecer do Seculo XIX (Salvador: Livraria Progresso, n.d.), pp. 51-183 (hereafter cited as Rodrigues de Brito).
12. Luis Viana Filho, "Intendente Câmara, Senhor de Engenho" Brasil Acucareiro 25 (1945): 55-66.
13. Ibid., p. 66.
14. Manoel Jesuino Ferreira, A Provincia da Bahia (Rio de Janeiro, n.p., 1875), pp. 80-81 (hereafter cited as Ferreira) and Luis Viana Filho, "A Missao Carson e o Melhoramento dos Engenhos-Baianos", Brasil Acucareiro 27 (1946): 66 (hereafter cited as Viana Filho, A Missao Carson).
15. Viana Filho, A Missao Carson, pp. 66-68.
16. Jose Honorio Rodrigues, "Alguns Reformadores da Economia Acucareira no Seculo XIX", Brasil Acucareiro 27 (1946): 81.
17. The abolition of slavery was carried out in Brazil through several laws. In 1850 the Queiroz Law abolished the slave trade; in 1871 the Law of the Free Womb freed all children born after its passage; in 1885 the Law of Sexagenarians declared all slaves free on their sixtieth birthday; and finally in 1888 the Golden Law abolished slavery.

18. Lucia Maria T. Tavares et al., "Cana-de-Acucar", in A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), p. 19 (hereafter cited as Tavares et al.).
19. Ibid., pp. 19-20.
20. Cited by Eisenberg, p. 106.
21. Ibid., p. 106.
22. Brasil, Diretoria Geral de Estatistica do Ministerio da Agricultura, Industria e Comercio, Recenseamento Geral do Brasil, 1920, vol. 3, tomo 1, 2a. Parte (Rio de Janeiro: IBGE), pp. 21-29 (hereafter cited as Recenseamento do Brasil, 1920).
23. MCA, A Terra e o Homem, pp. 118-131.
24. Harry William Hutchinson, Village and Plantation Life in Northeastern Brazil, ed. Verne F. Ray (Seattle: University of Washington Press, 1957), pp. 62-71 (hereafter cited as Hutchinson).
25. Ibid., pp. 63, 68.
26. Ibid., p. 63.
27. Ibid., p. 70.
28. MCA, A Terra e o Homem, p. 119.
29. Ibid., pp. 120-121.
30. Jose Luis Pamponet Sampaio and Tania Maria Bomfim da Silva, "Industria", in A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), pp. 251, 253 (hereafter cited as Sampaio & Silva).
31. Jose Luis Pamponet Sampaio et al., "Algodao e Textil na Bahia", in A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), pp. 189-198 (hereafter cited as Sampaio et al.).
32. Ibid., p. 203.
33. Ibid., p. 215.
34. Ibid., pp. 223-224.
35. Silza F. Costa Borba and Luiz Chateaubriand C. dos Santos, "Fumo" in A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889, vol. 2: Atividades Produtivas (Salvador: SEPLANTEC/CPE, 1978), p. 86 (hereafter cited as Borba & Santos).

36. Francisco Vicente Vianna, Memoria sobre o Estado da Bahia (Bahia: Typographia e Encadernacao do Diário da Bahia, 1893), p. 275 (hereafter cited as Vianna).
37. Borba & Santos, pp. 86-87.
38. AAPB; Fumo, pp. 180-184, 190-191.
39. See Silza F. Costa Borba, "Industrializacao e Exportacao de Fumo, 1870-1930" (Dissertacao de Mestrado, Universidade Federal da Bahia, 1975), pp. 21-22.
40. Carmen Vargas, ed., Economia Acucareira do Brasil no Sec. XIX: Cartas de Felisbello Caldeira Brant Pontes, Marquês de Barbacena (Rio de Janeiro: M.I.C./I.A.A., 1976), pp. 160, 179-180, 205-206 (hereafter cited as Vargas; Economia Acucareira).
41. See Luis Amaral, Historia Geral da Agricultura Brasileira, 3 vols. (Sao Paulo: Ed. Nacional, 1939-1940), 1: pp. 382-383 (hereafter cited as Luis Amaral) and Viana Filho, A Missao Carson, p. 68.
42. Gregorio Bondar, "A Cultura de Cacão na Bahia", Boletim Técnico do Instituto de Cacão da Bahia 1 (1938): 23-24 (hereafter cited as Bondar).
43. Ibid., p. 25.
44. Ibid., p. 27.
45. Ibid., p. 27.
46. Ibid., p. 28.
47. See Otto E. Seligsohn, Cacau da Bahia Historia e Problematica (Salvador: IPESA, n.d.), p. 21 (hereafter cited as Seligsohn) and Milton Santos, Zona do Cacau, Introdução ao Estudo Geográfico (Salvador: Artes Graficas, 1955), pp. 50-51. (hereafter Milton Santos, Zona do Cacau).
48. See Bondar, p. 164 and Seligsohn, p. 24.
49. See Seligsohn, p. 20.
50. Ibid., p. 22-23.
51. Manuel Diegues Junior, "Propriedade e Uso da Terra na "Plantation" Brasileira", Revista Geografica 48 (1958): 93 (hereafter cited as Diegues Junior).
52. Seligsohn, p. 26.
53. Bondar, p. 165.

54. Ibid., p. 165.
55. Diegues Junior, p. 91.
56. Ibid., p. 93 and Bondar, pp. 128-131.
57. See Bondar, pp. 148, 164.
58. Ibid., p. 164.
59. See Milton Santos, Zona do Cacau, pp. 30-31.
60. Vargas, Economia Acucareira, p. 1.
61. Mario Tarquinio, "Via de Comunicação e Meio de Transporte no Estado da Bahia", Revista do Instituto Geografico e Historico da Bahia 60 (1934): 312-314.
62. Ibid., pp. 314-316.
63. Ibid., pp. 316-317.
64. Vianna, p. 166.
65. Ibid., pp. 166-167.
66. Hammond & McCullagh, p. 50.
67. Edward J. Taaffe et al., "Transportation Expansion in Underdeveloped Countries: A Comparative Analysis", Geographical Review 53 (1963): 503-529.
68. Ibid., pp. 503-505.
69. Luis Amaral, 1: 164.
70. Vianna, pp. 419-560.
71. Area effectively occupied with the perennial crops (cocoa, coffee, coconut, banana, etc.) and temporary crops (sugar cane, tobacco, beans, manioc, corn, rice, castor beans and cotton) in September 1st, 1920.
72. Recenseamento do Brasil, 1920, pp. 251-259, 390-394.
73. Heaton, pp. 443-445.
74. Bahia, Diretoria do Serviço de Estatística do Estado, Anuario Estatístico da Bahia, 1923 (Bahia: Imprensa Official, 1924), p. 195.

CHAPTER 9

SPATIAL ADJUSTMENT: EFFECTS OF EXTERNAL AND INTERNAL PROCESSES ON AGRICULTURE, 1931-1970

9.1 Introduction

Historical descriptions and analysis carried out so far have revealed that agriculture in Bahia originated and expanded in response to a dual marketing system centred on Salvador which functioned both as a local market and entrepôt. This system prevailed in Bahia until the beginning of the Great Depression in 1929/1930 when the overall situation started to change. Overseas demand for agricultural products experienced a drastic decline and policies instituted among trading partners in Europe and North America, combined to push down the prices of export staples. As a result the Brazilian government was led to adopt a sectorial development policy aimed at greater industrial self-sufficiency. The main beneficiary area of this new national policy was the Southeast, particularly the manufacturing core of the country centred on Sao Paulo. Emphasis on import substitution and further improvements in transportation had as a consequence the breakdown of regional isolation. However, this sectorial economic policy did not have the expected spread effect. Instead it led to increased outmigration of both population and capital, from some areas especially from the Northeast and including Bahia. On

3
account of these changes in the economic environment, the dual marketing system of Bahia was disrupted. In its place there has developed a multiple marketing system in response to the new supply and demand relationships with several external and internal markets. On the global scale, Bahia continues to be linked to external markets through major export products notably cocoa and tobacco. On the national scale, Bahia has gradually become more integrated with the developing economy of Brazil but functions as a peripheral region in relation to the national economic core. On the regional scale the Salvador market has been reinforced through continued concentration of Bahian trade and transportation on this rapidly growing centre.

Internally, structural changes have also occurred. The long historical process of territorial integration and the breakdown of the colonial holding system have resulted in two major consequences: One is the territorial expansion of the state from the Mata into the Agreste and Sertao regions which has created a more heterogeneous physical structure in which rainfall variation may be identified as the most crucial problem for agriculture. The other consequence is the emergence of a dual ownership pattern represented by the minifundia and latifundia (see Chapter Three). In addition throughout most of the period (1940-1970) Bahia's population has continued growing at high rates which have supported an accelerated level of urbanization.

From the theoretical standpoint, how did Bahia's agriculture respond and to what extent was its earlier spatial organization affected by the relaxation of the assumptions previously held and their replacement by other conditions? The initial assumptions were trade isolation within Brazil, uniform physical conditions and prevalence of large

estates. These are replaced by a further improvement of transportation, decrease in demand for the traditional export staples (sugar, tobacco, cocoa, coffee, etc.) and an increase in demand for foodstuffs (beef, milk, beans, etc.).

It is here argued that Bahia's agricultural space has continued to expand. However, during the process of expansion the agricultural land use has experienced a spatial adjustment in which extensive types of agriculture have tended to prevail. Coffee areas were almost completely replaced by cattle pasture. Areas previously devoted to sugar cane, tobacco, and cocoa underwent a relative spatial contraction while pasture land experienced a rapid and substantial expansion. Spatial adjustment also occurred in the crop production pattern, originating with the improvement of the primitive semi-subsistence agriculture in the hinterland and the expansion and/or introduction of several cash crops (coconut, castor beans, agave, rubber, and oil palm).

Investigations carried out by DeWitt (1973) and Silva (1975) both trying to verify a von Thünen model in Bahia, resulted in opposite findings. The former author did not find any evidence in Bahia to support the verification of the model whereas the latter author identified a zoning in the state, which is very close to that predicted by von Thünen for "The Isolated State" (see Chapter Two, Section 2.3.2).

Based on the investigations so far carried out and on the processes (external and internal) affecting Bahia from 1931 to 1970, the classic von Thünen model does not seem appropriate to this last stage of agricultural evolution. Rather von Thünen's modified model predictions relating to a decrease in demand for staples (grain) and the prevalence of multiple markets seem to be a more realistic basis in this latter phase of historical

evolution. Despite the fact that von Thünen has implicitly held that under any condition, distance remains a strategic variable in explaining the location of agriculture, it seems that in Bahia farm size and rainfall are as important as distance to explain spatial differentiation in the later agricultural set up.

The aim of this chapter is to provide evidence in Bahia to support the following predictions of von Thünen:

- 1) That lower prices determined by a decrease in demand lead not only to the overall contraction of agricultural space but that under those conditions extensive farming systems tend to prevail.¹
- 2) That in a multiple market system the spatial organization of agriculture is determined by the magnitude of the market.
- 3) That under conditions 1 and 2 distance will remain a strategic variable in relation to spatial differentiation in the intensity of agriculture.

In order to document these changes and relationships the following aspects of the agricultural process will be studied: a) the impact of the Great Depression on Bahia's economy, b) the industrialization of Brazil and its effect upon regional development, c) the breakdown of regional isolation which resulted in the transformation of the Northeast into a peripheral zone in relation to the national core, d) population growth and demand for agricultural products. The second part of the chapter deals with the analysis of Bahia's agricultural patterns in the light of von Thünen's predictions (1 and 2). Finally, in the last part of the chapter a statistical test of the von Thünen modified model of intensity of agriculture will be carried out in respect of Bahia's agriculture as of 1970.

9.2 The Impact of the Great Depression on the Bahian Economy

Economic historians have identified the decade 1929/1939 as the most critical for Western economy because it saw the greatest economic depression and contained events which gave rise to the World War II (1939-1945). It is out of context to study these events thoroughly here. However, their effect extended to peripheral economies dependent on the industrialized countries, and therefore, Brazil was strongly affected.

The crisis broke out when the curve of business activity inflected downward. The manifestation of this was first felt in the United States but it rapidly spread throughout Europe and other continents. Real national income fell, rates of unemployment rose, wholesale prices decreased and industrial production, rates of investment, and world trade, experienced a sharp decline.³ On account of these manifestations the leader economies were inclined to adopt severe protective policies related to trade and credit.

The first important step of those policies was to increase tariffs. Tariff revision in the United States was to have been limited to farm produce but ended by raising the rates on virtually everything to an average of about 40%.⁴ This step combined with the contraction of American demand for imported raw materials and the end of capital exports presented a serious problem to America's debtors.

Other countries also raised tariffs on farm or industrial products. By 1931 the rates in most European countries were 60% to 100% higher than in 1929.⁵ Great Britain for instance abandoned free trade after the financial crisis of 1931. In most countries the tariff was also supplemented by three other protective devices, notably the

limitation of imported goods through fixed quotas, control of foreign exchange, and the abandonment of the gold standard in 1931 which permitted the countries to use their depreciated currency as a device for keeping out imports but expanding exports.⁶ As a result of these commercial controls, self-sufficiency became the desirable ideal by those countries which could not sell abroad the commodities they had to offer. Brazil made a striking effort in this economic direction as will be shown in Section 9.3.

The second type of protection dealt with credit. The restriction of external loans, followed by the demand for repaying foreign debts had a tremendous impact on business expansion. The policy of not exporting dollars and pounds made the situation worse for the debtor countries because they were forced to reduce their gold reserves. Countries owing sterling faced a less serious problem because they could ship whatever goods they had to London. However, the decline in prices made it necessary to send far more goods to pay the same amount of debts.⁷

In Brazil the economic situation became critical. The price of coffee, the major export, declined about 60% from 1924 to 1938 whereas the total value of exports fell from £102,875,000 in 1925 to £33,012,000 in 1935.⁸ In addition, the capital outflow increased in response to external credit policy. Consequently a chronic deficit in the balance of payments prevailed, while the Brazilian currency was devalued to aid the coffee exports. This relative increase in the price of imported goods forced Brazil to adopt a policy of increased industrialization.

The economic history of Bahia for the Depression and post Depression periods has not yet been analyzed. Hence, a thorough examination of its economic situation cannot be made in this dissertation.

However, from the available records of external trade it can be ascertained that the stagnation of Bahia's economy started during the Great Depression but accelerated under the impact of the industrialization of the Southeast. Evidence of the impact of the Depression on Bahia is shown in Table 28. Although the figures express a positive balance for Bahia's international trade the outstanding factor is the sharp decline of sterling inflows after 1927. Also evident is the devaluation of Brazilian currency after 1930. Both situations reflect, therefore, the policies undertaken by the Western developed nations which drastically affected the primary exports of their tributary areas.

Table 29 presents another view of Bahia's economic situation in which three aspects must be emphasized. First, the total balance of trade indicates that at the beginning of the time series (1921-1924) it was a positive factor reinforcing the economic growth of the state alongside the impact of the technological innovations. After 1924, however, the total trade shows a pattern in which positive and negative balances alternate regularly. That is, for each two positive years (1926-1927, 1931-1932, 1936-1937) there exist three negative years (1928-1929-1930, 1933-1934-1935). Second, the international trade throughout the period shows a constant surplus indicating that Bahia reduced its international imports favouring the interregional trade. On the one hand, this fact reinforces the breakdown of regional isolation which was a commencement of the establishment of a national and multi-centred market system. On the other hand, this new system probably benefited the Southeast via its control of regional exports and foreign re-exports. That is, a triangular trade seemed to be established so that Bahia sold its commodities directly in the external market. However, a substantial part of the foreign

TABLE 28

BALANCE OF INTERNATIONAL TRADE IN BAHIA, 1927-1939

| YEAR | IN CONTOS* | EXPORTS - IMPORTS | | |
|------|------------|----------------------------|--------------|----------------------------|
| | | INDEX NUMBER 1927 = 100 | IN 1000 £ | INDEX NUMBER 1927 = 100 |
| 1927 | + 238,616 | 100 | + 5,808 | 100 |
| 1928 | + 221,722 | 92 | + 5,442 | 93 |
| 1929 | + 145,956 | 61 | + 3,585 | 61 |
| 1930 | + 125,604 | 52 | + 2,768 | 47 |
| 1931 | + 153,051 | 64 | + 2,120 | 36 |
| 1932 | + 156,060 | 65 | + 2,285 | 39 |
| 1933 | + 115,585 | 48 | + 1,446 | 24 |
| 1934 | + 181,235 | 75 | + 1,858 | 31 |
| 1935 | + 202,662 | 84 | + 1,688 | 29 |
| 1936 | + 324,574 | 136 | + 2,694 | 46 |
| 1937 | + 310,163 | 129 | + 2,689 | 46 |
| 1938 | + 269,116 | 112 | data n.a. | data n.a. |
| 1939 | + 303,873 | 127 | data n.a. | data n.a. |

SOURCE: Bahia, Diretoria Geral de Estatística do Estado, Anuario Estatístico da Bahia, 1935 (Bahia: Papelaria Brasileira, 1936), p. 166 and Brasil, Instituto Brasileiro de Geografia e Estatística, Sinopse Estatística da Bahia, 1938-1940, vol. 1 (Salvador: Oficinas Graficas Era Nova, 1939), p. 89.

* 1 conto = 1,000,000 of reis.

TABLE 29

BAHIA: TOTAL BALANCE OF TRADE, 1921-1939
(IN CONTOS*)

EXPORTS* - IMPORTS

| YEAR | TOTAL BALANCE | INTERNATIONAL BALANCE | INTERREGIONAL BALANCE ^a |
|------|---------------|-----------------------|------------------------------------|
| 1921 | +144,991 | + 76,803 | + 68,188 |
| 1922 | +165,052 | +110,344 | + 54,708 |
| 1923 | + 53,872 | +158,866 | -104,994 |
| 1924 | + 39,452 | +165,627 | -126,175 |
| 1925 | - 30,835 | +176,964 | -207,799 |
| 1926 | + 437 | +162,950 | -162,513 |
| 1927 | + 23,501 | +238,616 | -215,115 |
| 1928 | - 17,053 | +221,722 | -238,775 |
| 1929 | - 38,638 | +145,956 | -184,594 |
| 1930 | - 31,967 | +125,604 | -157,571 |
| 1931 | + 13,088 | +153,051 | -139,963 |
| 1932 | + 10,725 | +156,060 | -145,335 |
| 1933 | - 38,226 | +115,585 | -153,811 |
| 1934 | - 3,717 | +181,235 | -184,953 |
| 1935 | - 1,396 | +202,662 | -204,058 |
| 1936 | + 84,267 | +324,574 | -240,308 |
| 1937 | + 11,801 | +310,163 | -298,862 |
| 1938 | - 55,548 | +269,116 | -324,664 |
| 1939 | - 9,441 | +303,873 | -313,314 |

SOURCE: Brasil, Instituto Brasileiro de Geografia e Estatística, Sinopse Estatística da Bahia 1938-1940 (Rio de Janeiro), p. 89.

* 1 conto 1,000,000 of reis.

^a Data include only coastwise trade.

merchandise destined for Bahia entered via Rio de Janeiro and Sao Paulo. This inference proceeds from the fact that in the 1930's the Southeast was not an industrialized region nor was its agriculture more diversified and modernized than that of Bahia. The third aspect of the table deals with the striking negative balance of interregional trade after 1922. This situation indicates that the other Brazilian regions, particularly, the Southeast, did not absorb the Bahian production in the amount necessary to compensate the net losses resulting from international transactions.

Table 30 illustrates not only the net losses experienced during the Great Depression but it also suggests that the internal market did not absorb much of the large agricultural production of Bahia (cocoa, tobacco, coffee, and hides). In terms of weight there is a slight trend to reduce the total amount from 1927 to 1932 but this increases again after 1932. Comparison between weight and the total value of exports shows that at the beginning of the time series (1927-1929) Bahia exported fewer commodities than after 1932 but the inflow of sterling followed an opposite trend. That is, the sharp decline in the value of exports reflects not only external policies but also the decrease in prices for all products. The trade composition on the other hand shows that sugar, Bahia's earlier major export, had already disappeared from its external trade due to the competition from sugar beet and high tariffs. Cocoa, thus replaced sugar, being followed by tobacco. Together these two products accounted for approximately 60% of the total exports while coffee, castor beans, and hides together shared an average of 15% in weight and value of exports. Bahia, however, continued to produce sugar which was partly absorbed by Southern Brazil at least until the 1940's.

TABLE 30

MAJOR AGRICULTURAL EXPORTS OF BAHIA, 1927-1939

| YEAR | IN METRIC TONS | | | | | | | | | | | |
|------|----------------|---------|----------|--------|--------------|-------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | TOTAL | COCOA | TOBACCO* | COFFEE | CASTOR BEANS | HIDES | TOTAL | COCOA | TOBACCO | COFFEE | CASTOR BEANS | HIDES |
| 1927 | 144,118 | 73,763 | 30,109 | 15,373 | 2,837 | 6,225 | 8,329 | 4,390 | 1,580 | 951 | 33 | 350 |
| 1928 | 142,342 | 70,904 | 27,913 | 25,054 | 289 | 6,794 | 8,313 | 3,573 | 1,600 | 1,712 | 4 | 544 |
| 1929 | 129,765 | 63,204 | 26,386 | 19,076 | 4,652 | 4,797 | 6,119 | 2,485 | 1,360 | 1,199 | 79 | 271 |
| 1930 | 135,098 | 64,158 | 31,199 | 17,856 | 5,486 | 4,690 | 4,607 | 1,980 | 1,305 | 542 | 63 | 156 |
| 1931 | 137,879 | 73,303 | 27,987 | 17,917 | 2,482 | 6,234 | 2,980 | 1,349 | 690 | 441 | 20 | 147 |
| 1932 | 146,856 | 95,860 | 23,898 | 13,407 | 2,102 | 4,362 | 2,894 | 1,626 | 496 | 464 | 13 | 96 |
| 1933 | 144,612 | 96,086 | 14,693 | 9,131 | 6,126 | 7,161 | 2,162 | 1,299 | 278 | 224 | 31 | 142 |
| 1934 | 172,159 | 99,253 | 27,555 | 14,801 | 6,391 | 6,522 | 2,476 | 1,307 | 448 | 332 | 31 | 139 |
| 1935 | 192,535 | 108,438 | 29,183 | 10,918 | 18,074 | 5,365 | 2,343 | 1,262 | 442 | 180 | 92 | 123 |
| 1936 | 223,041 | 118,565 | 26,971 | 15,114 | 33,542 | 4,201 | 3,340 | 2,031 | 454 | 265 | 191 | 119 |
| 1937 | 214,427 | 102,960 | 29,904 | 15,707 | 41,255 | 5,274 | 3,658 | 1,873 | 614 | 335 | 261 | 193 |
| 1938 | 220,700 | 125,586 | 22,733 | 10,888 | 39,755 | 3,432 | data na data na | data na data na | data na data na | data na data na | data na data na | data na data na |
| 1939 | 214,961 | 128,585 | 28,341 | 9,747 | 25,189 | 4,237 | data na data na | data na data na | data na data na | data na data na | data na data na | data na data na |

SOURCE: Bahia Bureau Estatístico, Boletim Estatístico da Bahia 12 (1958): 36-37, 68-70; Brasil, Instituto Nacional de Estatística, Anuário Estatístico da Bahia, 1996 (Rio de Janeiro), pp. 170-174; Brasil, Instituto Brasileiro de Geografia e Estatística, Anuário Estatístico da Bahia, 1937 (Rio de Janeiro), pp. 180-184; Associação Comercial da Bahia, Relatório da Bahia, 1938 (Bahia: Oficina Grafica do Indicador Bahiano, 1939); and Associação Comercial da Bahia, Relatório da 99a. Diretoria, 1939 (Bahia: Grafica Popular Ltda., 1940).

*Tobacco in leaf.

The Great Depression marked, therefore, the beginning of Bahia's economic stagnation which, however, continued even after the global crisis receded.

Brazil's economic growth remained based on primary products until World War II which both fostered demand but made Brazil aware of the need to develop a domestic manufacturing sector. The post war period brought drastic changes due to the fact that Brazil lost its relative share of the world market for its main export goods. According to Baer⁹ two reasons may justify this loss. One reason was the maintenance of high price for coffee in the early post war period when Brazil dominated the world market, which encouraged the development of competitive production in other tropical countries. The other reason Baer cites is the preferential treatment which countries associated with the European Economic Community have received at Brazil's expense. In addition, countries that had been traditional importers of some agricultural commodities, such as sugar and tobacco started to produce them, and therefore, the external demand for these products decreased and/or remained steady.

While these disadvantages were at first attenuated by the rise in the price of Brazil's major exports, there was a steady deterioration of the country's export prices from 1954 to 1970. The world wide unfavourable trend in the market for primary products, especially agricultural raw materials was aggravated by the reduction of industrial consumption. It has been argued that consumption of raw materials by the industries of developed countries tends to increase at a slower rate than production, due to more efficient techniques of production which tend to decrease the import of raw material required per unit of output. 10

Bahia's economic situation in the post war period was seriously aggravated by the factors just identified. From 1953 to 1970 severe currency devaluation and decrease in prices brought further difficulties for agriculture. Table 31 shows that while Bahia increased the total weight of exports the dollar value decreased. Therefore, the situation which had first occurred during the Great Depression continued to prevail (see Tables 28 and 30). With respect to the composition of trade, cocoa and tobacco remained as the chief commodities but their proportional role, especially of cocoa tended to decrease, mainly after 1959. On the other hand export of coffee and hides ceased, being replaced by agave. This new product brought into cultivation in Bahia in the 1950's has never had the same importance as did sugar and coffee in spite of relative high prices during the short period from 1954 to 1966. Although cocoa and tobacco remained as the major export commodities, the prices received experienced a significant decline. Castor beans continued to be exported, as semi-processed raw material, but the value was well below cocoa and tobacco.

The overall unfavourable situation depressed Bahia's economy. The same general context caused the Brazilian government to realize that not only was the country steadily losing its share of the world market but that there was little possibility of recovering its former preeminence. The government responded by its decision to gradually change the structure of economy via industrialization. To achieve such a goal, however, efforts were concentrated in the Southeast which was considered the country's dynamic region. Policy in this direction had the effect of further aggravating the stagnation of Bahia's economy, reinforcing the trend already established in the 1930's.

TABLE 31

TOTAL EXPORTS, TRADE COMPOSITION, AND AVERAGE PRICES FOR
BAHIA'S AGRICULTURAL PRODUCTS, 1953-1970

| YEAR | TOTAL EXPORTS IN METRIC TONS | TOTAL EXPORTS (1955 = 100) | TRADE COMPOSITION IN % | | | | | AVERAGE PRICE PER TON (US\$ 1955 = 100) | | | |
|------|---------------------------------|-------------------------------|-------------------------|-------|---------|-------|--------|--|-------|---------|-------|
| | | | IN CRUZEIROS IN US\$ | COCOA | TOBACCO | AGAVE | OTHERS | TOTAL | COCOA | TOBACCO | AGAVE |
| 1953 | 85 | 45 | 47 | 65.0 | 8.0 | 0.1 | 26.9 | 100.0 | 53 | 48 | 65 |
| 1954 | 94 | 97 | 132 | 74.0 | 12.5 | 0.4 | 14.1 | 100.0 | 151 | 94 | 107 |
| 1955 | 100 | 100 | 100 | 65.4 | 10.5 | 0.8 | 23.3 | 100.0 | 100 | 100 | 100 |
| 1956 | 100 | 92 | 83 | 58.4 | 14.0 | 2.5 | 25.1 | 100.0 | 72 | 100 | 113 |
| 1957 | 99 | 104 | 90 | 55.5 | 10.7 | 1.3 | 32.5 | 100.0 | 85 | 92 | 111 |
| 1958 | 605 | 166 | 124 | 50.3 | 7.2 | 1.5 | 41.0 | 100.0 | 116 | 78 | 104 |
| 1959 | 734 | 160 | 67 | 60.6 | 12.0 | 7.0 | 20.4 | 100.0 | 97 | 77 | 118 |
| 1960 | 409 | 295 | 110 | 46.6 | 11.0 | 5.0 | 37.4 | 100.0 | 74 | 90 | 166 |
| 1961 | 602 | 485 | 99 | 32.3 | 16.0 | 7.0 | 44.7 | 100.0 | 60 | 87 | 152 |
| 1962 | 264 | 533 | 65 | 26.6 | 22.0 | 10.0 | 41.4 | 100.0 | 59 | 91 | 146 |
| 1963 | 257 | 994 | 74 | 34.0 | 17.3 | 11.0 | 37.7 | 100.0 | 68 | 91 | 226 |
| 1964 | 138 | 1,807 | 69 | 36.0 | 20.0 | 13.0 | 31.0 | 100.0 | 63 | 72 | 230 |
| 1965 | 173 | 2,887 | 67 | 28.4 | 21.0 | 10.3 | 40.3 | 100.0 | 40 | 74 | 132 |
| 1966 | 185 | 4,850 | 92 | 40.0 | 13.0 | 7.8 | 39.2 | 100.0 | 61 | 76 | 122 |
| 1967 | 163 | 5,997 | 97 | 43.7 | 11.0 | 6.8 | 38.5 | 100.0 | 69 | 68 | 99 |
| 1968 | 149 | 6,638 | 85 | 36.4 | 10.6 | 7.0 | 46.0 | 100.0 | 82 | 76 | 93 |
| 1969 | 226 | 14,363 | 148 | 50.7 | 9.0 | 4.2 | 36.1 | 100.0 | 118 | 88 | 92 |
| 1970 | 250 | 13,657 | 124 | 43.3 | 10.0 | 5.0 | 41.7 | 100.0 | 87 | 91 | 87 |

SOURCE: Bahia, Secretaria do Planejamento Ciencia e Tecnologia/Fundacao de Pesquisa CPE, 105 Anos de Economia
Bahia: Estatisticas Basicas, 1872-1976, vol. 2, t. 2: Aspectos Economicos 1945-1976 (Salvador,
1979), pp. 146-147, 157, 173, 185.

9.3 Industrialization of Brazil and Its Effects Upon Regional Development

Prior to the second world war, Brazil faced several problems with respect to expansion of its industrial sector. First, the prolonged colonial status had contributed to extend dependence on external markets. Early attempts to develop any type of domestic manufacturing were aborted by the colonial policy because the Brazilian market was extremely advantageous to Portuguese and British manufacturers. The latter had received special privileges by treaty arrangements with Portugal and held these even after Brazil's independence, until 1844. Second, external loans to pay previous public debts and to cover internal deficits absorbed capital which might otherwise have been allocated to the infrastructure. Third, the free trade policy, which dominated the late nineteenth century, made it extremely difficult for domestic manufacturers to establish themselves due to the foreign competition. Finally, there was the lack of a skilled labour force partly due to the prolongation of slavery and to the agricultural orientation of the economy. In spite of these disadvantages some industrialization did occur in the late nineteenth century.

9.3.1 Industrialization Prior to World War II

Improvements in infrastructure, export revenue provided by the "coffee boom" and the inflow of skilled European immigrants created favourable conditions for the initial establishment of industrial enterprises in the 1880's. Table 32 traces the nineteenth century evolution of Brazilian industry. Figures indicate that of 636 enterprises operating in 1889, 238 had been founded from 1849 to 1879 whereas 398 new factories

TABLE 32

EVOLUTION OF BRAZILIAN INDUSTRY, 1849-1889

| DATE OF FOUNDATION | NO. OF ENTERPRISES | CAPITAL OUTLAY IN CONTOS* | MOTIVE POWER H.P. | NO. OF WORKERS | VALUE OF PRODUCTION IN CONTOS* |
|--------------------|--------------------|---------------------------|-------------------|----------------|--------------------------------|
| Prior to 1849 | 35 | 26,166 | 2,076 | 2,929 | 31,991 |
| 1850 - 1854 | 16 | 2,757 | 154 | 1,177 | 10,141 |
| 1855 - 1859 | 8 | 4,131 | 1,173 | 1,094 | 8,784 |
| 1860 - 1864 | 20 | 7,179 | 689 | 775 | 9,059 |
| 1865 - 1869 | 34 | 10,847 | 1,784 | 1,864 | 15,909 |
| 1870 - 1874 | 62 | 41,311 | 7,129 | 6,019 | 59,380 |
| 1875 - 1879 | 63 | 23,194 | 4,435 | 4,230 | 34,840 |
| 1880 - 1884 | 150 | 58,368 | 12,865 | 11,715 | 89,866 |
| 1885 - 1889 | 248 | 203,404 | 36,174 | 24,369 | 247,122 |
| TOTAL | 636 | 377,357 | 60,479 | 54,172 | 507,092 |

SOURCE: Jose Luis Pamponel Sampaio and Tania Maria Bomfim da Silva, "Industria", in A. Insecao da Bahia na Evolucao Nacional, la. Etapa: 1850-1889, vol. 2: Atividades Productivas, (Salvador: 1978), p. 273.

* 1 conto = 1,000,000 of reis.

emerged from 1880 to 1889. Although these new enterprises continued to emphasize manufacturing based mainly on foodstuffs and textiles, they did represent substantial growth in respect of capital outlay and use of motive power, resulting in a significant increase in the number of workers and value of production (see Table 32).

The Southeast dominated the rest of the country in its share of industrial establishments and by 1889 possessed 48% of the national total while the South and the Northeast had only 26% and 23% respectively.¹¹ In the latter region, Bahia was the leading state with the foundation of 35 enterprises most of which dealt with the processing of agricultural raw materials (sugar, cotton, and tobacco) as was pointed out in Chapter Eight.

In the first decade of this century, Brazil experienced further industrial expansion. Interruption of supplies of manufactured goods from overseas due to World War I and reductions in imports due to decline in foreign exchange encouraged domestic growth supported by protectionism. Positive stimulation included technological applications such as the development of electric power and expansion of railway trackage. In addition, a substantial inflow of foreign capital combined to produce an accelerated rhythm of industrialization. By 1907, for instance, the number of enterprises had increased to 3,258 employing 150,841 workers and a capital outlay of 665,577 contos.¹² Textiles, clothing, and food processing provided 63% of industrial output whereas 64% of the total enterprises were located in the Federal District (33%), Sao Paulo (16%), and Rio Grande do Sul (15%).¹³ From 1914 to 1919 a total of 5,936 new establishments were founded while the value of industrial production rose 212%.¹⁴ The "industrial boom" associated with wartime conditions

doubled the number of new factories. The census of 1920 recorded 13,336 industrial enterprises employing a little over 300,000 workers while by 1940 the enterprises trebled to 49,418 and the workers doubled to 781,185.¹⁵ Industrial structure remained, however, based on the production of consumer goods leading the industrial activity to continue to be heavily dependent on the import of machinery and parts. Despite this industrial expansion the structure of Brazilian economy remained based on agriculture but agriculture's share of the national product started to decrease. Between 1939 and 1947 income derived from agriculture decreased from 33.3% to 27.8% while that derived from manufacturing rose from 17.4% in 1939 to 21.7% in 1947.¹⁶ Several factors had participated in this change such as the quantitative control of imports, currency devaluation, credits provided by the Bank of Brazil, as well as the stimulus provided by the Great Depression and the external conditions prevailing with the outbreak of World War II.

9.3.2 Post War Industrial Growth and the Decline of the Northeast

After World War II the Brazilian government instituted a firm policy to drastically change the structure of the country's economy. To achieve this goal financial devices were adopted to both regulate and stimulate the economy. These included inflation-induced forced saving, import substitution, subsidies and special treatment for foreign and private investment, and protective tariffs for goods produced domestically.¹⁷ In response to this new policy Brazil experienced rapid economic growth and structural change in the economy. From 1947 to 1961 the real product increased by 128% while between 1968 and 1974 the overall rates

of growth were kept above 10%.¹⁸ In this so-called Brazilian economic miracle, manufacturing has been the dynamic sector, achieving annual growth rates above 12% over the latter period.¹⁹ On account of this sectorial growth, Brazil has become increasingly self-sufficient in manufactured goods so that its dependency on the traditional primary exports has rapidly changed. Internally, however, these changes created major regional imbalances.

The sectorial distribution of the net domestic product, presented in Table 33 indicates that the structural change of Brazilian economy took place only in the late 1960s. Comparison between Brazil, the Northeast and Bahia suggests that while the overall economy of the country experienced striking progress, the latter areas slowly regressed. That is, from 1939 to 1969 the income distribution by activity sector shows for Brazil a relative increase in the industrial sector which had already overtaken agriculture by 1968 while in the Northeast and Bahia the regional and state economies declined steadily during the period.

The economic thesis promoted by many scholars and underwritten at a national and international level, that industrialization constitutes the powerful key to eliminate underdevelopment, became well known and was adopted for Brazil after the second world war.²⁰ In addition, the concept that economic development rarely occurs uniformly over a particular region, but rather tends to be concentrated in growth poles that expand at a higher rate than the surrounding areas seems to account for and to have justified the concentration of investments in the Southeast.²¹ Despite industrial progress in the core area, some unwelcome effects appeared elsewhere. Regional disparities increased, the modernization of agriculture did not keep pace with industrial development and

TABLE 33

CHANGE IN THE SECTORIAL DISTRIBUTION OF THE NET DOMESTIC PRODUCT, 1939-1969
(% IN CURRENT PRICES)

| SECTOR | 1950 | | | 1969 | | | | | | | | |
|-------------|--------|-----------------|------------------------|--------|-----------------|------------------------|-------|-------|-------|-------|-------|-------|
| | BRAZIL | NORTHEAST BAHIA | BRAZIL NORTHEAST BAHIA | BRAZIL | NORTHEAST BAHIA | BRAZIL NORTHEAST BAHIA | | | | | | |
| Agriculture | 28.5 | 39.3 | 38.5 | 30.8 | 42.5 | 43.4 | 27.4 | 41.4 | 39.8 | 21.5 | 35.8 | 35.4 |
| Industry | 18.8 | 13.6 | 10.5 | 20.5 | 12.4 | 8.7 | 21.6 | 11.7 | 12.1 | 25.5 | 11.5 | 9.8 |
| Services | 57.7 | 47.1 | 51.0 | 48.7 | 45.1 | 47.9 | 51.0 | 46.9 | 48.1 | 53.0 | 52.7 | 54.8 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

SOURCE: Brasil, Banco do Nordeste S.A., Manual de Estatísticas Básicas do Nordeste (Fortaleza: FENE, 1977), pp. 59, 92.

the imbalance of the state per capita income rose rapidly. Evidence of these effects are shown below.

As was emphasized in Chapter Eight, in the late nineteenth century the "coffee boom" gave rise to heavy migration to the Southeast, especially from the Northeast, which resulted in a heavy concentration of population in the Southeast (see Table 26). This concentration became accentuated after 1920 through the impact of the industrial development. In 1950 the Southeast and South together accounted for 58.5% of the national population while in 1970 it had risen to 60.3%.²² This coincided with the state of Sao Paulo achieving the largest population of Brazil's states, rising from 17.6% (1950) to 19.0% (1970) while Bahia's population experienced a relative decline in the states' share from 9.3% (1950) to 8.0% (1970).

Of equal importance has been the concentration of Brazilian industrial output in Sao Paulo which increased from 5.0% in 1881 to 54.0% in 1959.²³ To aggravate this situation, in the period between 1955 and 1960, 75.0% of both domestic and foreign investments in Brazil were channeled to Sao Paulo.²⁴ Meanwhile Bahia which accounted for 25.0% of national industrial production in 1881 saw a relative decline to 1.7% in 1959.²⁵ This decline was also evident in Bahia's share of Brazil's sectorial employment. Bahia's share of industrial labour force in 1920 was 27.0% whereas Sao Paulo's share was 29.1%. In 1950, however, in Bahia it declined to 17.0% while in Sao Paulo it rose to 38.6%.²⁶ These examples confirm that Brazilian policy was not merely a theoretical approach to the search of concentrated development, but that it had a severe measurable effect in terms of the Northeast.

To reinforce this contention, Table 34 lists indicators of Brazilian regional industrialization in 1960 and 1970. The relative regional share in key indicators demonstrates increasing dominance of the Southeast as the Brazilian industrial core, at the expense of the other regions which have remained or been relegated to a peripheral situation.²⁷ The Northeast, reversing its earlier position reveals one of the worst situations among the regions. Its inferiority compared with the Southeast and South is noticeable not only in the small absolute share of number of industries, number of workers, workers per plant, and value of production, but also in its relative decline between the two decades.

Another aspect of Table 34 which deserves special attention, is the average worker-size of factories. Brazil's average size in both 1960 and 1970 was sixteen workers per plant, which seems to be low from the viewpoint of modern industrial plant capacity. The Southeast is the only region surpassing the national average but it is still low (21-22) while in the Northeast the average is low and declining from 10 to 9 workers per plant. It seems that Brazil's industrial growth did not create as many jobs as was expected. The 1970 census recorded 45.1% of the Brazilian labour force as still engaged in agriculture, only 12.0% in manufacturing, 37.0% in the tertiary sector and 5.9% in civil construction.²⁸ On the one hand, the figures illustrate that the secondary sector exceeded agriculture in its share of the net national product, but in terms of employment, the primary sector continued to absorb the largest proportion of the labour force. On the other hand, the number of workers per plant suggests that the secondary sector was not able to absorb the labour force available. While one might infer that the size

TABLE 34

REGIONAL INDUSTRIALIZATION IN BRAZIL, 1960-1970

| REGION | NO. OF FACTORIES | | NO. OF WORKERS | | WORKERS/ FACTORY | VALUE OF PRODUCTION IN 1,000 CRUZEIROS | |
|-------------|------------------|-------|----------------|-------|---------------------|---|-------|
| | | % | | % | | | % |
| | <u>1960</u> | | | | | | |
| North | 1,808 | 1.7 | 18,331 | 1.1 | 10 | 9,251 | 0.8 |
| Northeast | 20,505 | 18.9 | 208,059 | 11.8 | 10 | 87,734 | 7.4 |
| Southeast | 58,921 | 54.2 | 1,252,529 | 71.4 | 21 | 919,989 | 78.0 |
| South | 24,735 | 22.8 | 260,942 | 14.9 | 11 | 155,054 | 13.1 |
| Center-West | 2,624 | 2.4 | 13,801 | 0.8 | 5 | 8,278 | 0.7 |
| Brazil | 108,593 | 100.0 | 1,753,662 | 100.0 | 16 | 1,180,306 | 100.0 |
| | <u>1970</u> | | | | | | |
| North | 3,117 | 1.9 | 39,111 | 1.5 | 12 | 947,891 | 0.8 |
| Northeast | 29,944 | 18.6 | 262,975 | 9.9 | 9 | 7,492,441 | 6.4 |
| Southeast | 83,553 | 52.0 | 1,853,821 | 70.4 | 22 | 91,832,969 | 78.8 |
| South | 37,146 | 23.1 | 442,802 | 16.8 | 12 | 14,986,119 | 12.9 |
| Center-West | 7,125 | 4.4 | 35,915 | 1.4 | 5 | 1,256,017 | 1.1 |
| Brazil | 160,885 | 100.0 | 2,634,624 | 100.0 | 16 | 116,515,437 | 100.0 |

SOURCE: Brasil, Fundação Instituto Brasileiro de Geografia e Estatística, Anuário Estatístico do Brasil, 1977 (Rio de Janeiro: 1978), p. 424.

of Brazilian industries is small there are factors masking reality which must be emphasized. Much of the government post war industrialization policy favoured the establishment of capital-intensive industries with a high capital/employment ratio so that Brazil's recent industrialization has been heavily dependent on the import of modern technology which extremely limited the creation of new jobs.²⁹ Lack of investments in training of the population has forced Brazil to import not only technology but also a qualified labour force. Much of the changing balance in job structure is due to rural outmigration to the largest cities, where this unskilled labour force has found employment in marginal tertiary activities and civil construction. The persistence of agriculture as the largest employment sector also indicates how this activity has lagged behind the industrial progress. Finally, the high rates of population growth (yearly average of 3.0%) have offset the relative social benefits of Brazil's industrialization.

Expectation that the effects of industrialization would spread throughout the country is disproved by reference to official records of the regional income (Table 35). This indicates the overwhelming dominance of the Southeast and South regions which together account for over 70.0% of the country's income. Of equal significance is the steady decline of the Northeast which in 1939 contributed the second largest regional income but had already lost that position to the South by 1950. At the individual state level, Sao Paulo shows the highest income which has steadily increased over the period while most Brazilian states experienced decline or stagnation, including Bahia.

Another aspect of regional disparity is shown in Table 36 where per capita income is given by region and state. The first finding is

TABLE 35
REGIONAL INCOME AND STATE SHARE, 1939-1969.
(IN %)

| REGION | 1939 | 1950 | 1960 | 1969 |
|-------------------------|-----------|-----------|-------|-------|
| NORTH | 2.7 | 1.7 | 2.2 | 2.1 |
| Amazonas ^a | 1.1 | 0.7 | 0.8 | 0.7 |
| Para ^b | 1.6 | 1.0 | 1.4 | 1.4 |
| NORTHEAST | 16.7 | 14.7 | 14.8 | 13.8 |
| Maranhao | 1.2 | 0.8 | 1.1 | 1.0 |
| Piaui | 0.9 | 0.4 | 0.4 | 0.4 |
| Ceara | 2.1 | 2.1 | 2.0 | 2.0 |
| Rio Grande do Norte | 0.8 | 0.9 | 0.9 | 0.8 |
| Paraiba | 1.3 | 1.5 | 1.4 | 0.9 |
| Pernambuco ^c | 4.4 | 3.9 | 3.5 | 3.4 |
| Alagoas | 0.9 | 0.8 | 0.8 | 0.7 |
| Sergipe | 0.6 | 0.5 | 0.5 | 0.4 |
| Bahia | 4.5 | 3.8 | 4.2 | 4.2 |
| SOUTHEAST | 63.2 | 65.5 | 62.7 | 62.8 |
| Minas Gerais | 10.0 | 10.5 | 10.0 | 9.9 |
| Espirito Santo | 1.2 | 1.3 | 1.1 | 1.1 |
| Rio de Janeiro | 4.1 | 4.4 | 4.8 | 4.9 |
| Guanabara ^d | 16.8 | 14.5 | 12.0 | 11.3 |
| Sao Paulo | 31.1 | 34.8 | 34.8 | 35.6 |
| SOUTH | 15.3 | 16.3 | 17.8 | 18.2 |
| Parana | 2.9 | 4.9 | 6.4 | 6.8 |
| Santa Catarina | 2.2 | 2.4 | 2.6 | 2.7 |
| Rio Grande do Sul | 10.2 | 9.0 | 8.8 | 8.7 |
| CENTER WEST | 2.1 | 1.8 | 2.5 | 3.1 |
| Mato Grosso | 0.9 | 0.6 | 1.0 | 1.0 |
| Goiias | 1.2 | 1.2 | 1.5 | 1.7 |
| Distrito Federal | data n.a. | data n.a. | 0.0 | 0.4 |
| BRASIL | 100.0 | 100.0 | 100.0 | 100.0 |

SOURCE: Brasil, Banco do Nordeste S.A., Manual de Estatísticas Básicas do Nordeste (Fortaleza: ETENE, 1977), p. 53.

^aIncludes territories of Roraima, Acre, and Rio Branco.

^bIncludes territory of Amapa.

^cIncludes territory of Fernando de Noronha.

^dFormerly the Federal District until 1960.

that Brazil's average per capita income had still not surpassed US\$300.00 in 1969 although the structure of the economy had already changed. This contradiction reflects the fact that industrialization was accompanied by high inflation and that the population continued to grow at a yearly average of 3.0%. The second aspect of Table 36 is the reinforcement of regional inequalities. Again the Southeast and South present the highest per capita income, but intra-regional disparities are also found within these regions. At the state level, the per capita income over time shows surprising results. States with the highest per capita income in 1950 saw declines in 1960 and 1969 (Guanabara, Sao Paulo, Rio de Janeiro, and Parana). Other states experienced an increase in 1960 followed by a sharp decrease in 1969, (Amazonas, Para, Maranhao, etc.), while others had a steady increase over the period, although most of them at a percentage below the national average (Pernambuco, Sergipe, Bahia, Minas Gerais, etc.).

Figures confirm, therefore, a striking deviation between the growth pole model and the reality of Brazil. That is, development does not spread over space without removing social and economic barriers even when there is a deliberate intention to achieve such a goal. Actually, the federal government has created several programmes and institutions to encourage regional development, particularly in the Northeast.³⁰ However, until 1969 their effects were still hidden.

9.4 From an "Isolated State" to the Peripheral Zone of the National System

The economic development of Brazil from the earlier days of colonization until the 1930's was based on the production of primary commodities to supply the external market. During this long period,

5

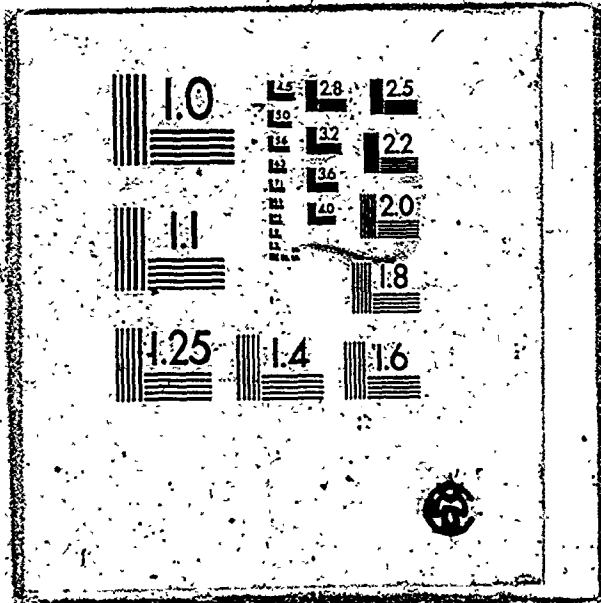


TABLE 36

PER CAPITA REGIONAL INCOME AND STATE SHARE, 1950-1969
(PERCENTAGE OF NATIONAL AVERAGE)

| REGION | 1950 | 1960 | 1969 |
|----------------------------|-------|-------|---------|
| NORTH | 48.1 | 60.9 | 53.6 |
| Amazonas ^a | 54.3 | 61.2 | 50.1 |
| Parab ^b | 44.6 | 60.4 | 55.7 |
| NORTHEAST | 42.4 | 46.9 | 45.4 |
| Maranhao | 25.7 | 31.5 | 30.1 |
| Piaui | 21.3 | 23.1 | 24.0 |
| Ceara | 40.2 | 41.8 | 42.1 |
| Rio Grande do Norte | 48.3 | 54.5 | 45.2 |
| Paraiba | 44.6 | 50.0 | 35.4 |
| Pernambuco ^c | 58.9 | 59.7 | 60.4 |
| Alagoas | 40.2 | 45.1 | 42.3 |
| Sergipe | 38.9 | 45.7 | 46.6 |
| Bahia | 40.4 | 50.3 | 51.8 |
| SOUTHEAST | 151.0 | 143.3 | 146.9 |
| Minas Gerais | 70.1 | 71.2 | 79.0 |
| Espirito Santo | 71.0 | 52.5 | 63.1 |
| Rio de Janeiro | 100.0 | 100.5 | 97.6 |
| Guanabara ^d | 317.6 | 258.4 | 246.6 |
| Sao Paulo | 197.6 | 190.4 | 188.3 |
| SOUTH | 107.9 | 106.4 | 103.5 |
| Parana | 120.0 | 106.2 | 94.0 |
| Santa Catarina | 80.7 | 85.8 | 87.7 |
| Rio Grande do Sul | 111.9 | 114.6 | 119.9 |
| CENTER WEST | 53.6 | 58.2 | 58.0 |
| Mato Grosso | 61.5 | 78.9 | 60.4 |
| Goiás ^e | 50.1 | 49.2 | 56.8 |
| BRASIL in NCR ¹ | 4.6 | 32.1 | 1,131.0 |
| in US ² | 246.0 | 169.3 | 277.8 |
| | 100.0 | 100.0 | 100.0 |

SOURCE: Brasil, Banco do Nordeste S.A., Manual de Estatisticas Basicas do Nordeste (Fortaleza: ETENE, 1977), p. 58.

^a Includes territories of Rondonia, Acre and Rio Branco.

^b Includes territory of Amapa.

^c Includes territory of Fernando de Noronha.

^d Formerly the Federal District until 1960.

^e Includes the Federal District after 1960.

¹ New cruzeiro.

² Transformation of Brazilian currency was based on Conjuntura Economica 4 (1977): 111.

agricultural regions emerged on the coastline, expanded and remained virtually isolated over three centuries.³¹ It was in this context of economic development that Bahia emerged as one of the most important agricultural regions of Brazil. Trade isolation within the country was, therefore, one of the key factors in promoting the expansion of settlement and agriculture in Bahia. This situation lasted, until the Great Depression when the economic crisis, forced the government to concentrate efforts in the industrial sector. The search for both resources (natural and human) and markets for the new industrial core resulted in the breakdown of regional isolation.

9.4.1 Removal of Customs Barriers

The available literature does not give precise information on when the customs barriers among the Brazilian states were set up nor when they were removed. Santos³² states that in 1900 the Associação Comercial da Bahia (Commercial Association of Bahia) solicited from the governor of the state the removal of customs barriers. In 1901 the same institution heavily criticized the duty charged on the coastwise trade.³³ Despite these complaints duties continued because they represented a significant source of revenue for the state governments. The fact that such trade constraints prevailed in Bahia in the earlier 1900's suggests that they were probably established during the colonial period.

Abolition of constraints in Brazilian interregional trade occurred in the 1930's as a result of the country's industrial policy.³⁴

9.4.2 International and Interregional Trade of the Northeast

The changing orientation and control of interregional trade can be considered one of the most critical elements of Brazilian government policy to aid the Southeast's industrialization. Evidence of the nature and impact of this change may be exemplified through records available for the Northeast, including Bahia.

Over time the Northeast has experienced different patterns of trade. During the colonial period a bilateral trade (dual marketing system) was developed between Portugal and the Northeast from which Portugal reaped the major benefits. More liberal trade concepts which diffused during the nineteenth century, together with effects of the industrial revolution, brought Brazil into a wider pattern of multilateral trade after 1808. However, liberal concepts did not extend to the removal of internal barriers which left Brazil as a collection of "individual" trading regions. The Brazilian policy of industrialization started in the 1930's and stressing import substitution, introduced drastic changes in the country's trade pattern.

The new so-called triangular trade already mentioned in Section 9.2 started to operate after the removal of customs barriers among the states in the 1930's. As part of general economic policy, the triangular trade was generally based on the following principle. The Northeast, for instance, continued to sell its commodities in an export market but since the region was not industrializing at as rapid a rate as the South, the structure of its import demand was oriented more toward goods against which restrictions were heavier.³⁵ In such circumstances the Northeast did not use the total of foreign exchange earnings generated by its exports.

Deprived of the use of its earned foreign exchange to import goods the Northeast needed from overseas, it had to turn to the Southeast's new high-cost industries for its supplies.

Table 37 illustrates the international trade of the Northeast and Bahia between 1948 and 1970. Figures reveal interesting aspects of this trade; the total export of the region shows a striking trend to increase from 1948 to 1970 while imports remain relatively low from 1953 to 1965. The trade surplus of the region suggests that most of it was used to buy national and/or nationalized goods in the Southeast. Considering Bahia's situation within the region it is important to observe the high participation of the state to the total regional exports (over 40%) while its participation in imports is below 30%. In short, Bahia was the highest contributor to the Northeast's foreign earnings. However, this high amount of foreign currency did not stay in the region.

Table 38 shows another aspect of the triangular trade. Records based on interregional trade reveal not only the increase in transactions between the Northeast and Centre-South³⁶ but also the increase in the deficit over the period. This suggests that a high amount of the regional foreign earnings was transferred to the Centre-South. Ritz³⁷ estimates that 75% of Bahia's foreign currency earnings were transferred to other regions, particularly to the Centre-South. Evidence shown in Table 29 indicates that this transfer process had already begun by 1923 but that it was refined and increased in the 1930's and in the post World War II period.

Analysis of the Northeast situation by the regional development authorities (1959) led them to conclude that:

TABLE 37
INTERNATIONAL TRADE OF THE NORTHEAST AND BAHIA, 1948-1970 (1,000 US\$)

| YEAR | N O R T H E A S T | | | B A H I A | | | D/A % | E/B % |
|------|----------------------|---------------------|------------------------|----------------------|---------------------|----------------|----------|----------|
| | (A) EXPORTS | (B) IMPORTS | (C) BALANCE | (D) EXPORTS | (E) IMPORTS | (F) BALANCE | | |
| 1948 | 197,600 ^a | 93,200 ^a | + 104,400 ^a | 87,000 ^c | 22,600 ^c | + 64,400 | 44.0 | 24.2 |
| 1949 | 133,000 | 100,300 | + 32,700 | 80,900 | 27,400 | + 53,500 | 60.8 | 27.3 |
| 1950 | 174,100 | 86,900 | + 87,200 | 113,100 | 22,800 | + 90,300 | 64.9 | 26.2 |
| 1951 | 197,600 | 166,400 | + 31,200 | 102,200 | 43,900 | + 58,300 | 51.7 | 26.3 |
| 1952 | 114,500 | 173,300 | - 58,800 | 94,200 | 49,100 | + 45,100 | 82.2 | 28.3 |
| 1953 | 169,600 | 95,300 | + 74,300 | 61,707 | 11,500 | + 41,400 | 31.2 | 12.0 |
| 1954 | 235,400 | 86,900 | + 148,500 | 174,715 | 15,000 | + 159,715 | 74.2 | 17.2 |
| 1955 | 238,500 | 86,200 | + 152,300 | 132,559 | 12,900 | + 119,659 | 55.5 | 15.0 |
| 1956 | 163,900 | 97,700 | + 66,200 | 109,830 ^b | 30,149 ^b | + 79,681 | 67.0 | 30.8 |
| 1957 | 212,100 | 131,900 | + 80,200 | 119,166 | 49,967 | + 69,199 | 56.2 | 37.8 |
| 1958 | 246,100 | 94,400 | + 151,700 | 164,632 | 27,075 | + 137,557 | 66.9 | 28.6 |
| 1959 | 216,100 | 79,300 | + 136,800 | 145,106 | 20,811 | + 124,295 | 67.2 | 26.2 |
| 1960 | 247,700 | 85,300 | + 162,400 | 146,138 | 23,379 | + 122,759 | 59.0 | 27.3 |
| 1961 | 262,600 ^b | 81,900 ^b | + 180,700 ^b | 131,797 | 26,497 | + 105,300 | 50.1 | 32.2 |
| 1962 | 195,900 | 73,500 | + 122,400 | 87,420 | 24,194 | + 63,226 | 44.7 | 32.8 |
| 1963 | 247,700 | 80,300 | + 167,400 | 98,192 | 20,436 | + 77,756 | 39.8 | 25.4 |
| 1964 | 215,500 | 96,300 | + 119,200 | 91,973 | 31,165 | + 60,808 | 42.7 | 32.3 |
| 1965 | 203,000 | 67,000 | + 136,000 | 88,321 | 18,767 | + 69,554 | 43.5 | 27.9 |
| 1966 | 278,200 | 104,300 | + 173,900 | 122,215 | 33,670 | + 88,545 | 45.2 | 32.2 |
| 1967 | 277,200 | 119,600 | + 157,600 | 128,407 | 28,497 | + 99,910 | 46.6 | 23.7 |
| 1968 | 279,500 | 123,500 | + 156,000 | 113,099 | 39,429 | + 73,670 | 40.5 | 31.9 |
| 1969 | 415,300 | 118,600 | + 296,700 | 196,297 | 34,540 | + 161,757 | 47.3 | 29.1 |
| 1970 | 381,100 | 144,700 | + 236,400 | 163,855 | 50,086 | + 113,769 | 42.9 | 34.6 |

SOURCE: a) Werner Baer, Industrialization and Economic Development in Brazil (Homewood: Richard D. Irwin, Inc. 1965), p. 175; b) Brasil, Banco do Nordeste S.A., Manual de Estatísticas Básicas do Nordeste (Fortaleza: ETENE, 1977), pp. 303, 317; and c) Bahia, Secretaria de Planejamento Ciência e Tecnologia, Fundação de Pesquisa CPE, 105 Anos de Economia Baiana, Estatísticas Básicas, 1872-1976, vol. 2, t. 2: Aspectos Econômicos, 1945-1976 (Salvador, 1979), pp. 147, 190. Transformation of Brazilian currency for Bahia's export and imports in the period 1948-1955 was based on Conjuntura Econômica 4 (1977): 111.

TABLE 38

VALUE OF NORTHEASTERN TRADE WITH THE CENTRE-SOUTH*
(1000 CRUZEIROS)

| YEAR | EXPORTS | IMPORTS | BALANCE |
|------|---------|---------|---------|
| 1948 | 4,069 | 5,541 | - 1,472 |
| 1949 | 4,579 | 6,630 | - 2,051 |
| 1950 | 5,349 | 7,141 | - 1,792 |
| 1951 | 6,843 | 8,298 | - 1,455 |
| 1952 | 6,687 | 8,159 | - 1,472 |
| 1953 | 7,975 | 10,792 | - 2,817 |
| 1954 | 10,804 | 12,871 | - 2,067 |
| 1955 | 13,495 | 16,477 | - 2,982 |
| 1956 | 19,845 | 19,692 | + 153 |
| 1957 | 17,892 | 21,078 | - 3,186 |
| 1958 | 16,878 | 22,732 | - 5,854 |
| 1959 | 21,857 | 26,699 | - 4,842 |

SOURCE: Werner Baer, Industrialization and Economic Development in Brazil (Homewood: Richard D. Irwin Inc., 1965), p. 176.

* Data refer to coastal shipping.

... by supplying foreign credits to the Centre-South, the Northeast has been contributing towards the development of the former, with a factor which is scarce for Southerners, capacity for importing.³⁸

This statement implicitly says that the Northeast became an effective market for the Southeastern goods but the reverse situation did not hold true. That is, the Southeast did not offer the market possibility for the Northeast's commodities, so that the region continued to be heavily dependent on the external market to sell its major production. In the long run such a situation would create severe difficulties particularly to the agricultural sectors as will be shown later in this chapter.

9.4.3 Flows of Human Resources

The transfer of foreign earnings from the Northeast to the Southeast was followed by outmigration of the labour force and loss of domestic capital.

Despite a nineteenth century trend toward regional outmigration from the Northeast the most striking exodus, however, has occurred during this century. The major labour force flows to Sao Paulo originated in the state of Bahia and Minas Gerais.

From 1908 to 1940 the Service of Immigration and Colonization located in Sao Paulo city, recorded the entrance into the state of Sao Paulo of 745,173 people from different regions of Brazil. Of these, 322,417 (43%) migrated in the six-year period from 1935 to 1940. The major regions involved in the latter outflow were the Northeast and the Southeast (Minas Gerais, Espirito Santo, and Rio de Janeiro) which contributed 69% and 31% respectively. In the Northeast, Bahia was the largest source area with 163,810 people or 15% of the total flow.³⁹

Outmigration continued in subsequent years. Between 1948 and 1950, 274,981 Brazilian immigrants entered Sao Paulo. During this period the Northeast contributed 188,660 people (69%) and Bahia was the state experiencing the greatest losses (97,836).⁴⁰ Comparison between the two periods considered above, indicates that the outmigration process not only accelerated, but also the annual average losses increased in the Northeast from 37,265 (1935/1940) to 62,886 (1948/1950) whereas in Bahia they increased over the same period from 27,301 to 32,612.

Table 39 shows the net balance of the Northeast's internal migration. The net losses of the region not only increased from 1940 to 1970 but also the acceleration of outmigration occurred between 1950 and 1970. This period coincides with the highest growth of industrialization in the Southeast as well as with improvement of the national transportation system (Section 9.4.4 below).

Among the states of the Northeast, only Maranhao presents a positive balance over the period while Bahia records the highest absolute losses. Considering the relative losses of population, Alagoas and Sergipe lost the largest percentage over the period. However, in 1970 the relative losses of the region are really striking. Although the records do not specify the direction of emigration it seems that the flows were mainly to the Centre-South, particularly to Sao Paulo and Parana.

Not enough data are available to judge the groups of emigrants who left the Northeast. It is known that the largest number of migrants belonged to the unskilled labour force. However, a substantial part of the best talent in the professional groups also migrated southward. Such a drain has caused shortages within the skilled labour force particularly

TABLE 39
NET BALANCE OF THE NORTHEAST'S INTERNAL MIGRATION, 1940-1970

| STATE | 1940 | | 1950 | | 1970 | |
|---------------------|-----------------------|--------------------------|-----------------------|--------------------------|-----------------------|--------------------------|
| | BALANCE (+) OR (-) | % OF TOTAL POPULATION | BALANCE (+) OR (-) | % OF TOTAL POPULATION | BALANCE (+) OR (-) | % OF TOTAL POPULATION |
| Maranhao | + 53,825 | 4.4 | + 60,928 | 3.8 | + 158,165 | 5.2 |
| Piaui | - 47,770 | 5.8 | - 58,616 | 5.6 | - 246,854 | 14.2 |
| Ceara | - 116,043 | 5.6 | - 160,948 | 6.0 | - 565,722 | 12.6 |
| Rio Grande do Norte | - 10,009 | 1.3 | - 26,381 | 2.7 | - 194,976 | 12.1 |
| Paraiba | - 54,572 | 3.8 | - 146,621 | 8.6 | - 508,960 | 20.8 |
| Pernambuco | - 113,255 | 4.2 | - 103,828 | 3.1 | - 641,042 | 12.2 |
| Alagoas | - 74,773 | 7.9 | - 140,575 | 12.9 | - 310,245 | 19.3 |
| Sergipe | - 42,111 | 7.8 | - 71,309 | 11.1 | - 217,348 | 23.9 |
| Bahia | - 233,963 | 6.0 | - 289,323 | 6.0 | - 983,528 | 13.0 |
| Northeast | - 633,484 | 4.4 | - 934,973 | 5.2 | - 3,515,581 | 12.3 |

SOURCE: Brasil, Banco do Nordeste, S.A., Mánuel de Estatísticas Básicas do Nordeste (Fortaleza: ETENE, 1977), p. 45.

for managerial personnel, technicians, etc. in the Northeast.

The drain of capital from the Northeast was also large. Baer⁴¹ estimated that between 1948 and 1960 over US\$413 million of capital assets were transferred to the Centre-South. This transfer occurred because the price at which the Northeast sold its foreign assets rose less than the price of the merchandise it bought in the Centre-South. Capital was also transferred through the official exchange system.⁴² Records on the outflow of private capital are not available but loss can be inferred because this type of flow is common between dynamic and stagnant regions.

9.4.4 Regional Integration Via Overland Transportation

The construction of railroads initiated in the second half of the nineteenth century represented the attempt of the Brazilian government to develop a more efficient and modernized transportation network. From 1854 to 1890 it had constructed 9,583 kilometers of tracks. However, most of these lines were oriented from sea-ports to their tributary areas in the hinterland. A further objective to link the Brazilian regions through railways only occurred at the beginning of this century. The first such railway linkage was that between the Southeast and South which was completed by 1910, while the Centre-West became linked to the Southeast by 1930.

By 1934 the General Plan of National Transportation was established which had primary emphasis on railways and secondary emphasis on highways and waterways. The railway section of the plan was ambitious and provided for four north-south trunk lines.⁴³ The main east-west lines involved extensions of existing railways radiating from Rio de Janeiro to

Goiás and Mato Grosso through Minas Gerais, besides other extensions, some of which linked Brazil to the Pacific Ocean.⁴⁴ Related to this plan, 1,356 kilometers of railways were constructed by 1945. Part of this construction took place between the Bahia Central Railway and the Brazil Central Railway in an attempt to link the Northeast to the Centre-South. Despite strong efforts, a connecting link between the regional railway systems of Bahia and Minas Gerais was completed only in 1954. By this time the railway projects had already slowed in favour of highway construction.

Highway projects as part of the national plan approved in the 1920's were neglected until 1945, when the National Highway Department was reorganized. It brought into execution the national highway plan of 1944, which in its first five years projected the completion of trunk lines, transversals, and interconnections.⁴⁵ In the 1950's the linkages between the Northeast and the Centre-South were already completed. The shift in 1960 of Brazil's capital to the Centre-West (Brasilia) stimulated other regional links such as the North to the Centre-West and the latter to the Southeast. Finally in 1970 the Plan of National Integration (PIN) was created to complete the links of national territory including the Trans-Amazon highway (link between the Northeast and North) and others.

The government focus on the construction of the roads has resulted in the development of a road pattern identified by Henshall and Momsen⁴⁶ as having the following features:

- 1) Export-import Routes, to move goods between the coast and interior.
- 2) Routes to control the "Backland" that have the function of putting new lands and their resources within the political and financial jurisdiction of the coastal centres.

- 3) Frontier Roads for strategic purposes.
- 4) Routes for Interregional Connection. These roads have the basic economic objective of linking one region to another, particularly to reinforce the ties between Brazil's heartland and its peripheral regions. Through these roads the flows of commodities and vehicles in both directions (heartland-periphery), have been increasing since 1950.

Figure 35 shows the intensity of Bahia's highway traffic in which both the internal and interregional connections are represented by means of the daily average flow of vehicles. It can be seen that the traffic pattern is characterized by a complete change in the transportation system of Bahia. The earlier railway network was basically characterized by the connections between the sea-ports and their tributary areas (Figure 26). This reflected not only the strength of the commercial relationships between Bahia and the external markets but also the isolation between the states. The transportation network in the 1970's presents a more complex orientation. The major ports (Salvador and Ilheus) continued to be linked to the hinterland but the new orientation of the network is basically focused on the Centre-South reinforcing, therefore, the breakdown of the regional isolation. For instance three of the earlier railways stopped operating (Nazare, Bahia-Minas Gerais and Ilheus-Vitoria d' Conquista Railways) while those connecting Bahia to the Northeast (the Sao Francisco and Timbo Railways) and the Centre-South (Bahia Central Railway) remained. The road system as presented in Figure 35 shows the same orientation. That is, the road network is more diffused within the state than that of the railway but the major links are also oriented to the Centre-South. This can be observed through the flow of vehicles feeding into the major trunk line (Rio-Bahia Highway) while another major highway (Tourism Highway) alongside the coast appears as under construction.

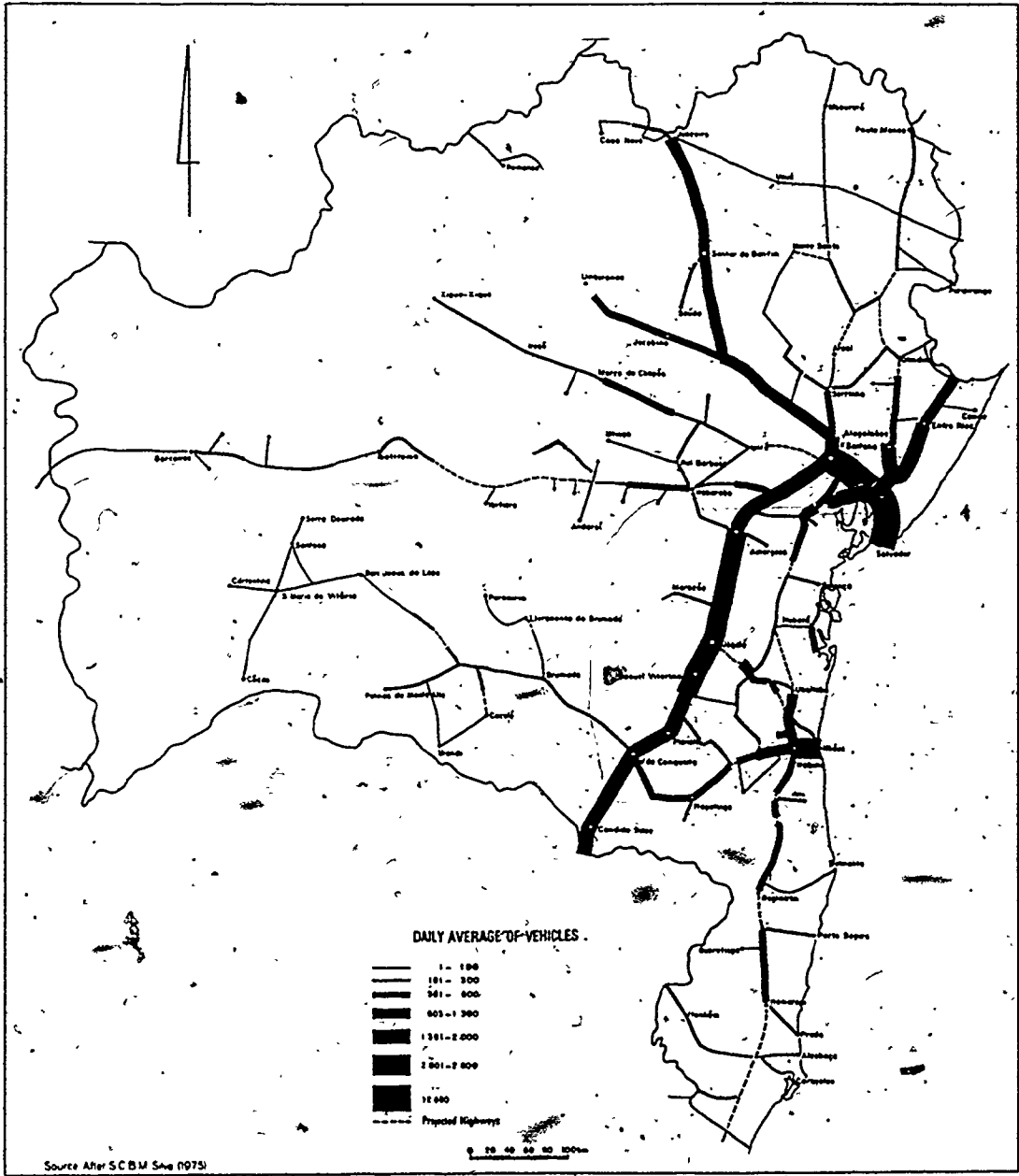


Figure 35 Intensity of Highway Traffic in Bahia (1972-1973)

9.5 Population Growth, Urbanization and Demand for Agricultural Products

The population of Bahia in this century has shown three basic trends. First, an increasing number of people have emigrated to other states from 1935 to 1970. Figures presented in Section 9.4.3 showed that from 1940 to 1970 the states experienced a net loss of 25% of population through outmigration. Second, despite outmigration, the total population of Bahia has grown at a high rate. Third, the exodus from the rural areas to the towns and cities has been accelerating since 1940.

This section is concerned with the population growth and urbanization of Bahia because both processes have implications for the internal demand for agricultural products.

Records presented in Table 40 describe several important aspects of Bahia's more recent population. For instance the total population grew at a lower annual rate (0.9%) between 1920 and 1940 than between 1940 and 1950 (2.3%) but in the following decades the net annual rates systematically increased from 2.4% in 1950/1960 to 2.6% in 1960/1970.

Considering the distribution of population by residence, 58.8% of Bahia's population still lived in the rural areas by 1970. However, when one takes into account the growth rates of both the rural and urban populations, figures reveal that the latter has been increasing rapidly since 1950. For instance, it took fifty years for the total population to double while the urban population doubled between 1940 and 1960 and it trebled in only thirty years (1940-1970). Salvador alone accounts for one-third of Bahia's urban population. However, the number of urban centres over 5,000 and 20,000 inhabitants has been increasing since 1940.

In the former category the number increased from twenty in 1940 to

TABLE 40

ABSOLUTE AND RELATIVE GROWTH OF BAHIA'S POPULATION, 1920-1970

| POPULATION | RATES OF INCREASE (%) | | | | | | | | |
|------------|-----------------------|-----------|-----------|-----------|-----------|-----------|---------|---------|---------|
| | 1920 | 1940 | 1950 | 1960 | 1970 | 1920/40 | 1940/50 | 1950/60 | 1960/70 |
| Total | 3,334,465 | 3,918,112 | 4,834,575 | 5,990,605 | 7,583,140 | 18.0 | 23.0 | 24.0 | 26.0 |
| Rural | data n.a. | 2,980,541 | 3,584,068 | 3,906,889 | 4,442,733 | data n.a. | 20.0 | 9.0 | 14.0 |
| Urban | data n.a. | 937,571 | 1,250,507 | 2,083,716 | 3,140,407 | data n.a. | 33.0 | 67.0 | 51.0 |
| Salvador* | 283,422 | 290,443 | 417,235 | 655,735 | 1,027,142 | 2.5 | 44.0 | 57.0 | 57.0 |

SOURCE: Brasil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Sinopse Preliminar do Censo Demografico: Brasil, 1970 (Rio de Janeiro: DECEN, 1971), pp. 82-85, 87.

* Includes the city and suburbs.

eighty-seven in 1970, while the number of centres in the latter category grew in the same period from one to fifteen.⁴⁷ With respect to the urban centres over 100,000 people, only Salvador and Feira-de-Santana had reached this size in 1970 and together they accounted for 15% of Bahia's total population.⁴⁸ On the one hand, Bahia's urbanization process suggests a strong resemblance to an underdeveloped urban structure in which a major market dominates the overall system. On the other hand, population growth and urbanization also suggest an increase in demand for agricultural products. Consequently, one may expect a proportionate increase in the price of agricultural products, particularly foodstuffs.

In Bahia the period of higher rate of population growth (1950-1970) coincides with a rise in prices for specific foodstuffs while raw materials show a trend to decline or fluctuate. Table 41 presents average prices for some of these agricultural products. It can be seen that from 1947 to 1952 all products experienced a significant increase in their prices and then a rapid decline until 1955. Such an oscillation may be explained by a brief stability of Brazilian currency in the period between 1946 and 1952 followed by a sharp devaluation in subsequent years, especially between 1953 and 1955. Cocoa and agave show a marked decline in price from 1953 to 1967 because their consumption depends basically on the external market. After 1968 cocoa experienced a very high increase while agave continued downward. Tobacco, castor beans, and cotton show wide fluctuation but prices have remained below those reached from 1950-1952. Agricultural products oriented to supply the domestic market present, however, show a trend upward in their prices after 1952. Among these products beef and beans experienced the highest increase followed by milk, sugar cane, and manioc. This change in the price trend caused by the decrease

TABLE 41

AVERAGE PRICES FOR THE BAHIA'S AGRICULTURAL PRODUCTS, 1947-1970
(Index of Dollar Prices, 1950-1952 = 100)

| YEARS | AGRICULTURAL RAW MATERIAL | | | | | | FOODSTUFF | | | | |
|---------|---------------------------|---------|-------|---------------|-----------------|-----------|-----------|--------|------|------|------|
| | COCOA | TOBACCO | AGAVE | SUGAR CANE | CASTOR BEANS | COTTON | BEANS | MANIOC | CORN | BEEF | MILK |
| 1947/49 | 75 | 65 | 75 | 71 | 58 | data n.a. | 62 | 53 | 64 | 65 | 70 |
| 1950/52 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1953/55 | 78 | 55 | 23 | 43 | 29 | 35 | 47 | 40 | 51 | 60 | 44 |
| 1956/58 | 60 | 58 | 23 | 43 | 42 | 39 | 59 | 47 | 58 | 69 | 43 |
| 1959/61 | 64 | 86 | 37 | 43 | 41 | 38 | 68 | 47 | 58 | 72 | 45 |
| 1962/64 | 62 | 80 | 68 | 43 | 53 | 51 | 74 | 47 | 76 | 103 | 51 |
| 1965/67 | 64 | 58 | 30 | 57 | 53 | 48 | 74 | 47 | 64 | 121 | 54 |
| 1968/70 | 115 | 72 | 24 | 57 | 67 | 51 | 80 | 53 | 61 | 120 | 65 |

SOURCE: Bahia, Secretaria do Planejamento Ciência e Tecnologia, Fundaçao de Pesquisa CPE, 105 Anos de Economia Baiana Estatísticas Básicas, 1872-1976, vol. 2, t. 2: Aspectos Econômicos, 1945-1976 (Salvador, 1979), pp. 51-53, 75-77.

^aTransformation of Brazilian currency based on Conjuntura Economica 4 (1977): III.

in the external demand for raw materials and the increase of the internal demand for foodstuffs must have altered the earlier process of Bahia's agriculture as will be shown below.

9.6 Response of Bahian Agriculture to the New Conditions

So far, external and internal processes which influenced agriculture in Bahia have been described. As was pointed out, agriculture remained as the major source of the state income despite the industrialization of Brazil. That the breakdown of regional isolation did not bring much benefit to Bahia's economy was revealed by the pattern of interregional trade. In addition, outmigration to the urban areas of the state and other regions of the country caused a substantial relative reduction in the rural population despite an increasing demand for foodstuffs.

The industrialization of Brazil stimulated the increase of overall domestic demand for foodstuffs and raw materials. But the heavy concentration of investment in the Centre-South; especially in the state of Sao Paulo, acted to intensify even this production in that state and its immediate neighbours.⁴⁹ The impact of gross economies of scale resulted in strong competition among national producers to supply the market and led to a spatial reorganization, particularly with respect to those products with appreciable comparative advantages based on market accessibility. Vegetables, poultry products, sugar, coffee, potato, rice, and cotton were the products most affected. The position of Bahia became, in effect, more peripheral with respect to a national market and its primary focus in the Sao Paulo area.

It is in this general context with its new pattern of supply and demand relationship involving the local, national, and international markets that the study of the agricultural land use of Bahia in the last forty years will be carried out. The general response of agriculture to new conditions will be first examined and then an analysis of the agricultural patterns will be presented. Finally, in the last two parts of this section the dynamics of Bahia's agriculture and its intensity will be interpreted in the light of von Thünen's predictions.

9.6.1 Expansion of Agricultural Space

If Bahia had remained isolated within Brazil and its population had not grown, the decrease in demand for export staples would have probably led to a contraction of the overall agricultural space. Evidence so far presented has shown, however, that such a situation could not be found in Bahia. Actually, the downward price trend for export products occurred when foodstuff prices presented an upward trend (Table 41). The latter provided a basis for the expansion of agricultural space in Bahia.

The totals of farmland, cropped land, and pasture land (Table 42) emphasize some particular aspects of Bahia's agriculture between 1920 and 1940. In the first place, the figures show that the overall agricultural space continued to expand; between 1920 and 1940 the total area in farmland expanded 59% or at an annual rate of 3%. In the same period the total population of the state grew 18% or at an annual rate of 0.9%. Outstanding, however, was the expansion of cropped land (232%) which represented an average annual increase of 12% or thirteen times more than the population growth rate. This was the latest stage in the

TABLE 42

EXPANSION OF THE BAHIA'S AGRICULTURAL SPACE, 1920-1970

| LAND CATEGORY | 1920 (ha) | 1940 (ha) | 1950 (ha) | 1960 (ha) | 1970 (ha) | RATES OF INCREASE (%) | | | |
|---------------|--------------|--------------|--------------|--------------|--------------|-----------------------|---------|-----------------|------|
| | | | | | | 1920/40 | 1940/50 | 1950/60 1960/70 | |
| Farmland | 8,451,440 | 13,408,150 | 15,732,988 | 17,666,218 | 22,260,827 | 59.0 | 17.0 | 12.3 | 26.0 |
| Cropped Land | 432,386 | 1,434,436 | 1,372,233 | 2,163,004 | 2,363,444 | 232.0 | - 4.3 | 57.6 | 9.3 |
| Pasture Land | data n.a. | 3,342,664 | 4,604,535 | 6,264,151 | 9,065,605 | data n.a. | 38.0 | 36.0 | 44.7 |

SOURCE: Brasil, Diretoria Geral de Estatística do Ministério da Agricultura, Indústria e Comércio, Recenseamento Geral do Brasil, 1920, vol. 3, tomo 1, 2a. Parte (Rio de Janeiro: IBGE), pp. 250-259; Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola: Estado da Bahia, 1940 (Rio de Janeiro: IBGE), p. 41; Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola 1950, Bahia, (Rio de Janeiro: IBGE), p. 63; Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola de 1960, Bahia, vol. 2, tomo 8, la. Parte (Rio de Janeiro: IBGE), pp. 34-35; and Brasil, Fundação Instituto Brasileiro de Geografia e Estatística, vol. 3, tomo 13 (Rio de Janeiro: DEGEN), pp. 156-157.

striking expansion of agriculture which occurred between the 1890's and 1940. The contrast between this and population growth suggest that the expansion was related to supplying the external market rather than that of Bahia. Between 1940 and 1970 expansion of agricultural space continued, but at much lower rates than in the prior period, whereas population grew at a faster rate than agricultural space for instance in the decade 1940-1950 (see Table 40). Finally between 1960 and 1970 both population and agricultural space grew at the same rate.

A second aspect to be considered is the relative increase of cropped land and pasture land. The former experienced a spectacular expansion between 1920 and 1940 but in the subsequent decade (1940-1950) it contracted, while population and pasture land grew at 2.3% and 3.8% a year, respectively. Cropland contraction was definitely related to the lower demand for export staples during the Great Depression and which continued into World War II. Thereafter, the cropped area grew until 1960 but growth slackened again between 1960 and 1970. The three decades (1940-1970) saw a significant expansion of pasture land of 117%, while the cropped area expanded only 65%. The rural exodus may have also had a strong effect on the huge differences in rates of change in these agricultural land categories. The lower growth of the rural population occurred after 1950 while the urban population continued growing at high rates (Table 40).

The third aspect to be considered is the percentage of cropped land and pasture land to total farmland. For instance in 1940 that percentage was 11% for the former and 25% for the latter. However, in 1950, 1960, and 1970 the percentage of cropped land was 9%, 12%, and 11% respectively. In the same period pasture land percentage grew to 29% (1950),

35% (1960) and 41% (1970). By taking into account the proportion of both categories to total agricultural land, within thirty years (1940-1970) the cropped area was reduced from 30% to 21% whereas the percentage of pasture land increased from 70% to 79%.

Finally, the striking expansion of pasture land observed between 1940 and 1970 leads one to conclude that agriculture was adjusting to new market conditions; pasture expansion was in response to the market price for beef in the regional market, while the traditional export crops experienced a relative contraction. The slight increase of cropped area was probably related to the introduction of new cash crops (agave, oil palm, and rubber, etc.) and the expansion of food crops. During this stage of adjustment, extensive types of agriculture tend to prevail in advantageous locations which in other market circumstances would be probably occupied by an intensive agriculture. Such a spatial effect in Bahia will be observed through the study of agricultural patterns.

9.6.2 Spatial Adjustment in the Agricultural Land Use Patterns

Study of the later stages of agricultural evolution is based primarily on the availability of the four decennial censuses (1940, 1950, 1960, and 1970) which has permitted an examination of four sub-periods, each of which is treated on a quasi-equilibrium or cross section basis. In order to classify the types of agricultural land use, in each sub-period, census variables were selected as surrogates of agricultural intensity as follows:

- 1) Total area in perennial crops as percentage of total agricultural land (PPC). In this category are included the traditional export crops (cocoa and coffee) and the secondary cash crops (agave, rubber, coconut, banana, and oil palm).

- 2) Total area in temporary crops as percentage of total agricultural land (PTC). In this category are included the traditional export crops (sugar cane and tobacco) secondary cash crops (cotton and castor beans) and food crops for sale (beans, manioc, corn, and rice).
- 3) Total area in natural and improved pasture as percentage of total agricultural land (PMP).
- 4) Total area in improved pasture as percentage of total agricultural land (PIP).
- 5) Total area in natural pasture as percentage of total agricultural land (PNP).

The data units used were the municipios of Bahia. In the search for a more accurate technique by which to classify the agricultural land use, cluster analysis was chosen (see Chapter Four, Section 4.4.4).

The major results of the cluster analysis are presented in Tables 43A, 43B, 43C, and 43D, from which the T-values were selected as the basis for mapping the agricultural land use. That is, the variable(s) having the largest T-value(s) were selected to define and label the dominant agricultural land uses. The map series derived from the clusters or groups is interpreted below. Throughout this interpretation the terms "shift" or "change" refer to the transition from a prevalent agricultural land use to another experienced by the municipios over time. The measurement used to identify this "change" is the cluster mean (MN-ORIG) in which the municipio is enclosed, measured in percentage of area of the dominant land use. This dominance is recognized by using the population sample mean (MN-ORIG) for each agricultural land use (variables) as the parameter with which the cluster mean is compared.

9.6.2.1 Agricultural Land Use Pattern, 1940. The striking expansion of the cropped area in Bahia between 1920 and 1940 can be appreciated through the interpretation of Figure 36, and the comparison

TABLE 43A

CLUSTER ANALYSIS RESULTS FOR MAPPING - 1940

VARIABLES

| NO. OF CLUSTERS | NO. OF DATA UNITS | PERENNIAL CROPS | | | TEMPORARY CROPS | | | MIXED PASTURE | | |
|-------------------|-------------------|-----------------|-----------|---------|-----------------|-----------|---------|---------------|-----------|---------|
| | | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG |
| 1 | 44 | .11 | -.33 | 6.91 | .08 | -.67 | 16.34 | .05 | .80 | 76.75 |
| 2 | 31 | .21 | -.24 | 8.25 | .08 | .10 | 29.39 | .07 | .10 | 62.36 |
| 3 | 14 | .00 | -.65 | 1.68 | .01 | -1.26 | 6.30 | .01 | 1.54 | 92.02 |
| 4 | 15 | .43 | 2.58 | 54.23 | .18 | -.89 | 12.49 | .37 | -1.29 | 33.28 |
| 5 | 22 | .01 | -.54 | 3.40 | .07 | .98 | 44.06 | .03 | -.36 | 52.54 |
| 6 | 15 | .21 | -.18 | 9.35 | .07 | 1.93 | 60.04 | .12 | -1.42 | 30.61 |
| 7 | 9 | .26 | -.82 | 25.70 | .06 | .75 | 40.32 | .19 | -1.26 | 33.98 |
| Population Sample | 150 | data n.a. | data n.a. | 12.29 | data n.a. | data n.a. | 27.59 | data n.a. | data n.a. | 60.12 |

Source on which the computer output is based: Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola: Estado da Bahia, 1940 (Rio de Janeiro: IBGE), pp. 41-43.

Small F-Ratio: indicates variable having comparatively low variation within the cluster.

Large T-Value: indicates continuous variable having cluster mean substantially different from the population sample mean for that variable.

MN-ORIG: refers to the mean measured in the original scale of the variable (i.e. before standardisation).

TABLE 43B
CLUSTER ANALYSIS RESULTS FOR MAPPING - 1950

| NO. OF CLUSTERS | NO. OF DATA UNITS | V A R I A B L E S | | | | | | | | | | | | | | |
|-------------------|-------------------|-------------------|-----------|---------|-----------------|-----------|---------|-----------------|-----------|---------|------------------|-----------|---------|---------|---|---------|
| | | PERENNIAL CROPS | | | TEMPORARY CROPS | | | NATURAL PASTURE | | | IMPROVED PASTURE | | | | | |
| | | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG |
| 1 | 35 | .29 | -.32 | 5.77 | .17 | -.52 | 13.36 | .17 | -.72 | 23.50 | .23 | 1.44 | 57.37 | | | |
| 2 | 37 | .21 | -.21 | 5.89 | .21 | -.63 | 11.68 | .38 | 1.30 | 69.33 | .16 | -.82 | 13.10 | | | |
| 3 | 20 | .51 | .05 | 10.23 | .08 | .93 | 36.01 | .51 | .15 | 43.43 | .10 | -.96 | 10.33 | | | |
| 4 | 15 | .08 | -.33 | 3.96 | .10 | -.53 | 13.25 | .02 | .30 | 46.66 | .03 | .35 | 36.12 | | | |
| 5 | 27 | .03 | -.42 | 2.49 | .32 | .95 | 36.44 | .17 | -.47 | 29.54 | .13 | .12 | 31.53 | | | |
| 6 | 11 | .24 | 3.08 | 59.64 | .18 | -.80 | 9.11 | .22 | -1.27 | 11.12 | .39 | -.46 | 20.13 | | | |
| 7 | 5 | .00 | -.53 | .67 | .13 | 2.91 | 66.79 | .14 | -.87 | 20.09 | .05 | -.85 | 12.44 | | | |
| Population Sample | 150 | data n.a. | data n.a. | 9.40 | data n.a. | data n.a. | 21.58 | data n.a. | data n.a. | 39.85 | data n.a. | data n.a. | 29.17 | | | |

Source on which the computer output is based: Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola 1950, Bahia (Rio de Janeiro: IBGE), pp. 63-65.

Small F-Ratio: indicates variable having comparatively low variation within the cluster.

Large T-Value: indicates continuous variable having cluster mean substantially different from the population sample mean for that variable.

MN-ORIG: refers to the mean measured in the original scale of the variable (i.e. before standardisation).

TABLE 43C

CLUSTER ANALYSIS RESULTS FOR MAPPING - 1960

V A R I A B L E S

| NO. OF CLUSTERS | NO. OF DATA UNITS | PERENNIAL CROPS | | | TEMPORARY CROPS | | | NATURAL PASTURE | | | IMPROVED PASTURE | | |
|-------------------|-------------------|-----------------|------|---------|-----------------|------|---------|-----------------|-------|---------|------------------|-------|---------|
| | | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG |
| 1 | 59 | .25 | -.22 | 8.03 | .16 | -.45 | 13.85 | .32 | .94 | 58.44 | .20 | -.37 | 19.68 |
| 2 | 32 | .00 | -.55 | 1.60 | .15 | -.51 | 12.66 | .12 | .17 | 42.54 | .10 | .83 | 43.20 |
| 3 | 19 | .35 | -.09 | 10.63 | .33 | -.51 | 12.81 | .07 | -1.39 | 9.86 | .49 | 2.04 | 66.69 |
| 4 | 17 | .41 | 2.64 | 64.03 | .11 | -.79 | 7.92 | .06 | -1.50 | 7.68 | .39 | -.34 | 20.36 |
| 5 | 50 | .37 | -.19 | 8.71 | .36 | .94 | 37.98 | .33 | -.02 | 38.29 | .24 | -.62 | 15.02 |
| 6 | 6 | .14 | -.36 | 5.34 | .04 | 3.17 | 76.61 | .09 | -1.33 | 11.22 | .13 | -1.04 | 6.83 |
| Population Sample | 183 | n.a. | n.a. | 12.47 | n.a. | n.a. | 21.63 | n.a. | n.a. | 38.85 | n.a. | n.a. | 27.04 |

Source on which the computer output is based: Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola 1960, Bahia (Rio de Janeiro: IBGE), pp. 34-45.

Small F-Ratio: indicates variable having comparatively low variation within the cluster.

Large T-Value: indicates continuous variable having cluster mean substantially different from the population sample mean for that variable.

MN-ORIG: refers to the mean measured in the original scale of the variable (i.e. before standardisation).

TABLE 43D

CLUSTER ANALYSIS RESULTS FOR MAPPING - 1970

V A R I A B I L É S

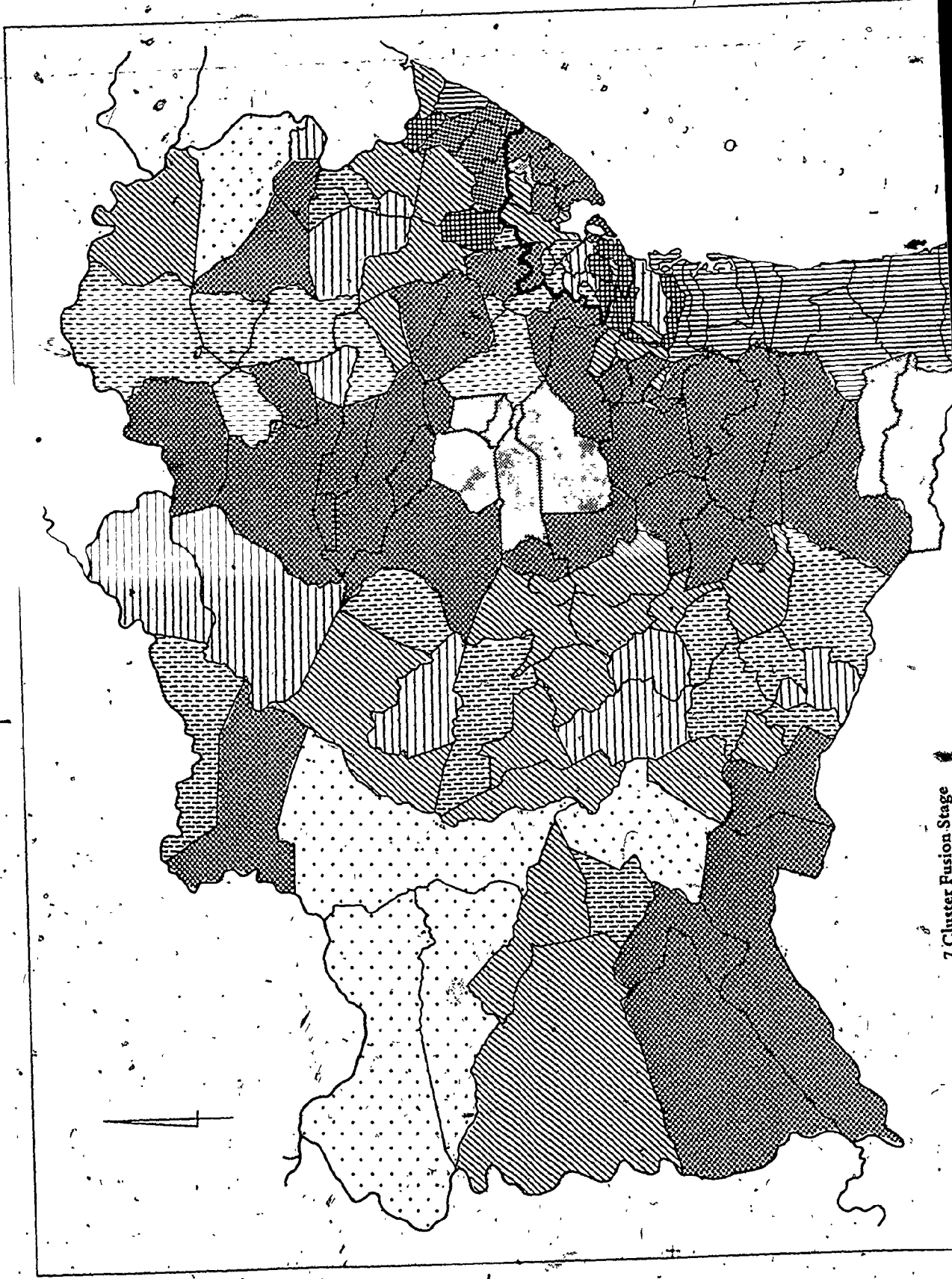
| NO. OF CLUSTERS | NO. OF DATA UNITS | PERENNIAL CROPS | | | TEMPORARY CROPS | | | NATURAL PASTURE | | | IMPROVED PASTURE | | |
|-------------------|-------------------|-----------------|-----------|---------|-----------------|-----------|---------|-----------------|-----------|---------|------------------|-----------|---------|
| | | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG | F-Ratio | T | MN-ORIG |
| 1 | 22 | .10 | -.31 | 5.48 | .30 | .80 | 28.60 | .10 | .67 | 55.98 | .06 | -.89 | 9.94 |
| 2 | 29 | .05 | -.49 | 2.24 | .44 | -.42 | 11.63 | .42 | -1.12 | 18.66 | .33 | 1.77 | 67.47 |
| 3 | 53 | .04 | -.41 | 3.72 | .13 | -.57 | 9.55 | .15 | .64 | 55.52 | .17 | .09 | 31.21 |
| 4 | 23 | .58 | 2.33 | 53.01 | .52 | -.39 | 12.04 | .25 | -1.08 | 19.55 | .44 | -.64 | 15.40 |
| 5 | 20 | .45 | .06 | 12.33 | .06 | -.60 | 9.26 | .44 | 1.30 | 69.17 | .07 | -.92 | 9.24 |
| 6 | 25 | .17 | -.29 | 5.93 | .22 | .72 | 27.53 | .13 | -.41 | 33.39 | .18 | .18 | 33.15 |
| 7 | 11 | .15 | -.38 | 4.22 | .18 | 2.59 | 53.28 | .25 | -.64 | 28.68 | .28 | -.71 | 13.82 |
| Population Sample | 183 | data n.a. | data n.a. | 11.16 | data n.a. | data n.a. | 17.54 | data n.a. | data n.a. | 42.07 | data n.a. | data n.a. | 29.23 |

Source on which the computer output is based: Brasil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Censo Agropecuario: Bahia, 1970 (Rio de Janeiro: DECEN), pp. 156-165.

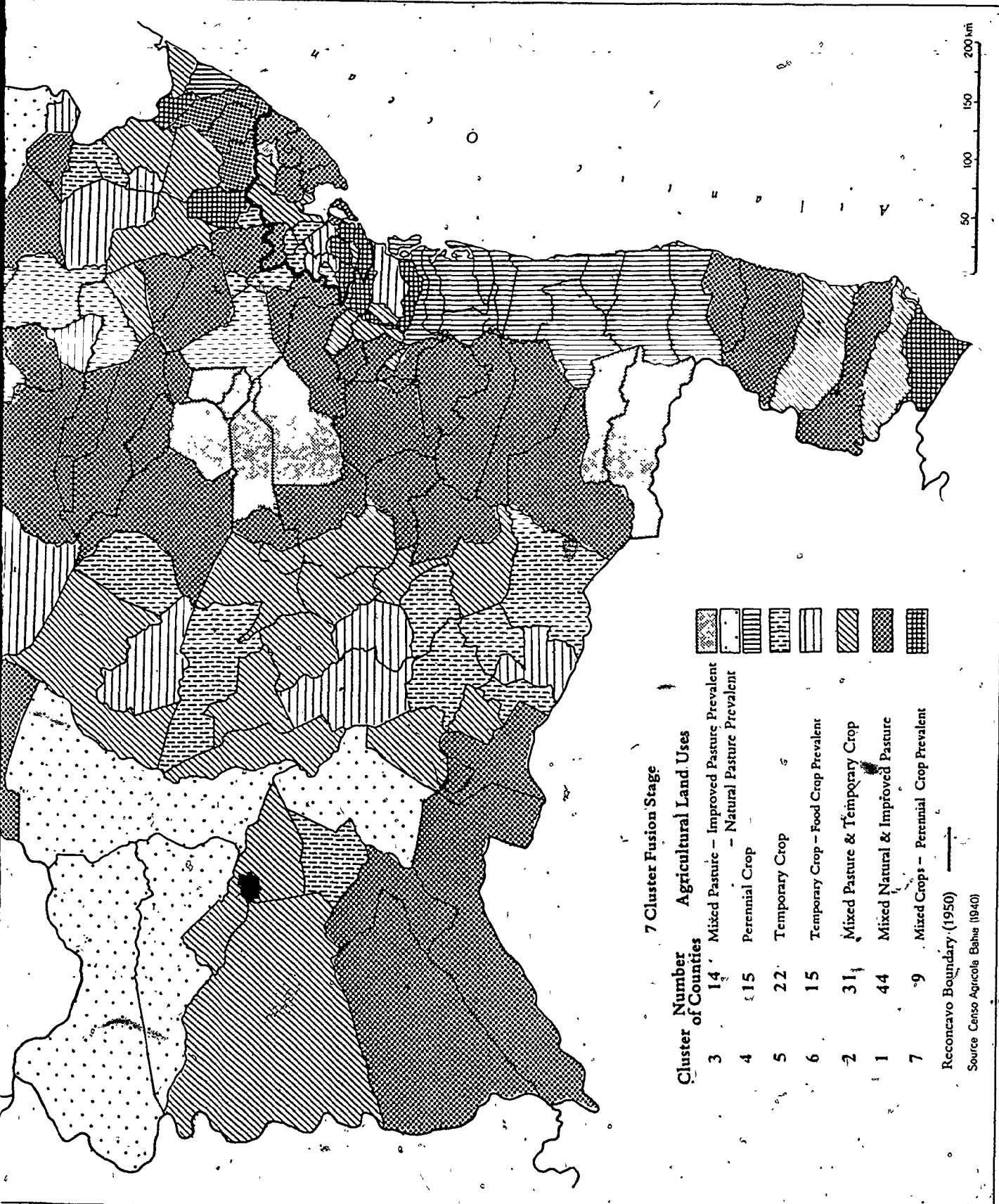
Small F-Ratio: indicates variable having comparatively low variation within the cluster.

Large T-Value: indicates continuous variable having cluster mean substantially different from the population sample mean for that variable.

MN-ORIG: refers to the mean measured in the original scale of the variable (i.e. before standardisation).



7 Cluster Fusion Stage



7 Cluster Fusion Stage

| Cluster Number of Counties | Agricultural Land Uses |
|----------------------------|---|
| 3 | 14 Mixed Pasture - Improved Pasture Prevalent |
| 4 | 15 Perennial Crop |
| 5 | 22 Temporary Crop |
| 6 | 15 Temporary Crop - Food Crop Prevalent |
| 2 | 31 Mixed Pasture & Temporary Crop |
| 1 | 44 Mixed Natural & Improved Pasture |
| 7 | 9 Mixed Crops - Perennial Crop Prevalent |

Reconcavo Boundary (1950)

Source Censo Agricola Bahia (1940)

Figure 36 Land Use Pattern in Bahia 1940

of the agricultural patterns in 1940 with that of 1920 (Figure 32).

First, the temporary crop area expanded more rapidly than that of perennial crops. This statement is supported by the percentage of both types of crop to the total agricultural land. That is, in 1940 the area in temporary crops represented about 20% of agricultural land while the perennial crops share was about 10%. Also the population sample mean for each crop category (Table 43A) shows that the temporary crops have a higher mean area (27.59%) than the perennial crops (12.29%). This expansion was probably related to population growth and the possibility of shipping foodstuffs to Bahia's neighbour states.

Second, the pattern (Figure 36) shows striking "changes" having taken place in the Sertao and Agreste zones while only a small alteration is observed in the Mata zone. In the Sertao zone "changes" occurred in three specific areas: 1. the northeastern Sertao alongside the Sao Francisco Railway. Here cattle grazing became less important in municipios producing food crops for sale to supply Salvador (Tucano, Queimadas, etc.). The trend observed in 1920 of the relocation of food supply areas for Salvador, was consolidated by 1940. The larger area comprising the eastern bank of the Sao Francisco River and the Diamantina Ridge. Although by 1920 this area had emerged as an important producer of cotton, coffee, and castor beans and food crops for sale (beans, corn, rice, etc.) several municipios engaged in raising cattle "shifted" to the production of temporary crops (Condeuba, Gaitite, Irecê, etc.). Others in a mixed agriculture became temporary cropping areas (Paramirim, Macaubas, etc.) while some traditional cattle raising areas also "shifted" to a mixed agriculture (Xique-Xique, Paratinga, Riacho de Santana, etc.). 3. The third area in the Sertao showing

substantial "shift" was western Bahia where the evolution was from ranching to a mixed agriculture, particularly in the centre of the area (Barreiras, Angical, and Santana).

In the Agreste "changes" also occurred in the north and centre. In the former area Itapicuru and Inhambupe "shifted" from cattle to a mixed agriculture while in the latter area Maracas, Ubaira, and Jequeie, formerly coffee growing areas, saw an expansion of pasture land.

In the Mata zone temporary crops expanded in a few municípios (Jandaira, Caravelas, and Prado) while a perennial crop (coconut) expanded in Conde. In the Recôncavo pasture became more prevalent in a wider area around Salvador, suggesting the beginning of the decline of plantations.

Finally, a third aspect to be considered is that the agricultural evolution which occurred in Bahia between 1920 and 1940 gave rise to the emergence of four well defined agricultural zones. The inner zone centred on the Mata zone expanded northward incorporating adjacent areas of the Agreste and Sertao. It continued to be an area basically oriented to supply the external market but the influence of the growing Salvador market accounted for the inclusion of areas of the Agreste and Sertao to produce the necessary foodstuffs (beans, corn, etc.). Expansion of pasture lands within the zone, particularly around Salvador, suggests an advanced stage of sugar plantation decline. Despite the evolution of this zone to one of mixed agriculture, crop specialization remained a basic orientation. The second zone, resulted from the evolution of the former mixed zone in which livestock specialization (breeding and fattening) became the chief orientation. Within the zone two major nuclei developed. One was located in the centre (Foothills of Diamantina

Ridge) in which Mundo Novo, Rui Barbosa, Itaberaba, Baixa Grande, Maiari, etc. reinforced their former specialization in breeding and fattening cattle to supply Salvador and the regional market. The other nucleus was located in the southern Agreste (Vitoria da Conquista, Itambe, and Encruzilhada). It also specialized in breeding and fattening but was oriented to supply both Bahia and the Southeast. The third zone, farther from Salvador developed north and south of the Diamantina Ridge. Here mixed agriculture and temporary crops became the major orientation of the zone but with the latter tending to prevail. The emergence of this new zone suggests a rapid increase of the internal and regional demand for foodstuffs. Lack of literature on the area does not permit statements about market orientation. However, the location of the zone between the Sao Francisco River and the major inland railway termini is a good indicator that the zone became oriented to supply Salvador and also to export to neighbouring states of the Northeast and to Minas Gerais. Finally, the fourth zone is located in western Bahia. This zone also evolved to include some mixed agriculture but ranching remained as the major type of land use. In order to simplify the complexity of agricultural land use existing within these zones in 1950, 1960, and 1970 and to facilitate the analysis, they will be labeled hereafter by taking into account their major agricultural orientation as follows:

Crop Zone, refers to the inner zone formerly oriented to grow the traditional export crops (perennial and temporary crops) and the food crops for sale (temporary crops).

Livestock Breeding Zone, refers to the second zone, evolved from the earlier Mixed Agriculture Zone, now basically occupied by

different types of pasture and oriented to breed and fatten cattle.

Mixed Agriculture Zone, refers to the third zone, resulting from the expansion of temporary crops (secondary and food cash crops) and pasture which coexist side by side in the municipios.

Ranching Zone, refers to the outer zone occupied by different types of pasture and oriented to raise and fatten cattle.

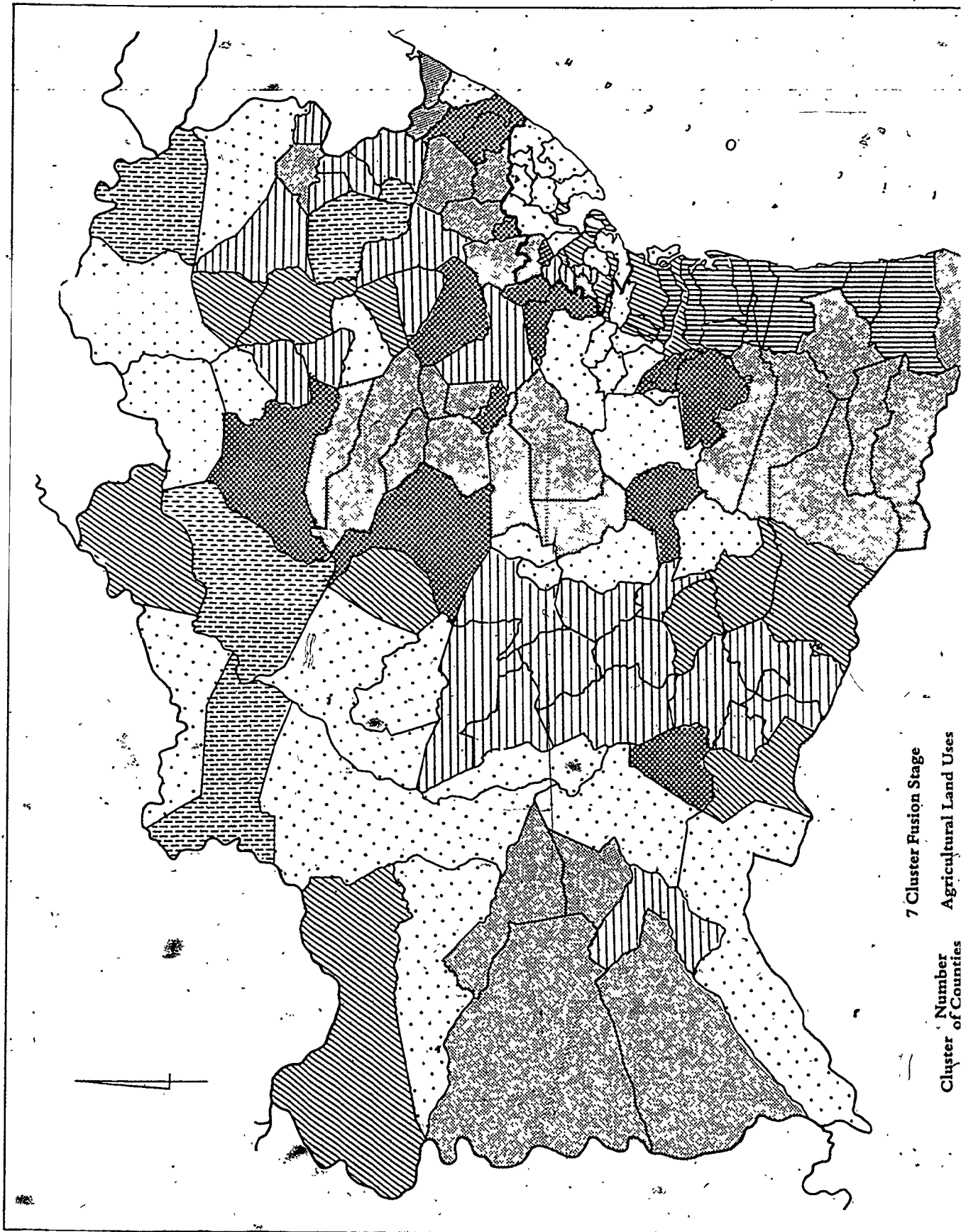
The substantial "change" observed by 1940 in Bahia's agricultural pattern permits one to draw the following conclusions. First, the population growth between 1920 and 1940 had a great impact on the increase in domestic demand and further intensification of agriculture. Second, the evolution observed in the overall pattern particularly in the zoning is definitely related to the effect of transportation improvements which occurred in the hinterland. Third, the agricultural zones became consolidated in their orientation. The zoning that had developed by 1940 seems to be a good indicator of the initial breakdown of trade isolation within the country. Actually the trend was for international trade to contract (Section 9.2), and therefore, it could not stimulate the expansion of agriculture as it had before 1929. This left only interregional trade, able to act as a "push factor" for agriculture in the period when the isolation began to breakdown.

9.6.2.2 Agricultural Land Use Pattern, 1950. As evidenced in Table 42 there was a reduction of 4.3% in cropped area in Bahia between 1940 and 1950 while there was an increase of 38% in pasture land. Considering the share of both land categories to the total agricultural land, crops (perennial and temporary) were reduced from 30% of the area in 1940 to 23% in 1950, whereas pasture (natural and improved) increased from 70% to 77% in the same period. The spatial effect of this significant

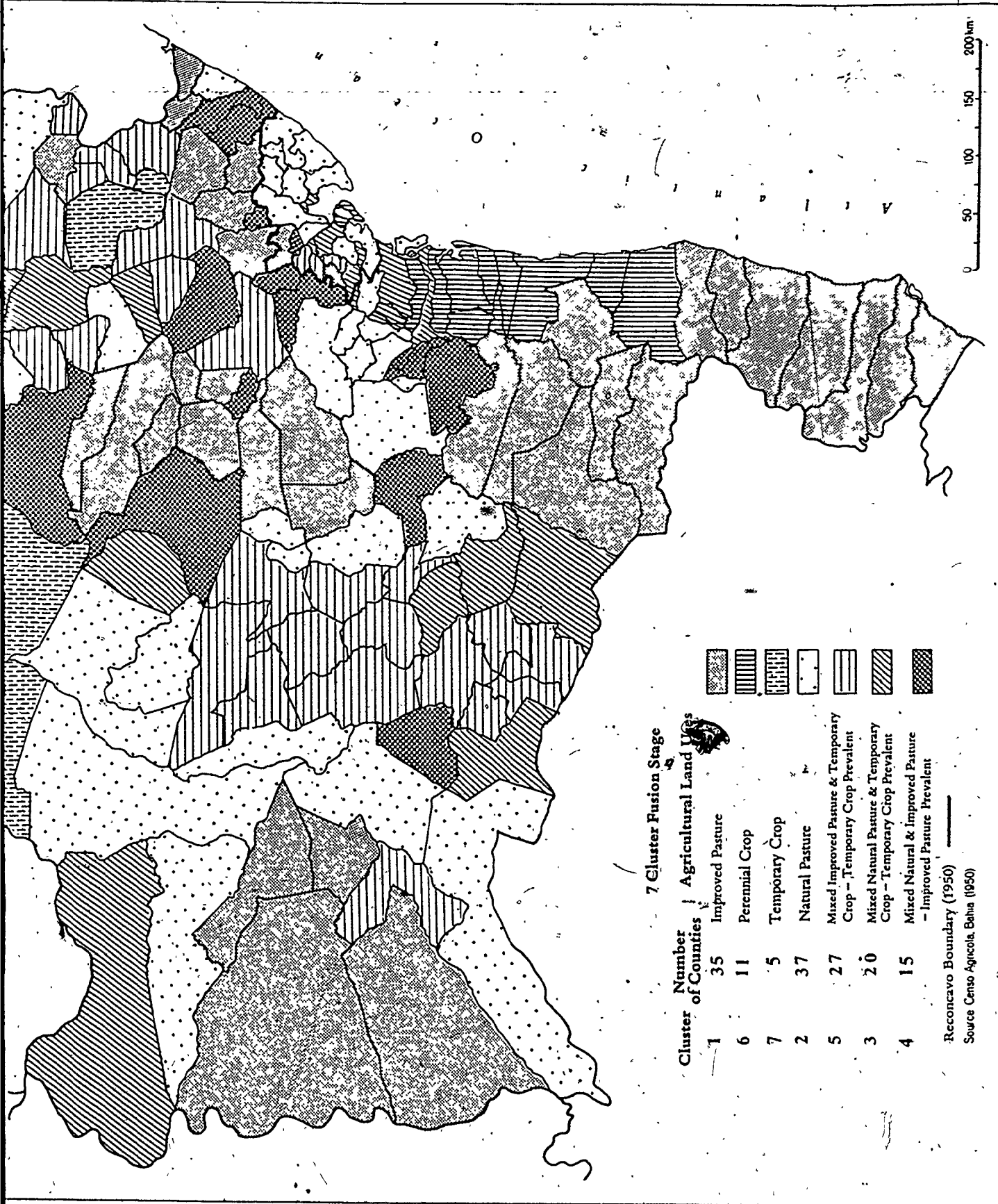
"change" in Bahia's agriculture can be appreciated by reference to the 1950 agricultural pattern in Figure 37.

Comparison between the 1940 pattern (Figure 36) and the 1950 pattern shows that substantial "changes" occurred in all four zones.

The Crop Zone, for instance, contracted and was fragmented into three "crop islands" surrounded by pasture land. The first "island" in the northern Agreste and northeastern Sertao, oriented to supply Salvador saw an expansion of cattle. Municípios formerly classified as temporary crops having a high cluster mean (44%) in 1940 "shifted" to a mixed agriculture in which the mean area of temporary crops decreased in 1950 to 36% (Table 43B) while the areas in improved or natural pasture increased to 31% and 43% respectively (Uauá, Monte Santo, Ribeira do Pombal, and Ribeira do Amparo). Municípios previously in the Crop Zone became incorporated into the Livestock Breeding Zone (Curaca, Jaguarari, and Queimadas) while Gloria and Euclides da Cunha intensified crop production. The second "crop island" was in the southwestern Recôncavo where municípios previously included in clusters having a high mean area in temporary crops (60% and 44%) "changed" to a mixed agriculture (Muritiba, Maragogipe, Cruz da Almas, São Felipe, etc.) with a significant reduction of temporary crops (Table 43B, clusters 3 and 5). The third "crop island" in the southeastern Mata zone was basically occupied by perennial crops. Here municípios which had a mean area in perennial crops of 54% in 1940 (Table 43A, cluster 4) saw it decrease to 5% (Table 43B, clusters 1 and 2) while their areas in improved and natural pasture increased to 57% and 69% respectively (Itabuna, Belmonte, and Cairu). Other municípios like Valença, Mutuípe and Nilo Pecanha also "changed" to a mixed agriculture. The spatial effect of the decrease



7 Cluster Fusion Stage
Cluster of Counties
Agricultural Land Uses



7 Cluster Fusion Stage

| Cluster | Number of Counties | Agricultural Land Uses |
|---------|--------------------|--|
| 1 | 35 | Improved Pasture |
| 6 | 11 | Perennial Crop |
| 7 | 5 | Temporary Crop |
| 2 | 37 | Natural Pasture |
| 5 | 27 | Mixed Improved Pasture & Temporary Crop - Temporary Crop Prevalent |
| 3 | 20 | Mixed Natural Pasture & Temporary Crop - Temporary Crop Prevalent |
| 4 | 15 | Mixed Natural & Improved Pasture - Improved Pasture Prevalent |

Reconcaço Boundary (1950) ———
 Source: Censo Agricola, Bahia (1950)

Figure 37 Land Use Pattern in Bahia 1950

64
00
5

in the external demand for the traditional export crops was therefore evident through the contraction of the Crop Zone.

The Livestock Breeding Zone consolidated and expanded in two directions; westward to incorporate Palmeiras and Mucugê, and eastward which saw pasture land become prevalent in the Recôncavo and Agreste. In the former area, pasture expansion was related to the contraction of sugar cane and tobacco areas. Here cattle farming gave rise to the beginning of expansion of Salvador's milkshed outside the city and to beef fattening to supply its packing house. In the latter area beef fattening to supply Salvador and the state of Sergipe may explain some crop replacement. With respect to the prevalence of a wide area in natural pasture in the Recôncavo, data do not seem to conform with the geographical reality as it was pointed out in Chapter Four (Section 4.2.2). Bush fallow and secondary forest or improved pasture seems to be the type of land use more evident in the Recôncavo and most of the Mata zone. Expansion also took place at the expense of the cocoa area while the south of the former Crop Zone was incorporated into the Livestock Breeding Zone.

The Mixed Agriculture Zone was more resistant to cattle expansion, however, the number of municípios oriented to the production of temporary crops and cattle increased from twelve in 1940 to nineteen in 1950. For instance Caitete, Cacule, Macaubas, Irecê, etc. "changed" from a crop only to a mixed agriculture orientation (crops and cattle) while other municípios like Riacho de Santana, Paratingá, Xique-Xique, etc. "changed" back to cattle. Despite these "changes", this zone started to emerge as most important in the production of cotton, beans, castor beans, corn, etc. to supply the domestic market.⁵⁰

The Ranching Zone, in the western Sertao also experienced some "changes". Municipios oriented to temporary crops (Santana) and a mixed agriculture (Barreiras and Angical) experienced a decrease in their cropped area from 44% and 29% in 1940 to 13% in 1950 while their areas in improved pasture enlarged to 57% (Table 43B, cluster 1). Only two municipios previously oriented to cattle "changed" to a mixed agriculture (Santa Rita de Cassia and Santa Maria da Vitoria) while other municipios remained cattle oriented.

The response of Bahia's agriculture to the processes operating both outside and within the state seem to be supported by the land use pattern in 1950. The relative contraction of the area producing the traditional cash crops oriented toward the external market was, however, the most striking. Assuming no technological improvement in the farming methods, such an areal contraction resulted in two major consequences in terms of economic development. One was that agriculture became more extensive, releasing labour and capital without increasing yields or productivity. The other consequence was that the labour and capital released from agriculture were applied to other non agricultural activities within or outside the state.

Among the crops, sugar cane and coffee were the most affected. Sugar the chief product of the Bahian economy for over three centuries experienced a decrease in the number of factories. In 1940 Bahia had eighteen sugar factories in operation but they decreased to fourteen and six in 1950 and 1970 respectively. Although sugar production increased from 50,910 metric tons (1939/1940) to 51,980 metric tons (1949/1950) it was not enough to supply even the domestic market. This led Bahia to import sugar from other states. Records presented in Table 44

TABLE 44

BAHIA'S SUGAR IMPORTS, 1950-1967

| STATES | IN METRIC TONS | | | |
|----------------|----------------|-----------|-----------|-----------|
| | 1952/1954 | 1955/1959 | 1960/1964 | 1965/1967 |
| Alagoas | 1,290 | 26,730 | 56,652 | 518 |
| Paraiba | data n.a. | 5,730 | 7,688 | 942 |
| Pernambuco | 3,815 | 25,482 | 61,239 | 49,503 |
| Sergipe | 9,026 | 9,138 | 2,108 | data n.a. |
| Rio de Janeiro | 9 | 7,426 | 15,971 | 32,364 |
| Minas Gerais | data n.a. | 453 | data n.a. | data n.a. |
| Total | 14,140 | 74,959 | 143,658 | 83,327 |

SOURCE: Data provided by the Institute of Sugar and Alcohol.

reveal not only the increase of imports over the period but also the competition from the Southeast to supply Bahia. This means that the Northeast, specially Bahia, began to lose even its own regional market. Andrade⁵¹ states that the Northeast's loss of the Centre-South market for sugar began during World War II. The lack of overland transportation between those regions on the one hand and the disruption of the coastwise trade on the other hand gave rise to Sao Paulo's development of sugar production. In a short time, a large part of the Centre-South sugar market was absorbed by Sao Paulo which started operating its sugar plantations at lower costs based on larger economies of scale. The decline of the sugar economy in Bahia only after the 1920's, reinforces the argument developed in Chapter Six that West Indies competition did not affect the expansion and further development of the colonial plantations.

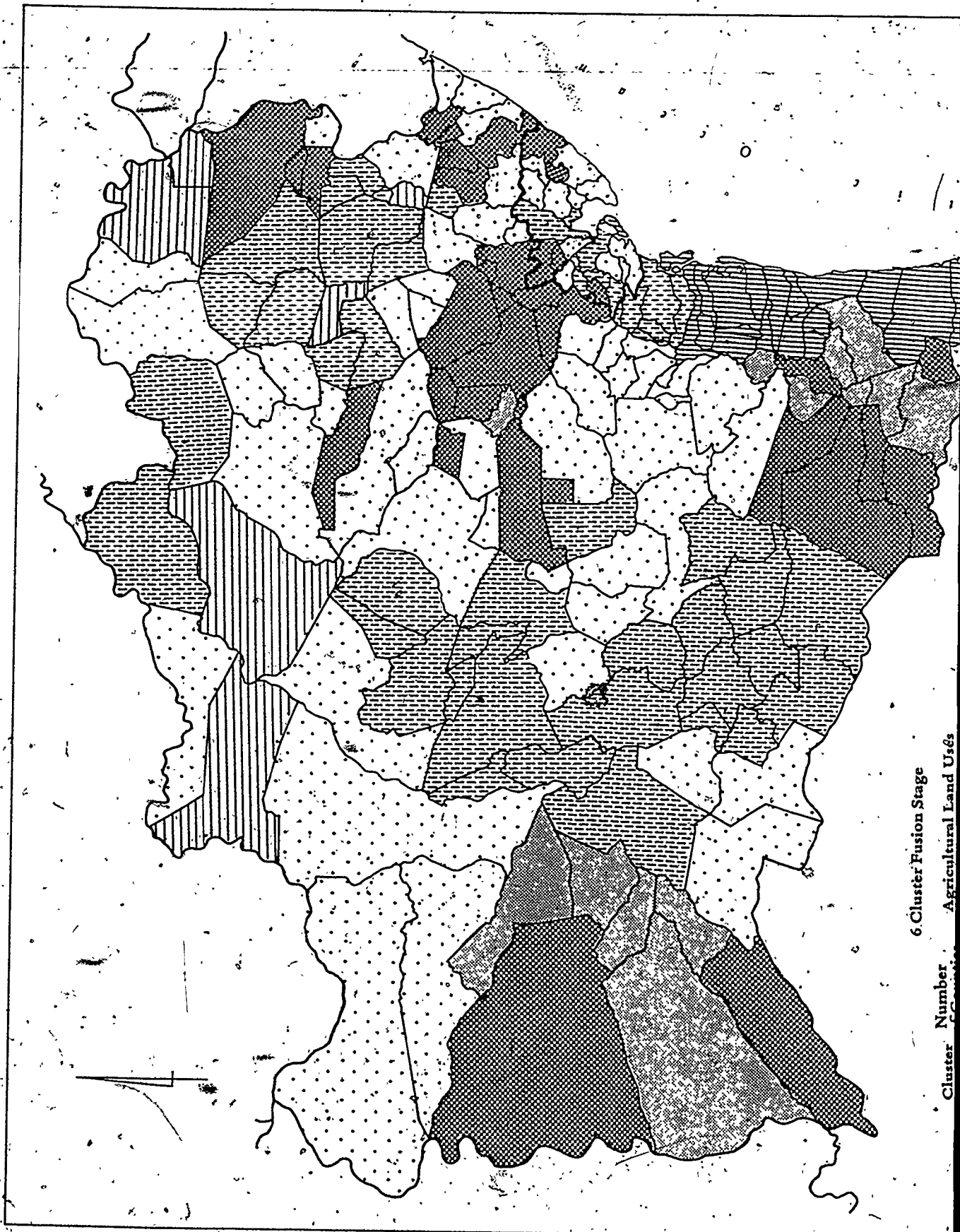
The contraction of coffee, although related to the reduction of external demand, became worse, however, following Brazil's policy of protecting this major national export staple. This occurred in the 1940's when the high costs of stock piling coffee production, to maintain a high price in the external market, led the government to destroy the stocks (27.5% of the internal production) and to set lower prices in the internal market.⁵² Such a policy resulted in the reduction of coffee areas especially in Bahia. A drastic policy was again undertaken in the 1960's when the government invested a large amount of capital in the eradication of old coffee trees. This new policy meant that by 1960/1970 the Northeast imported an annual average of 90,000 metric tons of coffee from the Centre-South.⁵³

The situation of Bahia's agriculture was further aggravated by outmigration and the breakdown of regional isolation through the improvement of inland transportation. Outmigration can be linked with an increased area under extensive types of agriculture while the linkages of Bahia to the Southeast through the railroad (Central Bahia Railway) and highway (Rio de Janeiro-Bahia) gave rise to market penetration by agricultural products from the Centre-South.

9.6.2.3 Agricultural Land Use Pattern, 1960. The process of contraction of the cropped area identified in 1950 had reversed by 1960. That is, the cropped area increased 57.6% while pasture land experienced a relative decrease from 38% in 1950 to 36% in 1960 (see Table 42). This expansion of the cropped area was chiefly due to the introduction of new perennial crops (agave, oil palm, and rubber) and the intensification of temporary crops (castor beans, beans, manioc, etc.) in municípios formerly oriented to produce food and/or industrial crops rather than in those oriented toward cattle.

Comparison between the agricultural pattern in 1960 (Figure 38) and that observed in 1950 (Figure 37) reveals that the increase in the cropped area resulted in "changes" of agricultural land use within the Crop and Mixed Agriculture Zones rather than in their expansion.

The Crop Zone remained as a set of "islands" separated by pasture land. In the north, municípios (Uaua, Euclides da Cunha, Itiuba, Araci, etc.) classified in 1950 as mixed agriculture, "changed" to temporary crops in 1960 because their mean area in these crops increased to 37.9% (Table 43C, cluster 5). This intensification may be related to the increase in Salvador's demand for foodstuffs; the city grew 57% between



Cluster Number: Agricultural Land Uses
6 Cluster Fusion Stage

105

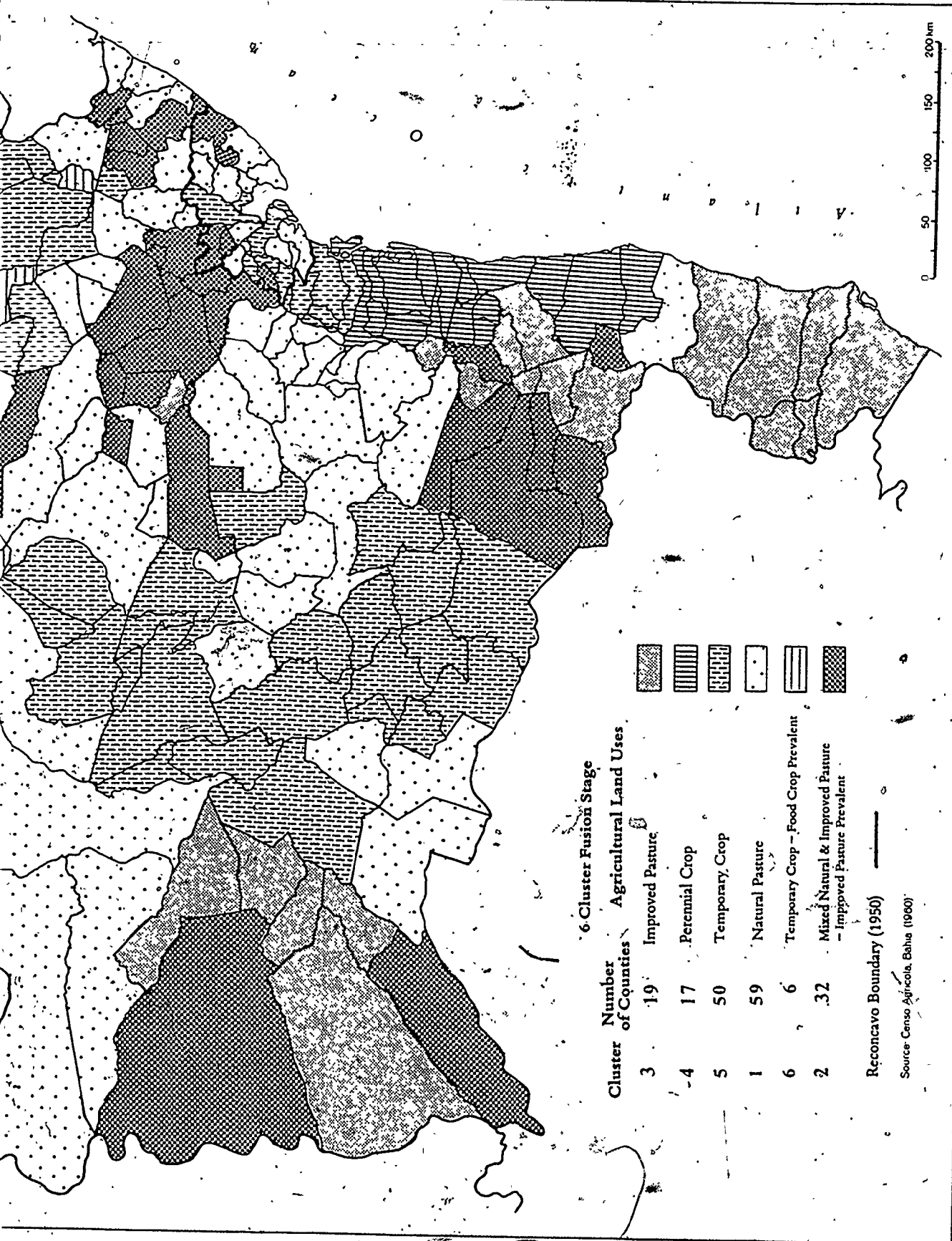


Figure 38 Land Use Pattern in Bahia 1960

1950 and 1960 (Table 40). Also agave started to expand within the area in the 1950's. In 1953 this area had 11,021 hectares in agave which had increased by 1960 to 51,504 hectares.⁵⁴ However, agave is a perennial crop cultivated in the area associated with beans and corn, and therefore, agave expansion by 1960 is masked by these temporary crops. In the centre the expansion of Salvador's milkshed outside the city encouraged further pasture expansion in the Mata and Agreste zones. Almeida,⁵⁵ in a survey carried out in 1958 on Salvador's milk supply, included seventeen municípios in its milkshed producing a total daily average of 69,936 litres of milk. Among these municípios seven were formerly basic sugar producers (Santo Amaro, Catu, Pojuca, Mata de Sao Joao, Sao Sebastiao, Camacari, and Salvador) while four were tobacco producers (Sao Goncalo dos Campos, Irara, Inhambupe, and Coracao de Maria). Despite an increase in milk production in the Recôncavo, intensification of sugar cane occurred in Santo Amaro and Sao Francisco do Conde. Southward the Crop Zone also shows an intensification of temporary crops (tobacco and manioc) in Cruz das Almas, Maragogipe, Sao Felipe, Mutupe, etc. and perennial crops in Cairu, Nilo Pecanha, Itubera, and Camamu. In this latter area new crops were introduced such as oil palm and rubber.⁵⁶ The spatial effect of these new crops is, however, observed only in Nilo Pecanha and Cairu in which the "change" was from temporary crops and natural pasture (bush fallow) to perennial crops (cluster mean increased from 59% in 1950 to 64% in 1960). On the other hand, the relative contraction of the cocoa area continued and pasture land and bush fallow replaced the former plantation areas.

The Livestock Breeding Zone reveals a further expansion as pasture replaced temporary and perennial crops eastward (Senhor do Bonfim,

Serrinha, Itapicuru, Santa Luz, Valente, Conceicao do Coite, Potiragua, and Itagimirim) and temporary crops westward (Ibitiara, Piata, and Rio de Contas). The land use within this zone "changed" in several municipios from improved to natural pasture. Such a "change" seems to be related to a data problem rather than a further extensification of livestock areas. For instance, Bahia's cattle herd increased from 4,426,000 in 1950 to 5,949,000 by 1960.⁵⁷ This represents a relative growth of 34% while the density of cattle also grew from 8/km² in 1950 to 11/km² in 1960. Other indicators of cattle intensification are given by average yields. In 1950 the average weight of a beef carcass was 162.3 kilograms while in 1960 it had increased to 176 kilograms,⁵⁸ or a net increase of 9%. Although part of this increase was due to breeding improvement, it also depended on better forage, and therefore, expansion of areas of natural pasture does not fit with these foregoing indicators.

The Mixed Agriculture Zone, remained virtually unchanged in size but it saw most municipios intensify production of temporary crops (beans, corn, cotton, rice, castor beans, etc.). Within the zone almost all municipios "changed" from a mixed agriculture in 1950 (mean areas of temporary crops, natural and improved pasture 36%, 43%, and 31% respectively) to temporary crops in 1960 (mean area of 37.9%).

The Ranching Zone remained also unchanged in size. However, within the zone two municipios (Santa Maria da Vitoria and Santa Rita de Cassia) "changed" from a mixed agriculture to pasture.

Persistence of pasture expansion, in 1960 suggests that Bahia became an important cattle supplier to other Brazilian regions. Figures on cattle trade are not available but there are indirect indicators. Bahia for instance has become the largest cattle producer of the Northeast.

In 1950 the state accounted for 40% of the regional production while in 1960 it increased to 42%.⁵⁹ In the same decade the value of the state's herd rose from 41% to 46%.⁶⁰ Meanwhile, the number of cattle slaughtered in Bahia increased slightly from 403,000 in 1950 to 425,000 in 1960.⁶¹ This means that the state's demand for beef did not increase much to justify the pasture expansion and herd growth. Actually, Bahia's beef consumption as a percentage of total herd (culling rate) decreased from 9.1% in 1950 to 7.1% in 1960.⁶² Such a relative decrease in consumption suggests that cattle were being shipped live to other states. This argument is supported by the fact that the herd growth, breeding improvement, yield and density increase did not make sense if the state's production were oriented to supply only the domestic market which did not keep pace with the sector improvement.

Another aspect of the agricultural pattern deserving special attention is the agricultural decline within the Recôncavo, earlier the most important region of the state. Such a decline is explained not only by the crisis faced by tobacco and sugar but also due to petroleum exploration in the region. Oil was found in Lobato (Salvador) in 1939 but intensification of exploration occurred in the 1950's, after the creation of PETROBRAS (The Brazilian Petroleum Company). This new activity caused further disintegration of agriculture in the Recôncavo through two basic processes. One was the incorporation of a significant area of agricultural land (sugar cane and pasture) into the oil enterprise.⁶³ The other process was the attraction of a labour force from the tobacco and sugar cane areas.⁶⁴ From 1950 to 1970 PETROBRAS hired approximately 8,300 employees of which 2,018 (24%) migrated from the sugar cane and tobacco areas.⁶⁵ After 1964 the process accelerated

with the emergence of Salvador's industrial centre (Aratu Industrial Centre). These new activities stimulated a further decline of agriculture around Salvador.

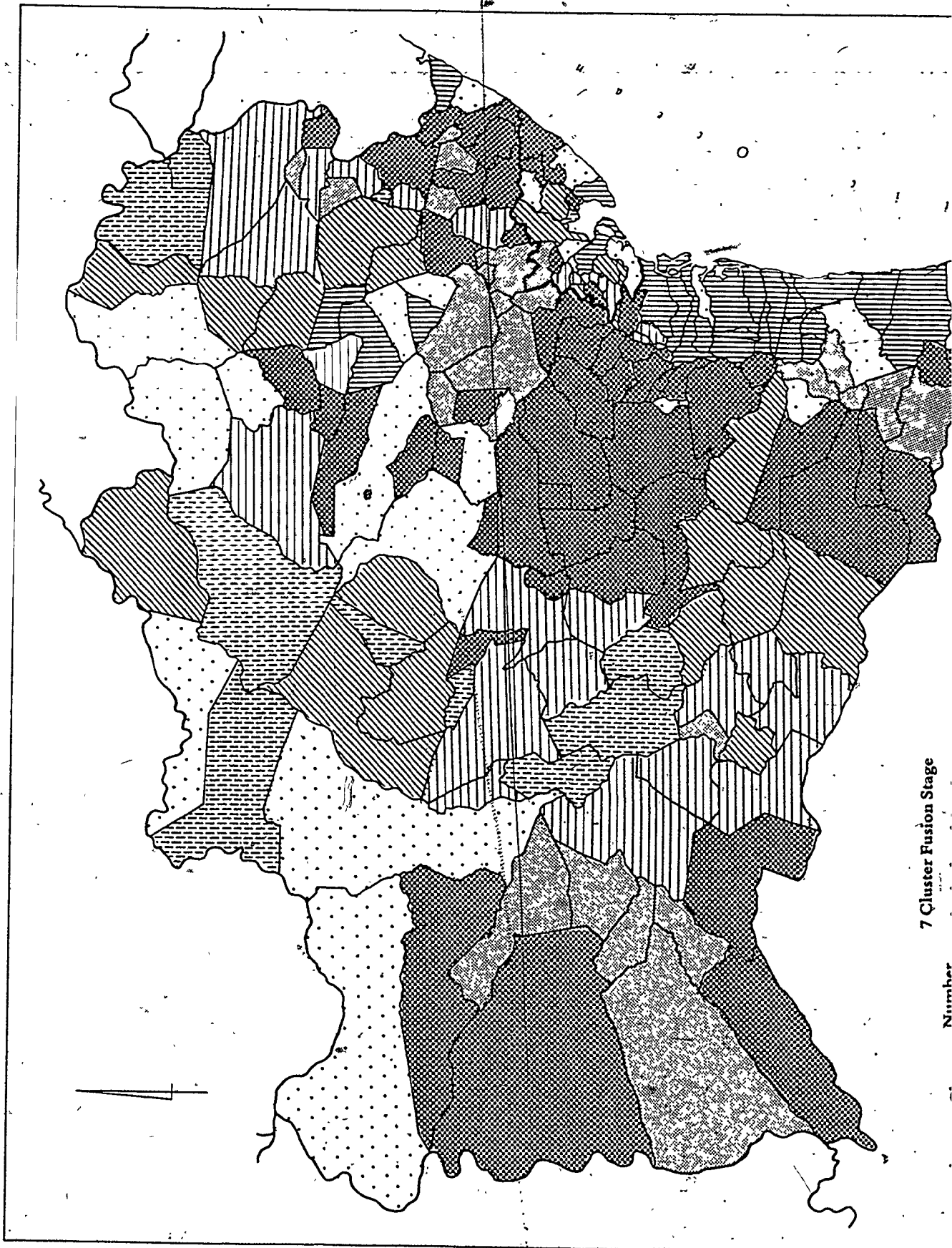
9.6.2.4 Agricultural Land Use Pattern, 1970. The situation of Bahian agriculture did not "change" much between 1960 and 1970. Persistence of pasture expansion continued, reinforced by several factors. First, beef prices experienced a substantial increase after 1962 (see Table 41) stimulating further livestock intensification. Second, the federal government in an attempt to find external markets for beef undertook a policy related to credit and the improvement of the Brazilian herd.⁶⁶ For instance, a law of 1968 created a new agricultural institution which had as its goal the eradication of foot-and-mouth disease.⁶⁷ Third, during the expansion of the meat industry in the Southeast, particularly in Sao Paulo the government encouraged the establishment of new processing plants farther away from the city in the producer areas inland.⁶⁸ These plants now process approximately one-third of beef produced in Brazil. Finally, the improvement of the national road system of paved highways improved all conditions for cattle expansion not only in Bahia but also in a large area of the Southeast (Minas Gerais, Rio de Janeiro, Espirito Santo, and Sao Paulo), Centre-West (Mato Grosso and Goias), and lately Amazonia.⁶⁹

Becker⁷⁰ states that out of a total of 15 million hectares freed by the Brazilian policy of eradicating uneconomic coffee plantations in 1966, 44% were subsequently devoted to pasture. Such a policy applied in Bahia resulted in the almost total replacement of coffee trees by pasture.

Stimulus to cattle expansion had as a consequence not only absolute and relative increases in pasture land (see Table 42) but also a further improvement of the livestock sector. New breeds oriented to increase beef and milk yields were introduced as well as new types of forage.⁷¹ As a result of all the improvements Bahia's herd grew 45% between 1960 and 1970, and yields also increased. For instance, the average weight of a carcass increased in the same period from 176 to 187 kilograms.⁷²

Comparison between agricultural land use in 1960 and 1970 (Figures 38 and 39) indicates that by and large the zoning pattern remained the same, but there were "changes" within the zones, some of which are not seen in Figure 39.

The Crop Zone maintained its previous boundary but exhibited "changes" in its internal pattern. There was a transition in the north in most municípios (Euclides da Cunha, Tucano, Uaua, Monte Santo, Araci, Satiro Dias, and Ribeira do Pombal, etc.) back from temporary crops to mixed agriculture or pasture. Most of these municípios had in 1960 a mean area of 37% in temporary crops (Table 43C, cluster 5) but in 1970 it decreased to 28% and 27% (Table 43D, clusters 1 and 6) while the mean area of natural and improved pasture increased to 55% and 33% respectively. The effect of agave expansion could be seen in municípios growing the perennial crop in the dry area (Cansancao, Queimadas, and Valente). In the centre, the pattern "changed" in a few municípios. Jandaira, Salvador, and Itaparica saw their area in perennial crops expand due to the intensification of coconuts (cluster mean 53%). The municípios traditionally growing tobacco (Sao Felix, Muritiba, Cruz das Almas, etc.) "changed" to a mixed agriculture in which the mean area of improved pasture increased



7 Cluster Fusion Stage

Number

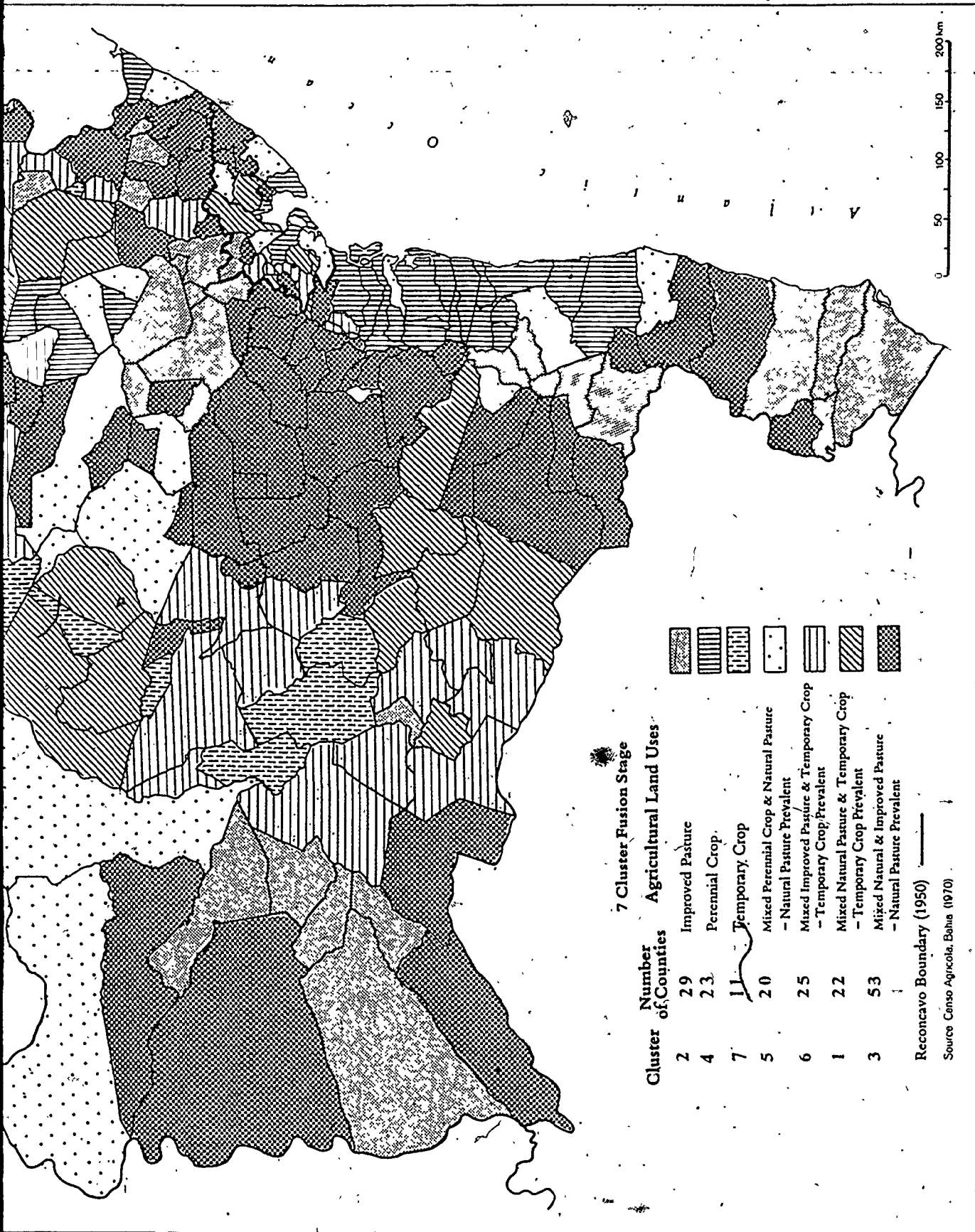


Figure 39 Land Use Pattern in Bahia 1970

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in 1970 to 33% (Table 43D, cluster 6). Southward the spatial effect of the oil palm expansion can be seen in Valença and Taperoá, an earlier manioc production area. Rubber expansion occurred in the municípios of Una, Camamu, Canavieiras, Marau,⁷³ etc., but its spatial effect is not evident because it expanded in the same counties that were growing cocoa. On the other hand, the relative contraction of cocoa area was still observed despite the rise in price after 1967 (see Table 41). Between 1960 and 1970 relative contraction of cocoa accelerated particularly in Ituberá and Belmonte (see Figure 39).

Important changes occurred in the location of areas supplying Salvador with perishable foodstuffs. As was pointed out in Chapter Seven (Section 7.3.1) the supply areas of vegetable and fruits for Salvador had developed since the earlier days of colonization in the bottomlands within the city and its outskirts. This location remained relatively unchanged up to 1950 when these areas converted to other land uses (avenues, residential and leisure areas, etc.) as the city grew.⁷⁴ This urban development resulted in the fragmentation of Salvador's supply areas in those foodstuffs. However, a few scattered units continued operating within the city and a survey carried out by CEASA (Centrais de Abastecimento da Bahia S.A.) in 1973, registered 178 small vegetable gardens within Salvador and its metropolitan area.⁷⁵ They operated at high costs and with obsolete technology so the production was too small to satisfy the city's demand.

Attempts have been made by the state government to establish agricultural colonies in the Recôncavo (Amélia Rodrigues, Camacari, Mata de São João, and Candeias) and Agreste (Feira de Santana, Itirucu, and Jaguaquara) to produce vegetables, fruits, potatoes, dairy and poultry

products.⁷⁶ Despite these attempts the production of these colonies did not meet Salvador's demand. The Agreste's colonies, particularly that one located in Jaguaquara until 1971, faced severe problems related to the lack of minimum prices and storage facilities, the influence of middlemen, credit difficulty, and competition in the production of potatoes and vegetables.⁷⁷ Increasing amounts of vegetables, fruits, and poultry products have been imported from other states, particularly from Sao Paulo. In 1965 just one market in Salvador (Sete Portas) imported a weekly average of 60 metric tons of vegetables (tomatoes, carrots, green peppers, etc.) from Sao Paulo.⁷⁸ By 1973 44% of the vegetables and fruits (carrots, beets, cabbages, cauliflowers, limes, melons, etc.) consumed in Salvador were imported from other states.⁷⁹ With respect to poultry products, by 1967 Salvador also imported 50% of chickens, turkey, etc., and 66% of eggs from the Southeast.⁸⁰ While Salvador imported these foodstuffs from other states, in a radius of approximately 50 kilometers from the city inland the land abandoned by sugar cane remained virtually unoccupied by agriculture until 1970.

The Livestock Breeding Zone remained almost unchanged in 1970 (Figure 39) although the pattern shows a slight trend in a few municipios (Camp Formoso and Picoes) which had formerly been beef producers to "shift" to a diversified agriculture in which the mean area of temporary crops increased to 27% and 28%. Further technological improvements related to breeding and diffusion of new types of forage occurred particularly in the south of this zone. Research carried out in 1972 by this author in the municipio of Itapetinga (southern Agreste) revealed changes in several aspects of livestock sector. For instance, new grasses such as pangola (Digitaria decumbens), napier (Pennisetum purpureum) and Brachiaria were

being rapidly diffused.⁸¹ New breeds of cattle were being introduced to increase the yield of meat (Santa Gertrudis and Red Poll) and milk (Swiss and Holsteins) and different species of buffalo were also introduced. The time to slaughter was shortened to two and a half years and yields of meat increased to an average of 236 kilograms per carcass.⁸² A new method of pasture rotation and artificial insemination were being introduced and adopted by the farmers.⁸³ The latter innovation was introduced by the Carnation Company which established a dairy plant in Itapetinga county. Other plants to pasteurise milk were established. As a result of these innovations plus transportation improvements after 1963 (paved highways), the Itapetinga region became in effect part of Salvador's milkshed shipping milk from 562 kilometers farther away. Despite these improvements, however, milk was still in short supply and expensive in Salvador in 1970.

Beef was fattened to supply not only Salvador but also markets in the Northeast and the Southeast.⁸⁴ This latter orientation is confirmed by Rodell.⁸⁵ Higher capitalization of the sector, transportation facilities, the government policy and proximity to advanced livestock centres in Minas Gerais together had the result of further intensification of the sector in southeastern and southern Bahia. Areas closer to Salvador in its traditional milkshed (central and north Agreste and Recôncavo) and the Foothills of Diamantina Ridge, however, did not adopt the innovations so rapidly.

The Mixed Agriculture Zone "changed" back again from temporary crops to a mixed agriculture in which the mean area of temporary crops in many municípios decreased from 37% in 1960 (Table 43C, cluster 5) to 28% and 27% in 1970 (Table 43D, clusters 1 and 6) while the mean area of

natural and improved pasture increased to 55% and 33% respectively. This caused a slight expansion of the zone both eastward and westward. Despite this relative contraction of cropped area, technological changes also took place in this zone. Mechanization was introduced in the zone by the 1950's, particularly in Irecê (northern Diamantina Ridge). By 1970 447 tractors (24%) out of 1,838 units operating in the state were concentrated in this zone besides 22,042 plows, i.e. 55% of all types existing in Bahia.⁸⁶ Taking into account the general persistence of traditional methods of farming in Bahia, this regional situation may be viewed as a striking improvement.

Irecê county also attracted processing plants for castor beans. This gave rise to the construction of the "beans highway" in the 1950's linking the Irecê region to Salvador and which was paved in the early 1970's (see Figure 35). These improvements did not preclude a shortage of beans in Bahia in the period between 1964 and 1967. The Bank of Northeast recorded a total consumption in the state of 789,690 metric tons in that period while the total production was 601,826 metric tons.⁸⁷ The state presented, therefore, a deficit of 187,864 metric tons which had to be imported from other states and/or from abroad. This shortage reflects the presence of several barriers in Bahia to food production which needed to be removed. The prevalence of minifundium, location of production in the driest areas, lack of technological orientation and basic infrastructure such as good transportation and storage facilities were, among others, the most important problems faced by the food crop growers in the 1970's:

Finally, the Ranching Zone, remained unchanged in terms of land use (Figure 39), although it experienced some technological improvements.

Improved pasture expanded in municípios earlier dominated by natural pasture (Cotegipe and Carinhanha). The earlier orientation toward cattle raising on the open range which started to change in the 1950's, and had seen further evolution in the 1960's, resulted in the area becoming a focus of attraction for large ranching enterprises primarily oriented for fattening beef to supply Bahia and the national market. This change was related to several factors; first, the rise in the beef price in the 1960's. Second, the policy undertaken by the government toward the improvement of the livestock sector. Third, the shift of Brazil's capital to the Centre-West in 1960. The new capital (Brasília) represented an important potential market for western Bahia. Finally, the construction of the highway linking Salvador to Brasília (see Figure 35) brought striking benefits to the zone such as the attraction of new livestock enterprises some of which were owned by entrepreneurs from other states, and led to an increase in the value of land.

With respect to the location of the agricultural land use it is important to emphasize the association of perennial crops with the areas of best rainfall conditions while temporary crops, particularly the food and secondary cash crops were associated with more marginal areas in terms of rainfall. Such a locational discrimination suggests a high concentration of minifundia in the driest areas of Bahia. On the other hand, pasture location seems to be related to latifundia. These relationships will be statistically measured in Section 9.6.4 below.

9.6.3 Impact of Market Conditions on the Dynamics of Agriculture.

From the evidence presented so far it can be inferred that Bahia's agriculture responded to the new marketing system in a number of

different ways.

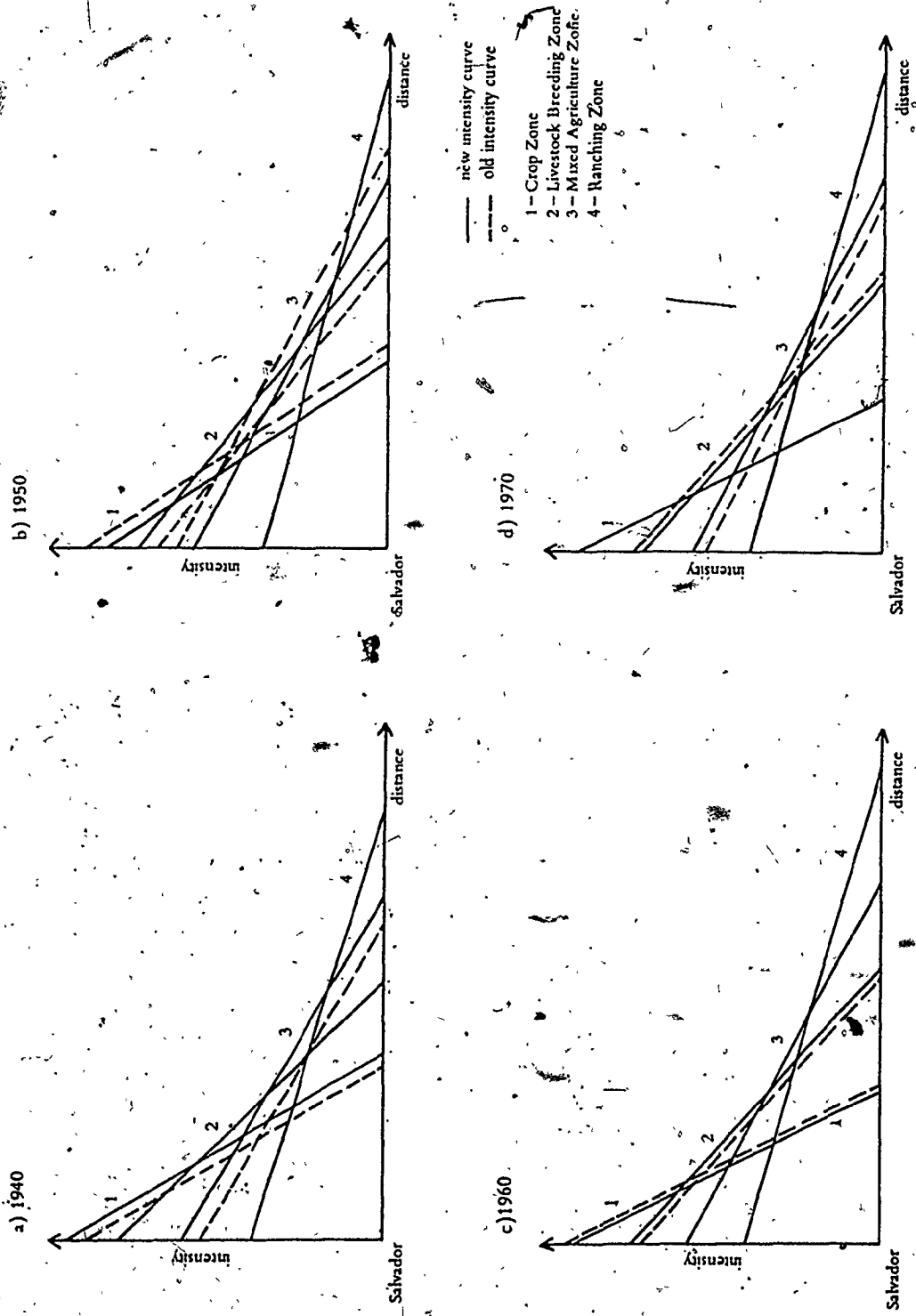
In the first place, agricultural space continued to expand, however, during this process extensive types of agricultural land use tended to prevail. The area in pasture grew rapidly and cattle occupied locations previously given over to the traditional export crops (sugar cane, tobacco, coffee, and cocoa).

In the second place, the agricultural zoning underwent further development. That is, the three zones that had emerged by 1920 (Figure 33c) evolved into four zones (Figures 40a, 40b, 40c, 40d). The Crop Zone continued to be oriented to supply both the external and Salvador markets. The Livestock Breeding Zone became specialized in fattening to supply the regional and national markets, while the Mixed Agriculture Zone had a wider orientation (regional, national, and world markets). Finally, the Ranching Zone earlier oriented to raise cattle to supply the Livestock Breeding Zone also changed its orientation after the 1950's.

In the third place, patterns shifted within the zones over time either through relocation or replacement of the agricultural land uses. Location of agriculture suggests not only changing market orientations but also evolution in respect of the holding system and the influence of rainfall conditions (see Chapter Three, Figure 6 and Table 1).

Finally, a spatial adjustment among zones was observed over the period which resulted in the displacement of their boundaries. For instance, the zones continued expanding between 1920 and 1940 (Figures 33c and 40a). However, between 1940 and 1950 there was contraction of the Crop and Mixed Agriculture Zones while those oriented for fattening and raising cattle expanded (Figure 40b). This contraction is diagrammatically represented by the dashed lines (old curve of intensity). By

Figure 40 Dynamics of Bahia's Agriculture Under the Effect of Change in Demand



1960 the Livestock Breeding Zone expanded slightly (Figure 40c) while in 1970 the same process was observed only in the Mixed Agriculture Zone (Figure 40d).

Despite the breakdown of trade isolation within Brazil, the spatial differentiation of the Bahia's agriculture (under the theoretical standpoint of zoning) still holds some resemblance to "The Isolated State".

Von Thünen⁸⁸ predicted that lower prices determined by a decrease in demand not only led to an overall contraction of the agricultural space but also during the process extensive farming systems tended to prevail. According to von Thünen, the crop rotation system disappeared from "The Isolated State" (Figures 3c and 22b) and inferior (marginal) land would be abandoned. The analysis of the actual situation in Bahia, in the light of this prediction of von Thünen reveals two major points, to be considered. The first point is that the decrease in external demand for Bahia's traditional export crops did not lead to an overall contraction in agricultural space. This deviation between the theory and reality is explained by the fact that Bahia became more integrated with the other states of Brazil, and therefore, had access to the national market for some products, particularly beef. In addition, Bahia's population growth contributed to an increase in internal demand for foodstuffs. If the trade isolation within Brazil had continued to prevail and the population had grown at very low rates or remained stable the agricultural space would have probably undergone contraction or at least remained stationary. The second point is that despite the continued expansion of agricultural space a spatial adjustment of the zones was observed. The Crop and Mixed Agriculture Zones experienced a

relative contraction (Figures 40b and 40c) whereas the livestock zones expanded. Despite the slight expansion of the Mixed Agriculture Zone in 1970 (Figure 40d), pasture (natural and improved) remained as the major agricultural land use in Bahia. The spatial effect of lower prices for the traditional export crops became evident over the period (1950-1970) as well as the internal competition in the production of sugar. Such evidence, therefore, brings theory and reality closer in the sense that the extensive types of agriculture tended to prevail. The sugar cane plantations (the most intensive agriculture) did not disappear, however, from the Recôncavo as the crop rotation system did in "The Isolated State", but the space they occupied contracted and its contribution to state revenue was reduced considerably. The land released from sugar cane production was occupied by pasture or remained in long bush fallow despite the proximity of Salvador. On the other hand the marginal lands (located in the driest areas) continued to be occupied either by cattle or temporary crops. This deviation is probably related to the emergence of a dichotomous holding system (latifundia-minifundia) in Bahia which has had a strong influence on the land use as well as on its market orientation. Cocoa which became the major cash crop of the state also contracted in area. However, the contraction was less marked because not only did cocoa continue to be exported to the external market but also the amount of capital invested in the cocoa plantations was smaller than that invested in the sugar plantations. The same investment analogy also holds true between cocoa plantations and the livestock sector.

The process of expansion and contraction of Bahia's agricultural zones accounts for the disparity between the findings of DeWitt and Silva.

The former author focused on the production of perishable foodstuffs and concluded that the von Thünen model did not fit the reality of Salvador. Evidence shown in this study suggests that DeWitt missed the historical process responsible for agricultural evolution in Bahia. In addition, his study is mainly concerned with the perishable food belt which makes the verification of the von Thünen classical model more difficult particularly at the present day. Silva's findings linked the theoretical model and the reality of Bahia more closely but his zoning in 1975 presents a time lag with respect to Salvador's horticulture and milkshed zones. As was previously pointed out, the supply areas of Salvador for perishable foodstuffs became fragmented and scattered, forcing the city to import large quantities from other states. As to the milkshed, it also expanded farther away from the city and became fragmented. Silva did not identify the zone of Mixed Agriculture. Rather he aggregated it with the Ranching Zone under the heading of traditional livestock.⁸⁹

These differences between Silva's zoning and that identified in this study do not invalidate, however, the von Thünen prediction of distance decay Silva wanted to emphasize. Actually, taking into account Bahia's agricultural zoning (1940-1970) the negative relationship between the intensity of agriculture and distance from Salvador still held true in the very broad sense of the model. That is, the Crop Zone remained as the most intensive in terms of global employment of capital, labour and land. The Livestock Breeding Zone had its location related to the total investment of capital (land, herd, buildings, etc.) in the livestock sector. Beef is one of the major staples in the nutrition of the Brazilians and yet it is the most expensive. The Mixed Agriculture Zone was intensive in terms of labour and use of land while the Ranching Zone

was the most extensive with respect to all factors of production. However, when the location of each agricultural land use in Bahia is measured more accurately (see Section 9.6.4) distance from the market as a major independent variable, does not account anymore for the intensity variation in the state.

Another von Thünen prediction to be examined is that related to the spatial organization of agriculture in a multiple market system.⁹⁰ That is, each product or type of land use has its own geography of supply areas and market centres. This leads to more complex spatial organization of agriculture because some products have a primarily local sale (such as beans, milk, etc.). Others are produced largely for the regional and/or national markets (such as beef) while still others are produced to supply the world market (such as cocoa) so that their price structures are based on the prices determined at few major markets. This market multiplicity contributes to the overall pattern of agricultural land use reveals broad tributary regions of the major markets in which smaller supply areas of lower market magnitude are included. Although such a nucleated pattern may exist in Bahia, the observed agricultural patterns suggested that the longitudinal shape of the zones are more oriented to the largest markets. The urbanization patterns of Bahia are such that only Salvador and Feira de Santana present markets over 100,000 inhabitants and yet they are spatially close. The scale of this study, i.e. at the county rather than the farm level, did not allow for the tributary areas of the many small scattered urban centres to show up within broad agricultural zones. These zones reflect much more the demands of the largest markets (Salvador, national, and external). The most advantageous areas in terms of rainfall and transportation facilities

are associated with beef production and traditional export crops such as cocoa, sugar cane, and tobacco. This can probably explain the location of some intensive types of agriculture (temporary crops, particularly beans, castor beans, and cotton) farther away from Salvador in the drier areas. These observations also seem to match the prediction of von Thünen relating to the market magnitude in which Salvador appears at the Brazilian and world scales as a market of lower magnitude but surrounded by wide agricultural zones which provide the city and other larger centres with staples. Salvador in the largest spatial scale presents, therefore, an homology to the peripheral small nodes scattered in "The Isolated State".

9:6.4 Modified Von Thünen Model of Agricultural Location

The basic argument underlying the von Thünen model under any condition (equilibrium or dynamic) is that "distance" remains as a strategic variable to explain the location of agriculture. However, it is questionable to what extent distance explains the spatial differentiation of agriculture in the further stages of historical evolution of commercial agriculture. Evidence in Bahia shows that different processes over time have substantially altered the agricultural patterns as well as the location of their land use components. Collectively the alterations have given rise to the emergence of a longitudinal zoning which, when analyzed in a theoretical fashion as to the factors of production does suggest that intensity decreases as distance from Salvador increases. However, Bahia's agricultural zones are not concentric nor necessarily as homogeneous as those predicted by von Thünen for "The Isolated State". Comparison between theory and reality suggests that the location of agriculture in Bahia is

not only oriented by economic factors. Rather a probabilistic multiple causation may better explain the spatial variation of agricultural intensity than a deterministic cause-effect relation between intensity and distance. This means that an increase in distance is not sufficient to change the intensity of agriculture because other variables like amount of rainfall and farm size may interfere. In addition, the analysis of intensity over time may also show that the strength of the relationship between two variables, also undergoes changes.

To verify the argument outlined above, data limitations as well as the difficulty in finding a good index of intensity, led this author to simulate intensity (dependent variable) by the same variables used to map the agricultural patterns (1940, 1950, 1960, and 1970). These variables are perennial crops (PPC), temporary crops (PTC), natural pasture (PNP), improved pasture (PIP) and mixed pasture (PMP). With respect to the independent variables distance from Salvador in straight line (DSL), average annual rainfall (AAR), and farm size (FS) were selected. The number of observations (sample) is based on the municipios level (data units) which varies from 150 (1940 and 1950) to 183 (1960 and 1970). The statistical technique selected was multiple regression (stepwise procedure) and the algorithm to execute the computation including the test of the hypothesis was provided by SPSS (see Chapter Four, Section 4.4.4).

The research hypothesis (H_1) holds that there is relationship between the intensity of agriculture (PPC, PTC, PMP, PIP, and PNP) and the set of independent variables (DSL, AAR, and FS). The expected signs of the regression coefficients based on the locational observation of the agricultural land use (Section 9.6.2) are listed in Table 45.

TABLE 45

EXPECTED SIGNS OF REGRESSION COEFFICIENTS
IN THE FIVE REGRESSION EQUATIONS

| NO. OF EQUATIONS | DEPENDENT VARIABLES | INDEPENDENT VARIABLES | | |
|---------------------|----------------------------|-----------------------|-------------------------------|------------------------|
| | | DISTANCE (x_1) | AVERAGE RAINFALL (x_2) | FARM SIZE (x_3) |
| 1 | Perennial Crops (y_0) | - | + | + |
| 2 | Temporary Crops (y_1) | + | - | - |
| 3 | Mixed Pasture (y_2) | + | - | + |
| 4 | Improved Pasture (y_3) | + | - | + |
| 5 | Natural Pasture (y_4) | + | - | + |

To carry out the test of significance for the functional relationships stated above the null hypothesis (H_0) holds that there is no relationship between intensity of agriculture and the set of independent variables. The observed relationship in the sample data is due to the sampling error or chance factors. The test will indicate whether the assumed random samples being analyzed were drawn from a population in which all independent variables have their regression coefficients (b's) equal to zero. This hypothesis will be rejected only if the probability of the b's non zero is equal to or smaller than 5% (level of significance). A summary of the major results for the stepwise regression model is provided in Appendices F1, F2, F3, F4 and F5. In order to facilitate the interpretation of the results each agricultural land use will separately be analyzed over the period instead of for each period at a time.

9.6.4.1 Perennial Crops. For the 1940 data, results show that rainfall alone accounts significantly for 31% of variation and has the expected positive coefficient. Farm size enters the equation with an unexpected negative coefficient over the period and yet it does not significantly improve R^2 . Distance in 1940 does not enter the multiple regression equation but in 1950 due to its moderate correlation with rainfall the direction of relationship is positive (unexpected) and enters the equation after farm size. The pattern is essentially the same in 1950, 1960, and 1970, but the percentage of variation accounted for ("b's") by rainfall decreases slightly to 29% in 1950 and 26% in 1960 before increasing to 30% in 1970. Distance in 1960 and 1970 has the expected negative coefficient but it is not statistically significant. The predictive equation is very stable over the period and rainfall is revealed to be the best independent predictor of perennial crops (Appendix F1).

9.6.4.2 Temporary Crops. Farm size over the period is revealed as the most important independent variable to explain variation in the temporary crops. It also has the expected negative coefficient while R^2 increases substantially from 5% in 1940 to 22% in 1970. Despite these low percentages it is highly significant in all sub-periods. Rainfall also shows the expected negative b while it significantly improves R^2 from 8% in 1940 to 20% in 1950 after farm size is allowed for. Distance, although entering the multiple regression equations in 1950, 1960 and 1970 with the expected positive coefficient does not significantly improve the R^2 after farm size and rainfall. This pattern changes in 1960 and 1970. In the former year distance and rainfall significantly improve R^2 about 16% and 2% after farm size (18%) so that the three independent variables together account for 36% of the total variance of the temporary crops. In the latter year distance significantly improves R^2 in about 10% while rainfall enters in the equation after farm size and distance but is not statistically significant. The best predictor of the dependent variable is, therefore, farm size while rainfall and distance interchange their predictive power through time (see Appendix F2).

9.6.4.3 Mixed Pasture. For the 1940 results, rainfall presents the highest significant correlation with mixed pasture accounting for 9% of variation. It has also the expected negative "b". Farm size is the second most significant predictor for mixed pasture which enters the equation with a positive coefficient. Distance has the expected positive "b" but it does not increase R^2 above 15% after rainfall and farm size enter the multiple regression equation. This pattern changes, however, in 1950, 1960, and 1970 so that farm size presents the highest significant

R^2 over the period (13%, 12%, and 15% respectively). Rainfall is added with high significance at the next step improving R^2 about 5%, 3%, and 9% over the period. Distance is not a significant predictor for mixed pasture in 1950 and 1970 but it is in 1960 after farm size and rainfall enter the equation. Only in 1960 do the three variables operate jointly to explain the variation of mixed pasture while in the other sub-periods, farm size and rainfall are the best predictors (Appendix F3).

9.6.4.4 Improved Pasture. In 1950 three independent variables enter the multiple regression equation in the following order: rain, farm size, and distance. However, none of them presents significance. The directions of the relationships between the independent variables and improved pasture conform with the expectation over the period. In 1960 farm size accounts significantly for the variance of improved pasture ($R^2 = 18\%$). Rain and distance enter in the equation in the second and third steps respectively but none of them improve R^2 . In 1970 farm size continues to be the best significant predictor of improved pasture accounting for 5% of its variation. Rain enters the equation at the second step improving R^2 about 2%. Despite this low contribution rain is statistically significant. Distance does not significantly improve R^2 after farm size and rain (see Appendix F4).

9.6.4.5 Natural Pasture. For the 1950 data, results show that farm size accounts significantly for 4% of variance of natural pasture and has the expected positive coefficient over the period. The regression coefficient of rain conforms also with the negative relationship expected over the period but it does not improve R^2 after farm size. Distance enters the equation after farm size and rain with an unexpected negative

relationship. This deviation appearing over the period is due to the moderate negative correlation between rain and distance. The sequence of independent variables entering the equation changes in 1960 and 1970. In both years rain enters the equation at the first step accounting significantly for the highest variation of natural pasture. After rain distance is the second independent variable to show significance in 1960 while farm size enters in the last step without improving R^2 . In 1970 after rain the order of the independent variable entering the equation is distance and farm size and both are statistically significant (see Appendix F5).

The results of multiple regression are significant with respect to this author's viewpoint that by 1970 distance variable does not account for the spatial variation of agricultural intensity within Bahia. The perennial crops revealed their significant positive relationship with rainfall and their negative relationship with farm size. The latter relation indicates that these crops do not grow in the largest farms as it was expected. With respect to distance although its relationship with the perennial crops did not present significance the negative relation in 1960 and 1970 reinforced their concentration closer to Salvador. The significant negative relationships among the temporary crops and farm size and rainfall confirmed their production on the minifundia and location in the driest areas while their positive relationship with distance also reinforced how far these crops are from Salvador. On the other hand, the significant positive relationship between pasture and farm size indicated that it is the land use matched with the latifundia, and therefore, the most extensive type of agriculture found in Bahia. Considering the types of pasture, the direction of relationships with distance showed that mixed and natural

pasture dominated closer to Salvador (negative relationship) while improved pasture prevailed farther away (positive relationship). These findings seem to be sufficient to confirm that the intensity of agriculture in Bahia in the later periods is primarily explained by physical (rainfall) and tenurial (farm size) variables rather than an economic variable (distance) alone. On the one hand, this fact reinforces the persistence of traditionalism of Bahia's agriculture as well as the peripheral situation of the state. On the other hand, evidence shows that modification of the von Thünen model is necessary, particularly in underdeveloped areas and in a further stage of historical evolution. That is, when the isolation of a spatial system collapses the deviation between reality and theory tends to increase. Under this condition one has to change the scale of investigation from micro to meso or from meso to macro in order to verify von Thünen's predictions. Evidence showed in this study suggests that at the present time the verification of von Thünen's model seems to be more appropriate at the scale of Brazil. In addition, to these observations, the use of multiple regression to measure the relationships between variables over time proved to be a powerful tool to show changes in their effects. For example, there appears to be a continuing decrease in the average size of farms producing temporary crops and conversely a continuing increase in the average size of farms producing beef. Finally, despite the statistical significance of the set of variables selected there still remained a high amount of unexplained variation in the intensity of Bahia's agriculture. This reinforces the necessity for a probabilistic multiple causation approach in geography.

REFERENCES AND FOOTNOTES, CHAPTER 9

1. See VTIS, pp. 217-220.
2. See VTIS, pp. 172-173, 216-217.
3. S: Clough, pp. 431-432.
4. Heaton, p. 698.
5. Ibid., p. 698.
6. Ibid., pp. 699-701.
7. Ibid., p. 701.
8. Caio Prado Junior, Historia Econõmica do Brasil, 7a. ed. (Sao Paulo: Ed. Brasiliense, 1962), p. 295n (hereafter cited as Prado Jr., H.E.B.) and Buescu, E.E.B., p. 160.
9. Werner Baer, Industrialization and Economic Development in Brazil (Homewood: Richard D. Irwin, Inc., 1965), pp. 40-41 (hereafter cited as Baer).
10. Baer, pp. 43-44.
11. See Sampaio & Silva, p. 274, anexo 1.4.
12. Prado Jr., H.E.B., p. 266.
13. Ibid., p. 266 and John P. Dickenson, Brazil, Studies in Industrial Geography (Folkestone: Dawson/Westview, 1978), pp. 3-8 (hereafter cited as Dickenson).
14. Baer, p. 16.
15. Ibid., p. 17 and Buescu, E.E.B., p. 178.
16. Ibid., p. 27.
17. See Baer, pp. 44-77; Dickenson, pp. 12-23; Joel Bergsman and Arthur Candal, "Industrialization: Past Success and Future Problems", in The Economy of Brazil, ed. by Howard S. Ellis, with a Foreward by Lincoln Gordon (Berkeley: University of California Press, 1969), pp. 29-73; Maria da Conceicao Tavares, Da Substituicao de Importacoes

- ao Capitalismo Financeiro, Ensaio sobre Economia Brasileira, 6a. ed. (Rio de Janeiro: Zahar Editores, 1977), pp. 59-124; Don Huddle, "Postwar Brazilian Industrialization: Growth Patterns, Inflation, and Sources of Stagnation" in The Shaping of Modern Brazil, ed. by Eric N. Baklanoff (Baton Rouge: Louisiana State University Press, 1969), pp. 86-108; Celso Furtado, Análise do "Modelo" Brasileiro, 6a. ed. (Rio de Janeiro: Civilização Brasileira, 1978), pp. 7-79 (hereafter cited as Furtado, A.M.B.).
18. Baer, p. 69 and Dickenson, p. 54.
 19. Dickenson, p. 54.
 20. Furtado, A.M.B., p. 8.
 21. See MCA, Polos de Desenvolvimento, pp. 95-105 and B. Becker, pp. 101-111.
 22. Brasil, Fundação Instituto Brasileiro de Geografia e Estatística, Sinopse Preliminar do Censo Demográfico, Brasil 1970 (Rio de Janeiro: DECEN, 1971), pp. 82-83.
 23. G. Frank, p. 190.
 24. Ibid., p. 190.
 25. Ibid., pp. 190-191.
 26. MCA, Polos de Desenvolvimento, p. 99.
 27. See B. Becker, pp. 106-111.
 28. Dickenson, p. 55.
 29. Ibid., p. 56 and Buescu, E.E.B., pp. 186-188, 205.
 30. The National Department of Works Against the Drought (DNOCS) was created in 1945 as well as the San Francisco Hydroelectric Company (CHESF); Bank of the Northeast (BNB) was founded in 1952; the Superintendency for Northeast Development (SUDENE) emerged in 1959 while the Superintendency of Sao Francisco Valley (SUVALE) came later.
 31. B. Becker, pp. 102-103.
 32. Mário Augusto da Silva Santos, "Associação Comercial da Bahia na Primeira República: Um Grupo de Pressão" (Tese de Mestrado, Universidade Federal da Bahia, 1973), p. 39.
 33. Ibid., p. 40.
 34. Furtado, A.M.B., p. 22.

35. See Stefan H. Robock, Brazil's Developing Northeast, a Study of Regional Planning and Foreign Aid (Washington, D.C.: The Brookings Institution, 1963), pp. 106-108; Baer, pp. 174-179; and Armin Ritz, "As Exportacoes Internacionais e Interregionais no Desenvolvimento Economico da Bahia (1950-1969)" (Dissertacao de Doutorado, Instituto de Scienze Sociais da Pontificia Universitas Gregoriana, Roma, 1972), pp. 66-68 (hereafter cited as Ritz).
36. Includes the following states: Espirito Santo, Rio de Janeiro, Minas Gerais, Sao Paulo, Parana, Santa Catarina, and Rio Grande do Sul.
37. Ritz, p. 66.
38. Conselho de Desenvolvimento do Nordeste (CODENO) cited by Baer, p. 176.
39. See T. Lynn Smith, "Demographic Factors Related to Economic Growth in Brazil", in Economic Growth: Brazil, India, Japan, ed. Simon Kuznets, Wilbert E. Moore, and Joseph J. Spengler (Durham, N.C.: Duke University Press, 1955), p. 259.
40. Riserio Leite, "Politica de Fomento da Producao Animal", Bahia Rural 6 (1981): 13.
41. Baer, p. 179.
42. *Ibid.*, p. 179-183 and Ritz, pp. 64-68.
43. See George Wythe, Royce A. Wright, and Harold M. Midkiff, Brazil an Expanding Economy (New York: Greenwood Press, 1968), pp. 195-196.
44. *Ibid.*, p. 196.
45. The major projects focused on the construction of the following highways: Rio de Janeiro-Porto Alegre (including the reconstruction of the Rio de Janeiro-Sao Paulo highway); Rio de Janeiro-Bahia; Rio de Janeiro-Belo Horizonte; Porto Alegre-Uruguaiana (connection between Brazil and Uruguay); and Belo Horizonte-Sao Paulo. *Ibid.*, pp. 206-207.
46. Janet D. Henshall and R.P. Momsen, A Geography of Brazilian Development (London: G. Bell & Sons, Ltd., 1974), pp. 208-213 (hereafter cited as Henshall & Momsen).
47. See SCBM Silva, pp. 84-90.
48. *Ibid.*, pp. 68, 88.
49. See Katzman, IASFS, pp. 25-42.
50. See Aluizio Capdeville Duarte, "Irecê: Uma Area Agricola "Insulada" no Sertão Baiano", Revista Brasileira de Geografia 25 (1963): 465-466 and Rodell, pp. 100-137.

51. Manuel Correia de Andrade, O Planejamento Regional e o Problema Agrário no Brasil (Sao Paulo: HUCITEC, 1976), pp. 97-98 (hereafter cited as MCA, O Planejamento Regional).
52. Brasil, Banco do Nordeste S.A., Cafe: Uma Nova Oportunidade Agricola no Nordeste (Fortaleza: ETENE, 1973), pp. 6-7.
53. Ibid., pp. 7-8.
54. See Brasil, Banco do Nordeste S.A., Sisal (Problemas Economicos) (Fortaleza: ETENE, 1957), p. 38 (hereafter cited as BNB, sisal) and Maria Novais Pinto, "Contribuicao ao Estudo da Influência da Lavoura Especulativa do Sisal no Estado da Bahia", Revista Brasileira de Geografia 31 (1969): 37 (hereafter cited as Novais Pinto).
55. The following municípios were included: Sao Goncalo do Campos, Feira de Santana, Irara, Inhambupe, Esplanada, Acajutiba, Conde, Entre Rios, Alagoinhas, Santo Amaro, Coracao de Maria, Catu, Pojuca, Mata de Sao Joao, Sao Sebastiao, Camacari, and Salvador. Aristeu Barreto de Almeida, O Problema do Abastecimento de Leite em Salvador (Salvador: CPE, 1958), Appendix, Table 11.
56. See Sylvio Carlos Bandeira de Mello e Silva, "L'Organisation Regionale du Reconavo Sud, Bahia" (These de Doctorat de Troisieme Cycle, Universite de Toulouse, 1969), pp. 135-142 (hereafter cited as SCBM Silva, L'Organisation Regionale) and Milton Santos, "Ituberá, Porto Cacaueiro Rejuvenescido pela Industria" in Anais da Associacao dos Geografos Brasileiros 10 (1955-1957): 129-131.
57. Brasil, Banco do Nordeste S.A., Manual de Estatisticas Basicas do Nordeste (Fortaleza: ETENE, 1977), p. 189 (hereafter cited as BNB, Manual de Estatisticas).
58. Ibid., p. 196.
59. Ibid., p. 189.
60. Ibid., p. 191.
61. Ibid., p. 192.
62. Ibid., p. 194.
63. Pinto de Aguiar, "A Petrobras e o Abastecimento de Salvador" in Ensaio de Historia e Economia (Salvador: Livraria Progresso, 1960), pp. 132-139.
64. Sônia de Oliveira Leao, "Atividade Comercial nas Pequenas "Cidades" Petrolíferas do Recôncavo Baiano" (Tese de Mestrado, Universidade Federal da Bahia, 1971), p. 41.

65. Maria Auxiliadora da Silva, "Les Migrations pour le "Reconcavo" du Petrole (Etat de Bahia, Bresil)" (These de Doctorat de 3e Cycle, Universite Louis Pasteur, Strasbourg, 1972), pp. 44, 45-46.
66. See Bertha K. Becker, "Changing Land Use Patterns in Brazil" in 21st International Geographical Congress, India 1968 (Calcutta: National Committee for Geography, 1970), p. 17 (hereafter cited as Becker, Changing Land Use) and Sônia de Oliveira Leao, "A Evolução da Pecuária na Bahia: O Exemplo de Itapetinga" (Tese de Professor Assistente, Universidade Federal da Bahia, 1973), p. 143 (hereafter cited as Leao).
67. Leao, p. 133.
68. Becker, Changing Land Use, pp. 24-25.
69. Ibid., pp. 14-15.
70. Ibid., p. 16.
71. Ibid., pp. 19-20 and Leao, pp. 118, 127.
72. BNB, Manual de Estatísticas, pp. 189, 196.
73. SCBM Silva, L'Organisation Régionale, p. 162.
74. See Milton Santos, "A Baixa dos Sapateiros", Revista do Instituto Geografico e Historico da Bahia 81 (1957): 71-72; Jose Augusto Guimaraes, "O Abastecimento de Generos Alimenticios em Salvador" (Tese de Livre Docencia, Faculdade Ciências Econômicas da Universidade Federal da Bahia, 1960), pp. 46-58; and Nilda Guerra Macedo and Antônia Dea Erdens, "A Vida Rural Dentro da Cidade do Salvador", Boletim Baiano de Geografia 10 (1970): 67-77.
75. Bahia, Centrais de Abastecimento S.A., "Hortas: Diagnostico e Cadastro" (Salvador: 1973), pp. 13-14 (Mimeographed).
76. See Jorge Calmon, "Imigracao e Colonizacao no Recôncavo" (Salvador, 1969), pp. 6-9 (Mimeographed); Regina Celeste de Almeida Souza, "A Fragilidade da Agricultura Alimentar no Recôncavo: O Exemplo de Canóias" (Dissertacao de Mestrado, Universidade Federal da Bahia, 1971), pp. 81-86; and Neyde Maria Santos Goncalves, "A Organizacao do Espaço Agrario no Municipio de Jaguaquara (Dissertação de Mestrado, Universidade Federal da Bahia, 1971), pp. 33-62 (hereafter cited as Goncalves).
77. Goncalves, pp. 62-86.
78. Brasil, Banco do Nordeste S.A., Suprimento de Genêros Alimenticios da Cidade do Salvador (Fortaleza: ETENE/DAA, 1965), p. 92.

79. Sistema Nacional de Centrais de Abastecimento, Relatório Anual, 1973, CEASA-Ba (Salvador, 1974), pp. 28-36.
80. Brasil, Banco do Nordeste S.A., Mercado Consumidor de Aves e Ovos em Salvador (Fortaleza: ETENE, 1968), pp. 20-21.
81. Leao, p. 118.
82. Ibid., p. 125.
83. Ibid., pp. 160-163, 170-171.
84. Ibid., p. 164 and Appendix 24.
85. Rodell, p. 102.
86. Brasil, Fundação Instituto Brasileiro de Geografia e Estatística, Censo Agropecuária Bahia, 1970 (Rio de Janeiro: DECEN), pp. 251-256.
87. Brasil, Banco do Nordeste do Brasil, S.A., Aspectos Econômicos da Cultura do Feijão no Nordeste (Fortaleza: ETENE, 1969), p. 68.
88. VTIS, pp. 217-389.
89. SCBM Silva, pp. 36, 38-39.
90. VTIS, pp. 172-173, 216-217.

CHAPTER 10

CONCLUSIONS

The broad underlying premise of this dissertation is that the present spatial organization of agriculture, particularly in developing areas, cannot be thoroughly explained without investigating past conditions. The dissertation has sought to verify this in the case of Bahia where, since the beginnings of colonization, agriculture has been the major activity, the source of state revenue and to a large extent market oriented. Explanation was sought in terms of an appropriate model framework for the location of agricultural activity. In this respect, the comprehensive model of J.H. von Thünen was chosen because it seemed to this author that from its market-oriented yet distinct local nature Bahia reflected the classic elements of von Thünen's "Isolated State". Examination of and use of the von Thünen model was held to be most appropriate because not only does it contain assumptions and predictions relating to agricultural location under both steady and dynamic conditions, but also because an increasing number of scholars have adopted a skeptical position vis a vis the validity of the model to explain the present location of agriculture.

The particular relevance of an attempt to verify von Thünen's model involves reference to the works of DeWitt and Silva who have both

carried out research with respect to Bahia (see Chapter Two, Section 2.2.2). However, other work by Grotewold (1959) and Clark (1967), and Sinclair (1967) (Chapter Two, Section 2.3) also make generalizations which deserve particular attention. Grotewold and Clark both analyzed von Thünen's classical model of agricultural location and suggested that improvements in transportation (lowered costs) had been one of the basic factors disrupting the Thünian landscape; including that found in northern Germany prior to the transportation revolution. Sinclair considered that the von Thünen model was outdated with respect to the explanation of agricultural land use patterns in developed countries, while the "basic forces" identified by von Thünen remained important in the less developed parts of the world (Chapter Two, Section 2.3). In other words, Sinclair's viewpoint is that the von Thünen model can be verified at the present-day only in developing areas. To what extent do these viewpoints match the findings of this dissertation? The aim of this chapter is to consolidate the findings in the light of the selected predictions of von Thünen and see to what extent they agree with the criticisms of the model.

Comparison between Bahia and von Thünen's "Isolated State" through time and space revealed interesting relationships between actual conditions and von Thünen's predictions. Von Thünen formulated his "Isolated State" under the influence of several factors, among which the trade embargo enacted by England (1815-1846) exerted the strongest influence. This viewpoint is supported not only by the title of von Thünen's book, but above all by the method of investigation he used in "The Isolated State". For instance, von Thünen relaxed the assumptions relating to the single market, the high costs of transportation, the price of grain, soil fertility and taxation, and even suggested research into climatic conditions and farm

size, but did not relax the assumption of trade isolation at all. This last assumption, associated with high transportation cost, therefore, emerges as the key factor accounting for the strongest relationship between intensity of agriculture and distance from a market. The corollary of this is that the breakdown of trade isolation and transportation development together, would considerably alter the spatial organization of agriculture, no matter whether the area under consideration is developed or underdeveloped. This conclusion is supported by the historical evidence from the stages of agricultural development in Bahia. For the purpose of final conclusions related to the comparison between the von Thünen model and Bahia's reality, the four earlier stages may be aggregated into just two; namely, the periods before and after ca. 1930. This distinction is between the period during which economic isolation was a dominant condition and the recent period in which it can be shown to have broken down, with the predicted results in terms of von Thünen's model.

10.1 Bahia's "Isolated State" (1549-1930)

Commercial agriculture originated in Bahia in the second half of the sixteenth century under conditions very close to those predicted by von Thünen for "The Isolated State". There was a relative physical uniformity to Bahia's coastal area; large estates were granted to aristocratic colonists; sugar prices were relatively steady in the European market; there was a single mode of transportation which was cheap in terms of coastal shipping but very costly in terms of transoceanic freight; and Salvador was founded and functioned as the major local market. Bahia was not totally isolated in the strict sense because it maintained trade relationships with Portugal, however, within the Portuguese Kingdom Bahia occupied a peripheral location which, due to the long absolute and relative

distance from the metropolis caused it to function as an "Isolated State" within Brazil. The fact that Bahian agriculture had to supply commodities to the two separate markets of Salvador and Portugal contributed to the development of an agricultural landscape which from an economic standpoint was similar to that elaborated by von Thünen for "The Isolated State". Von Thünen's ideas were actually formalised with reference to the transitional period in Europe in the early nineteenth century between mercantilism and industrial capitalism. This explains why von Thünen's predictions better fit a less advanced stage of technology and economic development. For instance, the spatial organization of the world under mercantilist rules was dominated by "small isolated states" (the colonies) enclosed in "large isolated states" (the Portuguese, Spanish, English, French, etc., colonial empires). Agricultural development of Bahia is a good example within this spatial system and one which remained locally unchanged until 1930.

From the beginning of the Portuguese agricultural enterprise in Bahia in 1549 to 1822 two agricultural zones centered on Salvador emerged and gradually expanded into the interior (Chapter Five, Figure 11 and Chapter Seven, Figures 20 and 21). The inner Crop Zone was characterized by several different types of agriculture, each of which exhibited a market locational relationship. Salvador developed its own tributary area of perishable foodstuffs close to the city, while the colonial plantations occupied the immediately adjacent area close to the entrepôt (Salvador) and thus to the metropolitan market. This agricultural system was the most intensive in terms of capital and labour, and its locational position in Bahia was similar to that of the crop rotation system in "The Isolated State". Just beyond the colonial plantations came tobacco, the second most

intensive agricultural system of Bahia in terms of its use of land, labour and capital, while cotton, the starchy food crops (manioc, beans, rice and corn) and later coffee occupied relatively less advantageous locations compared to the plantations and tobacco areas.

The second outer zone that evolved was that of Ranching and Subsistence Agriculture, in which cattle were raised to supply beef, draught animals and hides to the local market (Salvador and the plantations) and in which foodstuffs were grown and consumed locally. Only later were hides also exported to Portugal. The zoning did not develop randomly; rather it was closely associated with the technological and economic conditions of transportation prior to the industrial revolution. Despite the paucity of statistical measures, there is strong evidence that the Bahian agricultural landscape during the colonial period was very close to that theoretically developed by von Thünen (see Figures 3a and 21). There existed differences, for instance with respect to the geometrical shape of the zones, however, when the horse transportation assumption is relaxed and comparison is made between Bahia and "The Isolated State" crossed by a navigable river (Figure 3b), the homology between the reality and the model is evident. Von Thünen's prediction that intensity of agriculture is inversely related to distance (absolute and relative) from a market is, therefore, empirically observed in Bahia during the colonial period (Figures 12 and 23). It is also confirmed that in this zoned arrangement, Salvador, as a smaller peripheral market than Lisbon, developed its tributary area of agricultural products which with the exception of hides were rarely sent to Portugal (i.e. manioc flour and cotton). There was, however, a difference between Bahia and the "Isolated State" with respect to the location of the staple food crop zone. In Bahia food crops, except

those which were perishable, occupied a marginal location compared with the industrial cash crops (sugar cane and tobacco) while in "The Isolated State" cereal production had a locational priority. Both situations are explained by the economic dependence of each state on the external market. Germany, prior to the repeal of the Corn Laws, was a tributary area of England particularly in food production, so that grain was the key crop in both the local and export market, while Bahia was a tributary area of Portugal for tropical commodities notably sugar, tobacco and coffee, whereas, its foodstuff production was totally domestic.

As for the von Thünen predictions that lower prices for major agricultural products cause both a contraction of agricultural area and a disappearance of the most intensive crop rotation system from "The Isolated State", it does not necessarily hold true in reality. West Indies competition might have affected the expansion of the colonial sugar plantations in Bahia, according to the above prediction (Chapter Six, Section 6.3). This deviation between "The Isolated State" under the effect of lower grain prices and Bahia under lower sugar prices again results from the type of agricultural product with which von Thünen worked i.e. grain (staple and export crop). In addition, he considered that lower prices are determined only by lower demand. He did not consider, for instance, that lower prices can be caused by excessive production and that when prices are lowered effective demand will be stimulated, as happened in the case of sugar in the eighteenth century. Theoretically, all things being equal, in such circumstance the producers can make different types of decisions according to the type of agricultural output. They can replace one product with another when the cost of replacement is not so high as grain, or they can reduce the variable costs through a move

to extensive production (von Thünen's solution for grain). This solution for "The Isolated State" in which land was a costly input would, if applied, drive many entrepreneurs to bankruptcy and/or to outmigration, particularly those in the peripheral locations. Such a consequence was not, however, discussed by von Thünen especially as it related to wage workers. Another solution of reducing variable costs is through vertical integration of enterprises producing inputs to supply an agro-industry such as a sugar plantation. Faced with a real life situation and less flexibility to alter the crops produced, the Bahian entrepreneurs were able to make adjustment in the latter (vertical integration) context and at a stage of economic development in which a slave labour force could be bartered for an agricultural product (tobacco for instance), and land to grow sugar cane and to raise cattle was plentiful (see Chapter Six, Section 6.5). This unexpected possibility gave rise to the deviation between "The Isolated State" under the effect of lower grain price and Bahia under the effect of the West Indies competition during the colonial period. However, a prediction of lower prices causing a contraction came to be partially true in other circumstances as, for example, those faced by Bahia after the Great Depression (Section 10.2).

From 1823 to 1930 the effects of the industrial revolution and the breakdown of the world mercantilistic spatial system brought political, economic and technological benefits to Bahia but without disrupting its isolation within Brazil. The improvement of transportation and the increase of the overall external demand gave rise to a rapid areal expansion of agriculture but with the main focus still on Salvador and the Mata zone. Comparison between Bahia and "The Isolated State" reveals that two of von Thünen's predictions were empirically observable in Bahia during this.

period. One was that under the condition of transportation improvement, agriculture would expand selectively (Figure 34). The other was that the overall agricultural area also would expand under the effect of increasing demand for agricultural commodities. On account of both transportation improvements and higher demand, the earlier zoning around Salvador expanded to give three broad zones by 1920 (Figure 32).

The Crop Zone expanded irregularly from Salvador southward and inland basically following the railways. The earlier Ranching and Subsistence Agriculture Zone evolved into a zone of Mixed Agriculture in which agriculture experienced substantial improvement through the evolution of the open range system and the expansion of secondary cash crops and food crops for sale. On the other hand, the previous Ranching and Subsistence Agriculture Zone advanced westward beyond the Sao Francisco River, forming a third zone (Ranching and Semi-Subsistence Agriculture). The expansion of cropping was based on a combination of transportation improvements and climatic conditions, nevertheless, the spatial differentiation of agriculture could still be largely explained by the principle of distance decay. That is, the most intensive types of agriculture (such as the sugar plantations, tobacco, cocoa and coffee) expanded closer to Salvador and/or where the transportation facilities were the best (Figure 32).

The expansion of the agricultural frontier to continental interiors during the late nineteenth century has been confirmed by other empirical observations carried out by Schlebecker (1960) and Peet (1969) who have both identified this in terms of the creation of a Thünian landscape. The transportation improvements which occurred during the nineteenth century did not disrupt the von Thünen landscape in the New World.

Von Thünen foresaw the transportation development mentioned by Grotewold and Clark. What he did not foresee was the development of a complex transportation network (planar and non-planar) linking multiple markets within a country and among countries, nor the striking improvement of industrial and agricultural technology which took place in the late nineteenth century in Western Europe and eastern North America but not until after World War II in former colonial areas like Brazil. This evolution substantially affected the spatial organization of agriculture, including some relatively underdeveloped areas. Thus, most of von Thünen's predictions were empirically observed in Bahia before 1930, but since then a major re-orientation has begun to alter both the agricultural patterns and relationships.

10.2 Bahia's Transformation to a Peripheral Location Within a Wider "Isolated State" (1931-1970)

After 1930 the economic system of the world underwent striking changes which drastically affected the Brazilian economy. External and internal processes gave rise to a belated integration of the Brazilian spatial system which resulted in the breakdown of Bahia's isolation within the country.

Comparison between Bahia and "The Isolated State" in this last period of agricultural evolution becomes increasingly complex. Explanation of agricultural patterns requires the integration of both internal (Bahian) and external (Brazilian and beyond) conditions as agriculture underwent a spatial adjustment in response to forces acting both outside and inside Brazil. The lower global demand for tropical products in the 1930's on the one hand, and the higher domestic demand for foodstuffs on the other hand, altered the agricultural zoning around Salvador. Between 1940 and

1970 the Crop Zone experienced a relative contraction on account of the decline of the capitalistic plantations (sugar and cocoa) and tobacco, while coffee was almost replaced by cattle pasture. Although the cocoa plantations resisted the economic crisis somewhat, the area in cocoa experienced a relative contraction. Pasture lands expanded even within this zone causing a substantial change, particularly around Salvador (Figures 37, 38 and 39). The previous Mixed Agriculture Zone, identified in 1920 as a second zone, also contracted and shifted westward forming a third zone, while between it and the Crop Zone there emerged a Livestock Breeding Zone (second zone). In the far west the Ranching Zone remained but now forming the fourth outermost zone. These changes not only altered the zoning arrangement, but also reinforced the increasing importance of cattle in Bahia's economy. The underlying processes at work have two implications in terms of von Thünen's predictions and the spatial organization of Bahia compared with "The Isolated State".

Von Thünen predicted that a lower demand for a major staple would cause a contraction of the agricultural area as well as the increased dominance of extensive types of agriculture. This prediction was not verified during the eighteenth century, however, between 1940 and 1970 it was partially observed in Bahia. "The Isolated State", under the effect of lower prices for grain, experienced an overall contraction of agricultural area (Figures 3c and 22b). This, of course, could not be verified in Bahia because it was not an "isolated state" anymore. However, the loss of external and internal market for sugar as well as the attendant fall in prices for cocoa, tobacco, etc., (Table 41) resulted in the contraction of cropped area (Table 42). This partial observation, along with an increase in the dominance of pasture lands, gave rise to the formation of two separate livestock zones.

When one observes the spatial organization of "The Isolated State" under the effect of lower demand, the order of the rings does not change at all (Figure 3c). This means that despite the disappearance of the crop rotation system, the production of grain (improved and three-field systems) remains as occupying more advantageous locations than stock farming. One reason for this is that in von Thünen's representation of changes in his system he always represents changes in the distance to which economic rent will support production (margin of production) in such a way that crops always earn a higher economic rent than livestock, causing the latter not to appear explicitly in the system. Therefore, crops in "The Isolated State" always had a locational priority over cattle. In Bahia before 1930, particularly during the colonial period, crops had locational priority over livestock. However, after 1940 livestock began to replace crops in the inner zone while the secondary cash crops and food crops for sale have occupied a less advantageous location than cattle. Why does this locational deviation occur between the von Thünen model and Bahia's reality? First, von Thünen used a type of bivariate analysis in which the relative distance remained as the independent variable as the assumptions were relaxed. For instance, when he analyzed the relationship between prices and land rent, the other assumptions (horse transportation, single market, isolation, etc.,) remained unchanged. This method is logical in theoretical terms and works when assumptions are met in the real world as they are in a less advanced stage of technological and economic development. However, at the present day, a bivariate analysis in agriculture even though in underdeveloped areas, does not seem proper because strategic assumptions of the model are not met anymore. Second, in "The Isolated State", cattle do not have

the economic and nutritional importance they do in Brazil as a basic staple, especially in Bahia. Farming methods in "The Isolated State" are more advanced than in Bahia. In the former, cattle could be fattened in the inner rings through more intensive methods because land was a valuable input while in Bahia farming methods were more traditional and land plentiful. Further, Bahia in this later stage of development experienced several changes, such as the breakdown of its traditional holding system and isolation, as well as further improvements involving several different modes of transportation. On account of the latter changes Bahia became integrated within the Brazilian "Isolated State" but as a peripheral area. Such a peripheral condition favoured some technological improvement of the livestock sector from which Bahia became an important cattle supplier of the national market, especially of the Northeast. Investment of capital in the livestock sector led cattle to occupy an advantageous location relative to the markets, while the temporary crops (secondary cash crops and food crops for sale) though more intensive in the employment of labour and the use of land, were relegated to locations further away from Salvador.

The changes which took place at a Brazilian scale, relocating the country's economic core to the Southeast, were reinforced by the rapid and recent industrialization of that region. Despite the increasingly peripheral condition of Salvador, it continued growing while some of its relationships with the external market remained unchanged. That is, it continued exporting cocoa, tobacco and agave. Integration of Bahia to several markets resulted in a zoning which suggests adjustment to both the orientation of the markets and their magnitude. This confirmed von Thünen's prediction that under the influence of several markets, agriculture tends to be located according to the market size.

Finally, the fact that von Thünen relaxed several assumptions to investigate the consistent negative relationship between land rent (or intensity of agriculture) and distance (absolute and relative) from a market led him to emphasize the power of the latter variable to explain the spatial variation of land use. However, as was pointed out, von Thünen did not relax his assumption of trade isolation. In the viewpoint of this author, trade isolation and high costs of transportation are the most important assumptions accounting for the high explanatory power of the distance variable. These assumptions are difficult to meet in the real world at later stages of economic and technological development. That is why the verification of a Thünian landscape at the present-day has become more and more difficult even in underdeveloped areas. This viewpoint is based on the results of the statistical test performed for Bahia (1940-1970) in which distance did not emerge as the most important predictor of agricultural intensity. This finding agrees with the findings of Grotewold and Clark but is in complete disagreement with those of Sinclair. However, the evidence presented for Bahia does not enable this author to generalize conclusions beyond the study area. For instance, studies carried out by Geiger, et al. (1974), Katzman (1975) and Mesquita (1978) for Sao Paulo showed that the von Thünen classical model was verified there (see Chapter Two, Sections 2.3.1 and 2.3.2). There is a possibility, therefore, that at the present-day, the model can be verified at the Brazilian scale by taking into account the cities of Sao Paulo and Rio de Janeiro which function as the macro/national markets.

Bahia's agricultural patterns by 1970 differed substantially from those observed during the colonial period and from those of the beginning of this century. These differences resulted from the response of agri-

culture to the processes operating at the global, Brazilian and Bahian scales over time. However, time lags over space and between processes help to explain the coexistence of types of agriculture of different ages in the Bahian landscape. This justifies the necessity of recalling past conditions to explain the present spatial organization of agriculture, particularly in the underdeveloped areas. The use of the von Thünen model as the theoretical framework for the explanation of agricultural location seems to be more suitable at the earlier stages of economic development. Whether it can be usefully applied at an advanced stage of economic development depends, on whether the model can be modified to encompass larger and more complex agricultural systems.

EPILOGUE

To the knowledge of this author, no other study on the evolution of agricultural land use patterns has been carried out so far either in Bahia or in Brazil. This means that this is a pioneer study and as such the viewpoints and interpretations presented in this dissertation need to be reinforced and complemented by other studies.

For instance, it was argued in Chapter Six that the colonial plantations faced the West Indies competition through vertical integration between sugar plantations, cattle and tobacco. To add more evidence on this subject more investigation needs to be done on the relationship between these types of agriculture, mainly related to land ownership and the slave trade.

Another aspect deserving more clarification concerns the food crops growing in the Mata zone during the colonial period. They were considered in this dissertation as market oriented. More evidence on prices,

food crop growers, commercialization, etc., may change the established classification for colonial agriculture.

A decennial expansion-contraction of temporary crops between 1940 and 1970 was observed. To what extent is this process related only to market prices? Investigations on farming methods, particularly land rotation (temporary crops versus pasture) and fragmentation of operating units may add more explanation to observed phenomena.

Emphasis put on the agricultural land use precluded this author from investigating role of agricultural institutions on the modernization of Bahian agriculture. It seems that the types of agriculture oriented to internal markets (such as ranching and the production of food crops) have showed more propensity to adopt innovations related to farming methods than those types ruled by agricultural institutions and yet traditionally oriented toward external markets (sugar plantations, tobacco and cocoa). This observation deserves more investigation as well as explanation.

Decline of Bahia's sugar plantations after 1940 does not seem related only to competition from the Southeast. Investigation might show that locational problems associated with high costs of production must have precluded modernization and given rise to inefficiencies in sugar production.

Finally, Bahia's agricultural zoning from 1940 to 1970 showed an orientation indicative that an empirical verification of the von Thünen classical model may be possible at the scale of Brazil and for the same period. Further investigation using this theoretical framework and then use of other models would throw more light on the interpretation of Brazilian and Bahian agriculture through time and space.

BIBLIOGRAPHY

- Abreu, J. Capistrano. Caminhos Antigos e Povoamento do Brasil. Rio de Janeiro: Sociedade Capistrano de Abreu, 1930.
- _____. Capitulos de Historia Colonial (1500-1800). 3a. ed. Rio de Janeiro: Sociedade Capistrano de Abreu, 1934.
- Aereboe, F. Beitrag zur Wirtschaftslehre des Landbaus. Berlin: n.p., 1905.
- Ackerman, Edward A. "Geography as a Fundamental Research Discipline". Research Paper 53. Chicago: Department of Geography, 1958.
- Ackoff, Russel L.; Gupta, Shiv K.; and Minas, Sayer. Scientific Method: Optimizing Applied Research Decisions. New York: John Wiley & Sons, Inc., 1962.
- Aguiar, Durval Vieira de. Descrições da Provincia da Bahia: Com Declaraçao de Todas as Distâncias Intermediarias das Cidades, Villas e Povoados. Bahia: Typographia do Diario da Bahia, 1888.
- Aguiar, Pinto de. A Abertura dos Portos: Cairu e os Ingleses. Salvador: Livraria Progresso, 1960.
- _____. "A Petrobras e o Abastecimento da Regiao de Salvador". In Ensaio de Historia e Economia, pp. 133-139. Salvador: Livraria Progresso, 1960.
- Almeida, Aristeu Barreto de. "A Economia Bovina na Bahia". Salvador: CPE, 1957. (Mimeographed).
- _____. O Problema do Abastecimento de Leite em Salvador. Salvador: CPE, 1958.
- _____. "Descapitalizacão da Pecuaria". Salvador: FIEBA/CODITA, 1969. (Mimeographed).
- Almeida, Miguel Calmon du Pin e. Memoria sobre a Cultura do Tabaco. Salvador: Typographia do Diario, 1835.

Almeida, Rômulo. Tracos da História Econômica da Bahia no Último Século e Meio. Salvador: Instituto de Economia e Finanças da Bahia, 1951.

Alonso, William. Location and Land Use: Toward a General Theory of Land Rent. Cambridge, Mass.: Harvard University Press, 1964.

Amadeo, Douglas and Gollidge, Reginald G. An Introduction to Scientific Reasoning in Geography. New York: John Wiley & Sons, Inc., 1975.

Amaral, Braz do. "Colonização na Bahia". Revista do Instituto Geográfico e Histórico da Bahia 43 (1918): 93-98.

_____. História da Bahia do Império a República. Bahia, 1923.

Amaral, Luis. História Geral da Agricultura Brasileira. 3 vols. São Paulo: Ed. Nacional, 1939-1940.

Anais do Arquivo Público da Bahia. "Algodão". Vol. XIV, pp. 199-203. Bahia: Imprensa Oficial, 1931.

_____. "Do Discurso Preliminar, Histórico e Introductivo com Natureza de Descrição Econômica da Comarca da Bahia". Vol. XIX, pp. 153-154. Bahia: Imprensa Oficial, 1931.

_____. "Fumo". Vol. XIV, pp. 176-193. Bahia: Imprensa Oficial, 1931.

_____. "Senhores de Engenho". Vol. XIV, pp. 154-157. Bahia: Imprensa Oficial, 1931.

Anderberg, Michael R. Cluster Analysis for Applications. New York: Academic Press, 1973.

Andrade, Manuel Correia de. "Padrões da Agricultura Nordestina". In Recursos e Necessidades do Nordeste, pp. 313-342. Recife: ETENE, 1964.

_____. "Produção Animal e Derivados". In Recursos e Necessidades do Nordeste, pp. 343-367. Recife: ETENE, 1964.

_____. Nordeste: Polos de Desenvolvimento. 2a. ed. São Paulo: Ed. Brasiliense, 1970.

_____. A Terra e o Homem no Nordeste. 3a. ed. revista. São Paulo: Ed. Brasiliense, 1973.

_____. O Planejamento Regional e o Problema Agrário no Brasil. São Paulo: HUCITEC, 1976.

Andreoni, Joao Antonio Andre Joao Antonil. Cultura e Opulência do Brasil (Texto da edição de 1711). Introdução e Vocabulário por A.P. Canabrava. 2a. ed. São Paulo: Ed Nacional, 1966.

- Araujo, Ubiratan Castro and Barreto, Vanda Sampaio de Sa. "A Bahia Econômica e Social". In A Insercao da Bahia na Evolucao Nacional, 1a. Etapa: 1850-1889. Vol. 1: A Bahia no Seculo XIX. Salvador: SEPLANTEG/CPE, 1978.
- Argollo, Miguel de Teive. Estrada de Ferro do S. Francisco, Relatorio de 1897. Bahia: Officinas dos Dois Mundos, 1898.
- Arruda, Jose Jobson de Andrade. "O Brasil no Comercio Colonial (1796-1808), Contribuicao ao Estudo Quantitativo da Economia Colonial" Tese de Doutorado, Universidade de Sao Paulo, 1972.
- "As Terras de Guedes de Brito". Revista do Instituto Geografico e Historico da Bahia 42 (1916): 69-74.
- Associacao Comercial da Bahia. Relatorio da Junta Diretora, 1870. Bahia: Typographia de J.G. Tourinho, 1871.
- _____. Relatorio da Junta Diretora, 1871. Bahia: Typographia de J.G. Tourinho, 1872.
- _____. Relatorio da Junta Diretora, 1879. Bahia: Typographia de J.G. Tourinho, 1880.
- _____. Relatorio da Junta Diretora, 1880. Bahia: Typographia de J.G. Tourinho, 1881.
- _____. Relatorio da Junta Diretora, 1882. Bahia: Typographia de J.G. Tourinho, 1883.
- _____. Relatorio da Junta Diretora, 1888. Bahia: Imprensa Popular, 1889.
- _____. Relatorio da Junta Diretora, 1893. Bahia: Officinas dos Dois Mundos, 1894.
- _____. Relatorio da Junta Diretora, 1895. Bahia: Officinas dos Dois Mundos, 1896.
- _____. Relatorio da Junta Diretora, 1900. Bahia: Litho-Typographia e Encadernacao de Reis & Comp., 1901.
- _____. Relatorio da Diretoria, 1901. Bahia: Officinas dos Dois Mundos, 1902.
- _____. Relatorio da Diretoria, 1906. Bahia: Typographia Bahiana, 1907.
- _____. Relatorio da Diretoria, 1911. Bahia: Typographia Bahiana, 1912.
- _____. Relatorio da Diretoria, 1916. Bahia: Officinas da Livraria Duas Americas, 1917.

- Relatorio da Diretoria, 1921. Bahia: Officinas da Livraria Duas Americas, 1922.
- Relatorio da Diretoria, 1926. Bahia: Officinas da Livraria Duas Americas, 1927.
- Relatorio da Diretoria, 1930. Bahia: Officina da Papelaria Universal, 1931.
- Relatorio da 98^a Diretoria, 1938. Bahia: Officina Grafica do Indicador Bahiano, 1939.
- Relatorio da 99^a Diretoria, 1939. Bahia: Grafica Popular Ltda., 1940.
- Relatorio da 101^a Diretoria, 1941. Bahia: Tipografia Naval, 1942.
- Azevêdo, Aroldo de. "Vilas e Cidades do Brasil Colonial". Anais da Associacao dos Geografos Brasileiros 9 (1957): 83-168.
- Azevêdo, J. Lucio de. "Epocas de Portugal Econômico". Lisboa, 1947.
- Azevêdo, Thales de. "Povoamento da Cidade do Salvador". Salvador: Itapua, 1969.
- Baer, Werner. "Industrialization and Economic Development in Brazil". Homewood: Richard D. Irwin, Inc., 1955.
- Bahia. Arquivo Público. Vol. 136. "Cartas do Governo, 1793-1796".
- _____ Vol. 137. "Cartas do Governo, 1794-1797".
- _____ Vol. 138. "Cartas do Governo, 1797-1798".
- _____ Vol. 139. "Cartas do Governo a S.M., 1798-1800".
- Bahia. Bureau de Estatistica. "Bolero Estatistico da Bahia 12" (1958): 36-70.
- Bahia. Centrais de Abastecimento S.A. "Hortas: Diagnostico e Cadastro". Salvadr: 1973. (Mimeographed).
- Bahia. Diretoria do Serviço de Estatistica do Estado. "Anuario Estatistico da Bahia, 1923". Bahia: Imprensa Official, 1924.
- _____ "Anuario Estatistico da Bahia, 1924-1925". Bahia: Imprensa Official, 1926.
- Bahia. Diretoria Geral de Estatistica e do Bem Estar Publico do Estado. "Anuario Estatistico da Bahia, 1926-1927". Bahia: Imprensa Official, 1930.

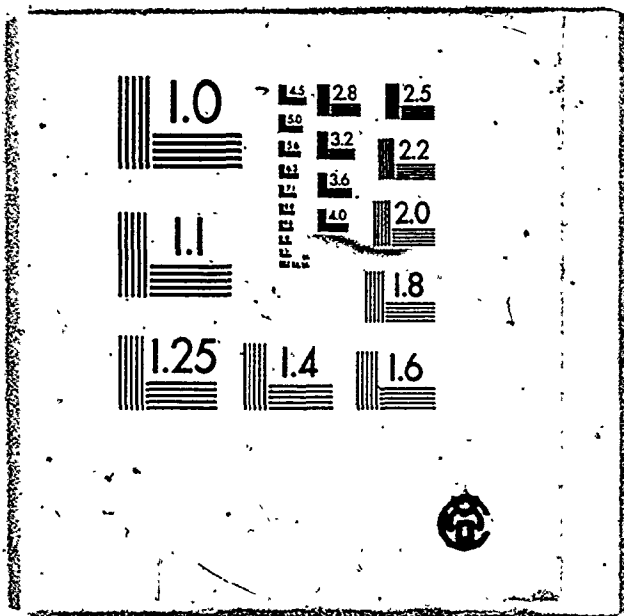
- Bahia. Diretoria Geral de Estatística do Estado. Anuario Estatístico da Bahia, 1929-1930. Bahia: Imprensa Oficial, 1933.
- . Anuario Estatístico da Bahia, 1931-1932. Bahia: Imprensa Oficial, 1934.
- . Anuario Estatístico da Bahia, 1933. Bahia: Imprensa Oficial, 1936.
- . Anuario Estatístico da Bahia, 1934. Bahia: A Graphica, 1936.
- . Anuario Estatístico da Bahia, 1935. Bahia: Papelaria Brasileira, 1936.
- Bahia. Secretaria de Transporte e Comunicacao. Roteiro Rodoviario do Estado da Bahia. Salvador: DERBA, 1968.
- Bahia. Secretaria de Viação e Obras Publicas. Historico do Rodoviarismo no Estado da Bahia, 1917-1949. Salvador: Tipografia Beneditina, 1949.
- Bahia. Secretaria do Planejamento Ciencia e Tecnologia. Anuario Estatístico da Bahia, 1973. Vol. 2, tomo 1. Salvador: DGE, 1975.
- . Atlas Climatológico do Estado da Bahia. Doc. 2: Analise Espacial da Pluviosidade. Salvador: CEPLAB, 1976.
- . Atlas do Estado da Bahia. Salvador: CEPLAB, 1976.
- . Evolucao Territorial e Administrativa dos Municipios Baianos. Salvador: CEPLAB, 1976.
- . Atlas Climatológico do Estado da Bahia. Doc. 4: Potencial Agróclimático do Estado da Bahia. Salvador: CEPLAB, 1977.
- . A Inserção da Bahia na Evolução Nacional 1ª Etapa: 1850-1889. 5 vols. Salvador: Fundacao de Pesquisa CPE, 1978.
- . 105 Anos de Economia Baiana, Estatísticas Básicas, 1872-1976. Vol. 2, t. 2: Aspectos Econômicos, 1945-1976. Salvador: Fundacao de Pesquisa CPE, 1979.
- Baklanoff, Eric N. "External Factors in The Economic Development of Brazil's Heartland: The Center-South, 1850-1930". In The Shaping of Modern Brazil, pp. 19-35. Edited by Eric N. Baklanoff. Baton Rouge: Louisiana State University Press, 1969.
- Balbi, Adrien. Essai Statistique du Royaume du Portugal et Algarves, 1821.
- Barnbrock, Joern. "Ideology into the Work of J.H. von Thünen". Ph.D. dissertation, The Johns Hopkins University, 1977.

- Barros, Francisco Borges de. "Terras Patrimoniais da Casa da Terra". In Anais do Arquivo Publico da Bahia. Vol. XI. Bahia: Imprensa Official.
- _____. Bandeirantes e Sertanistas Baianos. Bahia: 1920.
- Becker, Bertha K. "Expansao do Mercado Urbano e Transformacao da Economia Pastoril". Revista Brasileira de Geografia 28 (1966): 297-328.
- _____. "Changing Land Use Patterns in Brazil". In 21st International Geographical Congress, India 1968, pp. 14-27. Calcutta: National Committee for Geography, 1970.
- _____. "Crescimento Economico e Estrutura Espacial do Brasil". Revista Brasileira de Geografia 34 (1972): 101-115.
- Beckford, George L. Persistent Poverty, Underdevelopment in Plantation Economies of the Third World. New York: Oxford University Press, 1972.
- Benedict, Elizabeth; Stippler, Heinrich Hermann; and Benedict, Murray Reed. Theodor Brinkmann's Economics of the Farm Business. Berkeley: University of California Press, 1935.
- Bergsman, Joel and Candal, Arthur. "Industrialization: Past Success and Future Problems". In The Economy of Brazil, pp. 29-73. Edited by Howard S. Ellis, with a Foreword by Lincoln Gordon. Berkeley: University of California Press, 1969.
- Bernardes, Nilo. "Caracteristicas Gerais da Agricultura Brasileira no Seculo XX". Revista Brasileira de Geografia 23 (1961): 363-420.
- _____. "A Utilizacao da Terra no Nordeste". In Recursos e Necessidades do Nordeste, pp. 249-311. Recife: ETENE, 1964.
- Berry, Brian J.L.; Conkling, Edgar C.; and Ray, D. Michael. The Geography of Economic Systems. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1976.
- Beschorner, Franz. "Zur Geographie der Hauptsächlichen Landwirtschaftlichen Betriebssysteme". Bonn: 1923.
- Best, Lloyd. "Outlines of a Model of Pure Plantation Economy". Social and Economic Studies 17 (1968): 283-326.
- Birch, J.W. "Rural Land Use and Location Theory: A Review". Economic Geography 39 (1963): 273-276.
- Blakie, P.M. "Spatial Organization of Agriculture in some North Indian Villages: Part I". Transactions Papers 52 (1971): 1-40.
- _____. "Spatial Organization of Agriculture in some North Indian Villages: Part II". Transactions Papers 53 (1971): 15-30.

- BlaLock, Hubert M., Jr. Social Statistics. 2nd. ed. New York: McGraw-Hill Book Company, 1972.
- Blaut, J.M. "Space and Process". The Professional Geographer 13 (1961): 1-7.
- Bondar, Gregorio. "A Cultura de Cacao na Bahia". Boletim Technico do Instituto de Cacao da Bahia 1 (1938): 7-165.
- Borba, Silza F. Costa. "Industrializacao e Exportacao de Fumo na Bahia, 1870-1930". Dissertacao de Mestrado, Universidade Federal da Bahia, 1975.
- Borba, Silza F. Costa and Santos, Luiz Chateaubriand C. dos. "Fumo". In A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889. Vol. 2: Atividades Produtivas, pp. 65-89. Salvador: SEPLANTEC/CPE, 1978.
- Boxer, C.R. The Dutch in Brazil, 1624-1654. Oxford: Clarendon Press, 1957.
- _____. The Portuguese Seaborne Empire, 1415-1825. New York: Alfred A. Knopf, 1969.
- Brasil. Banco do Nordeste S.A. Sisal (Problemas Economicos). Fortaleza: ETENE, 1957.
- _____. Suprimento de Generos Alimenticios da Cidade do Salvador. Fortaleza: ETENE/DAA, 1965.
- _____. Mercado Consumidor de Aves e Ovos em Salvador. Fortaleza: ETENE, 1968.
- _____. Aspectos Economicos da Cultura do Feijao no Nordeste. Fortaleza: ETENE, 1969.
- _____. Producao e Mercado de Fumo no Nordeste. Fortaleza: ETENE, 1970.
- _____. Cafe: Uma Nova Oportunidade Agricola do Nordeste. Fortaleza: ETENE, 1973.
- _____. Manual de Estatisticas Basicas do Nordeste. Fortaleza: ETENE, 1977.
- Brasil. Banco do Nordeste S.A. and Superintendencia do Desenvolvimento do Nordeste. Pecuaria Bovina de Corte do Nordeste. Fortaleza: ETENE, 1965.
- Brasil. Diretoria Geral de Estatistica do Ministerio da Agricultura, Industria e Comercio. Recenseamento Geral do Brasil, 1920. Vol. 3, tomo 1, 2a. Parte. Rio de Janeiro: IBGE.

66

OF / DE



- _____. Recenseamento Geral do Brasil, 1920. Vol. 4, 4a. Parte.
Rio de Janeiro: IBGE.
- Brasil. Fundação Instituto Brasileiro de Geografia e Estatística. Áreas Mínimas de Comparação 1960-1970. Rio de Janeiro: DECEN, 1970.
- _____. Sinopse Preliminar do Censo Demográfico, Brasil, 1970.
Rio de Janeiro: DECEN, 1971.
- _____. Censo Agropecuario: Bahia, 1970. Vol. 3, tomo 13. Rio de Janeiro: DECEN, 1975.
- _____. Anuario Estatístico do Brasil, 1977. Rio de Janeiro: 1978.
- Brasil. Instituto Brasileiro de Geografia e Estatística. Anuario Estatístico da Bahia, 1937.
- _____. Sinopse Estatística da Bahia 1938-1940. Salvador: Oficinas Gráficas Era Nova, 1939.
- _____. Censo Agrícola: Estado da Bahia, 1940. Rio de Janeiro: IBGE.
- _____. Censo Agrícola 1950, Bahia. Rio de Janeiro: IBGE.
- _____. Censo Agrícola de 1960, Bahia. Rio de Janeiro: IBGE.
- _____. I Centenário das Ferrovias Brasileiras. Rio de Janeiro: IBGE, 1954.
- _____. Ferrovias do Brasil. Rio de Janeiro: IBGE, 1956.
- Brasil. Instituto Nacional de Estatística. Anuario Estatístico da Bahia, 1936.
- _____. Sinopse Estatística do Estado da Bahia, 1936-1937. Salvador: Livraria e Papelaria Brasileira, 1936.
- Brasil. Ministério da Indústria, Viacao e Obras Públicas. Relatorio de 1896.
- Brito, Joao Rodrigues de. A Economia Brasileira no Alvorecer do Seculo XIX. Salvador: Livraria Progresso, n.d.
- Brown, Robert C. "The Use and Mis-Use of Distance Variables in Land-Use Analysis". The Professional Geographer 20 (1968): 337-341.
- Buescu, Mircea. Historia Econômica do Brasil: Pesquisas e Analises. Rio de Janeiro: APEC, 1970.
- _____. 300 Anos de Inflação. Rio de Janeiro: APEC, 1973.
- _____. Evolução Econômica do Brasil. 3a. ed. Rio de Janeiro: APEC, 1977.

- Buescu, Mircea and Tapajos, Vicente. Historia do Desenvolvimento Econômico do Brasil. 2a. ed. Rio de Janeiro: Casa do Livro, 1969.
- Burns, E. Bradford. A History of Brazil. New York: Columbia University Press, 1970.
- Burton, Richard F., Captain. The Highlands of the Brazil. Vol. 2. London: Finsley Bros., 1869.
- Caldas, Jose Antônio. Noticia Geral de Toda esta Capitania da Bahia desde o seu Descobrimento ate o Presente Ano de 1759. Edicao fac-similar. Salvador: Tipografia Beneditina, 1951.
- Calmon, Antonio. "Benemeritos da Agricultura, Industria e Comercio da Bahia". Revista do Instituto Geografico e Historico da Bahia 31 (1905): 167-181.
- Calmon, Jorge. "Imigracao e Colonizacao no Reconcavo". Salvador, 1969. (Mimeographed).
- Calmon, Pedro. Historia da Casa da Torre, uma Dinastia de Pioneiros. 2a. ed. Rio de Janeiro: Jose Olympio, 1958.
- Calogeras, Joao Pandia. A History of Brazil. Translated and edited by Percy Alvin Martin. New York: Russell & Russell Inc., 1963.
- Canabrava, P.A. "Joao Antonio Andreoni e sua Obra". Introducao a Cultura e Opulência do Brasil (Texto da edicao de 1711) por Joao Antonio Andreoni [Andre Joao Antonil]. 2a. ed. Sao Paulo: Ed. Nacional, 1966.
- Cardim, Fernao. Tratado da Terra e Gente do Brasil. Rio de Janeiro: J. Leite & Cia., 1925.
- Cardoso, Ciro F.S. "Sobre os Modos de Producao Colinais da America". In America Colonial, pp. 61-88. Organizacao de Theo Santiago. Rio de Janeiro, 1975.
- Carvalho, Ana Dias da Silva. "Feira de Santana e o Comercio do Gado". Boletim Paulista de Geografia 28 (1958): 14-36.
- Champion, A.G. "Antecedents of von Thünen". Area 11 (1979): 258.
- Chisholm, Michael. "Agricultural Production, Location, and Rent". Oxford Economic Paper 13 (1961): 342-359.
- _____. Rural Settlement and Land Use: An Essay in Location. London: Hutchinson & Co., 1962.
- _____. "The Relevance of von Thunen". Annals of the Association of American Geographers 59 (1969): 401.
- _____. "Von Thünen Anticipated". Area 11 (1979): 37-38.

- Christaller, Walter. Central Places in Southern Germany. Translated by C.W. Baskin. Englewood Cliffs, N.J.: Prentice-Hall, 1966.
- Clark, Colin. "Von Thünen's Isolated State". Oxford Economic Papers 19 (1967): 370-377.
- Clough, Shepard Bancroft and Cole, Charles Woolsey. Economic History of Europe. 3rd. ed. Boston: D.C. Heath and Company, 1952.
- Clough, Shepard B. European Economic History: The Economic Development of Western Civilization. 2nd. ed. New York: McGraw-Hill Book Company, 1968.
- Cohen, R.L. The Economics of Agriculture. London: James Nisbet & Co. Ltd., 1957.
- Congregacao Beneditina Brasileira. Documentos Historicos. vol. 1. Liuro Velho do Tombo do Mosteiro de Sao Bentó da Cidade do Salvador. Bahia: Tipografia Beneditina, 1945.
- Costa Pinto, L.A. "O Reconcavo como uma Sintese Regional". In O Reconcavo, pp. 8-56. Salvador: SEPLANTEC, 1970.
- Courtenay, P.P. Plantation Agriculture. London: G. Bell & Sons, Ltd., 1965.
- Crossley, J.C. "The Location of Beef Processing". Annals of the Association of American Geographers 66 (1976): 60-75.
- Daland, Robert T. Brazilian Planning, Development, Politics and Administration. Chapel Hill: The University of North Carolina Press, 1967.
- Davis, L. Harlan; Erdens, Antonia Dea; Silva, Maria Auxiliadora; Goncalves, Neyde Maria Santos; and Leao, Sonio de Oliveira. Agricultura na Bahia. Salvador: PROPED, 1975.
- Day, Richard H. and Tinney, E. Herbert. "A Dynamic von Thünen Model". Geographical Analysis 1 (1969): 137-151.
- Deerr, Noel. The History of Sugar. 2 vols. London: Chapman & Hall Ltd., 1949-1950.
- Dempsey, Bernard W.S.J. The Frontier Wage: The Economic Organization of Free Agents. With the Text of the Second Part of The Isolated State by Johann Heinrich von Thünen. Chicago: Loyola University Press, 1960.
- DeWitt, John Wainwright. "Food Production and Regional Development in Bahia, Brazil". Ph.D. dissertation, University of Florida, 1973.
- Dickenson, John P. Brazil: Studies in Industrial Geography. Folkestone: Dawson/Westview, 1978.

Dickinson, H.D. "Von Thunen's Economic". Economic Journal 79 (1969): 894-902.

Dickinson, Joshua C. III. "Variation on the von Thünen Theme in a Semi-Traditional Society". Annals of the Association of American Geographers 57 (1967): 172.

Diegues, Manuel, Jr. "Propriedade e Uso da Terra na 'Plantation' Brasileira". Revista Geografica 48 (1958): 66-100.

Documentos Historicos do Arquivo Municipal. Vol. 4. Atas da Camara 1659-1669. Salvador: Prefeitura do Municipio do Salvador, 1949.

_____. Vol. 5. Atas da Câmara 1669-1684. Salvador: Prefeitura do Municipio do Salvador, 1950.

_____. Vol. 6. Atas da Câmara 1684-1700. Salvador: Prefeitura do Municipio do Salvador.

Domingues, Alfredo Jose Porto and Keller, Elza Coelho de Souza. Bahia: Guia de Excursao no. 6, XVIII Congresso Internacional de Geografia. Rio de Janeiro: Conselho Nacional de Geografia, 1958.

D'Orbigny, Alcide. Viagem Pitoresca Atraves do Brasil. Traducao de David Jardim: Belo Horizonte: Itatiaia, 1976.

Duarte, Aluizio Capdeville. "Irecê: Uma Area Agricola 'Insulada' no Sertao Baiano". Revista Brasileira de Geografia 25 (1963): 453-474.

Dunn, Edgar S., Jr. The Location of Agricultural Production. Gainesville: University of Florida Press, 1954.

Eisenberg, Peter L. The Sugar Industry in Pernambuco: Modernization without Change, 1840-1910. Berkeley: University of California Press, 1974.

Engelbrecht, T.H. Landwirtschaftliche Jahrbücher. Berlin: 1883.

"Estrada de Ferro da Bahia ao S. Francisco, Inauguracao da Estacao de Joazeiro". Revista do Instituto Geografico e Historico da Bahia 7 (1896): 77-96.

Found, William C. A Theoretical Approach to Rural Land-Use Patterns. London: Edward Arnold, 1971.

Frank, Andre Gunder. Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil. Rev. and enl. New York: Monthly Review Press, 1969.

Ferreira, Manoel Jesuino. A Provincia da Bahia. Rio de Janeiro, n.p., 1875.

Fisher, W. "Vergleichung der Intensitätsstufen in den Einzelnen Europäischen". In Berichte über Landwirtschaft, pp. 295-347. Berlin: 1928.

Freire, Felisbello. Historia Territorial do Brasil. Vol. 1. Bahia, Sergipe e Espirito Santo. Rio de Janeiro: Typographia Jornal do Commercio, 1906.

Freitas, Normo Ramos de. "O Recôncavo Açucareiro da Bahia". Separata dos Anais da Associação dos Geógrafos Brasileiros 13 (1964): 213-224.

Freyre, Gilberto. The Masters and the Slaves [Casa-Grande & Senzala], A Study in the Development of Brazilian Civilization. Translated by Samuel Putnam. New York: Alfred A. Knopf, 1946.

Furtado, Celso. Formação Econômica do Brasil. 6a. ed. Rio de Janeiro: Fundo de Cultura, 1964.

_____. Análise do "Modelo" Brasileiro. 6a. ed. Rio de Janeiro: Civilização Brasileira, 1978.

Gandavo, Pero de Magalhães. Tratado da Terra do Brasil. Rio de Janeiro: Anuário do Brasil, 1924.

_____. Historia da Provincia de Santa Cruz. Rio de Janeiro: Anuário do Brasil, 1924.

Garcez, Angelina Nobre Rolim and Freitas, Antonio Fernando Guerreiro de. Diagnostico Socio-Econômico da Região Cacaueira. Vol. 8. Historia Econômica e Social da Região Cacaueira. Ilheus: IICA/CEPLAC, 1975.

Garrison, William L. and Marble, Duane F. "The Spatial Structure of Agricultural Activities". Annals of the Association of American Geographers 47 (1957): 137-144.

Gasson, Ruth. "The Changing Location of Intensive Crops in England and Wales". Geography 51 (1966): 16-28.

Geiger, Pedro Pinchas; Lima, Maria Salette Ney da Motta; and Abib, Myriam Emile Abi. "Distribuição de Atividades Agropastoris em torno da Metrópole de São Paulo". Revista Brasileira de Geografia 36 (1974): 3-36.

Gonçalves, Neyde Maria Santos. "Organização do Espaço Agrário no Município de Jaguaquara". Dissertação de Mestrado, Universidade Federal da Bahia, 1971.

Graham, Maria Dundas [Lady Maria Calcott]. Journal of a Voyage to Brazil, and Residence There, During Part of the Years 1821, 1822, 1823. New York: Frederick A. Praeger, 1969.

Gregor, Howard F. "The Changing Plantation": Annals of the Association of American Geographers 55 (1965): 221-238.

- Geography of Agriculture: Themes in Research. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.
- Griffin, Ernst. "Testing the von Thunen Theory in Uruguay". Geographical Review 63 (1973): 500-516.
- Grigg, D.B. The Agricultural System of the World: An Evolutionary Approach. Cambridge: Cambridge University Press, 1974.
- Grotewold, Andreas. "Von Thünen in Retrospect". Economic Geography 35 (1959): 346-355.
- Grotewold, Andreas and Sublett, Michael D. "The Effect of Import Restriction on Land Use: The United Kingdom Compared with West Germany". Economic Geography 43 (1967): 64-70.
- Gudin, Eugenio. "The Chief Characteristics of the Postwar Economic Development of Brazil". In The Economy of Brazil, pp. 3-25. Edited by Howard S. Ellis, with a Foreword by Lincoln Gordon. Berkeley: University of California Press, 1969.
- Guimaraes, Alberto Passos. Quatro Seculos de Latifundio. Sao Paulo: Fulgor, 1964.
- Guimaraes, Alisson P. "A Pecuaría no Nordeste de Minas Gerais". Boletim Mineiro de Geografia 4 and 5 (1962): 29-60.
- Guimaraes, Jose Augusto. "O Abastecimento de Gêneros Alimentícios em Salvador". Tese de Livre Docencia, Faculdade de Ciências Econômicas da Universidade Federal da Bahia, 1960.
- Haggett, Peter. Location Analysis in Human Geography. London: Edward Arnold, 1965.
- Haggett, Peter and Chorley, Richard J. Network Analysis in Geography. London: Edward Arnold, 1969.
- Hall, Peter, ed. Von Thünen's Isolated State. Translated by Carla M. Wartenberg. Oxford: Pergamon Press, 1966.
- Hammond, R. and McGullagh, P.S. Quantitative Techniques in Geography: An Introduction. London: Oxford University Press, 1974.
- Harvey, D.W. "Locational Change in the Kentish Hop Industry and the Analysis of Land Use Patterns". Transactions and Papers 33 (1963): 123-144.
- _____. "Theoretical Concepts and the Analysis of Agricultural Land-Use Patterns in Geography". Annals of the Association of American Geographers 56 (1966): 361-374.
- _____. "Models of the Evolution of Spatial Patterns in Human Geography". In Models in Geography, pp. 549-608. Edited by R.J. Chorley and P. Haggett. London: Methuen, 1967.

Hauser, D.P. "Some Problems in the Use of Stepwise Regression Techniques in Geographical Research". Canadian Geographer 18 (1974): 148-158.

Hausleiter, Leo. The Machine Unchained, Revolution in the World Economic System from the First Steam Engine to the Crisis of Plenty. Translated by Margaret M. Green. New York: D. Appleton-Century Comp., 1933.

Heaton, Herbert. Economic History of Europe. Rev. ed. New York: Harper & Brothers, 1948.

Hennessy, Alistair. The Frontier in Latin American History. London: Edward Arnold, 1978.

Henshall, Janet D. "Models of Agricultural Activity". In Socio-Economic Models in Geography, pp. 425-458. Edited by Richard J. Chorley and Peter Haggett. London: Methuen, 1967.

Henshall, Janet D. and Momen, R.P., Jr. A Geography of Brazilian Development. London: G. Bell & Sons, Ltd., 1974.

Herring, Hubert. History of Latin America from the Beginnings to the Present. 2nd. ed. rev. New York: Alfred A. Knopf, 1965.

Hoover, Edgar M. The Location of Economic Activity. New York: McGraw-Hill Book Company, Inc., 1948.

Horvath, Ronald J. "Von Thünen and Urban Sprawl". Annals of the Association of American Geographers 57 (1967): 811-812.

"Von Thünen's Isolated State and the Area Around Addis Ababa, Ethiopia". Annals of the Association of American Geographers 59 (1969): 308-323.

Huddle, Don. "Postwar Brazilian Industrialization: Growth Patterns, Inflation, and Sources of Stagnation". In The Shaping of Modern Brazil, pp. 86-108. Edited by Eric N. Baklanoff. Baton Rouge: Louisiana State University Press, 1969.

Hutchinson, Harry William. Village and Plantation Life in Northeastern Brazil. Edited by Verne F. Ray. Seattle: University of Washington Press, 1957.

Instituto Nacional de Colonizacao e Reforma Agraria. Estatisticas Cadastrais. Vol. 1. Base Recadastramento 1972. Brasilia, 1974.

Isard, Walter. Location and Space-Economy: A General Theory Relating to Industrial Location, Market Areas, Land Use, Trade, and Urban Structure. Cambridge, Mass.: The M.I.T. Press, 1956.

Jackson, R.T. "Some Observations on the von Thünen Method Analysis: with Reference to Southern Ethiopia". The East African Geographical Review 8 (1970): 39-46.

James, Preston E. Latin America. 4th ed. Indianapolis: Bobbs-Merrill Company, Inc., 1976.

Jancso, M. Istvan. "As Exportacoes da Bahia Durante a Republica Velha (1889-1930)". In L'Histoire Quantitative du Bresil de 1800 a 1930, pp. 335-359. Paris: Centre National de la Recherche Scientifique, 1973.

Johnson, Hildegard Binder. "A note on Thünen's Circles". Annals of the Association of American Geographers 52 (1962): 213-220.

Johnston, R.J. Multivariate Statistical Analysis in Geography: A Primer on General Linear Model. London: Longman, 1978.

Jonasson, Olof. "Agricultural Regions of Europe". Economic Geography 1 (1925): 277-314.

Jones, Alan P.; McGuire, William J.; and Witte, Ann. "A Reexamination of Some Aspects of von Thünen's Model of Spatial Location". Journal of Regional Science 18 (1978): 1-15.

Jones, Donald W. "Rent in an Equilibrium Model of Land Use". Annals of the Association of American Geographers 68 (1978): 205-213.

_____. "The Price Theory of Thunen's Theory of Rent: Assumptions and Implications of a Familiar Model". Canadian Geographer 23 (1979): 322-336.

Jones, Richard C. "Testing Macro-Thünen Models by Linear Programming". The Professional Geographer 28 (1976): 353-361.

Katzman, Martin T. "The Von Thünen Paradigm, the Industrial-Urban Hypothesis; and the Spatial Structure of Agriculture". American Journal of Agricultural Economics 56 (1974): 683-696.

_____. "Industrialisation, Agricultural Specialisation, and Frontier Settlement in South-Central Brazil, 1940-1970". Development and Change 6 (1975): 25-49.

Kellerman, Aharon. "The Pertinence of the Macro-Thünen Analysis". Economic Geography 53 (1977): 255-264.

_____. "Determinants of Rent from Agricultural Land Around Metropolitan Areas". Geographical Analysis 10 (1978): 1-12.

_____. "Location Theory Anticipated". Area 11 (1979): 347-348.

Kidder, Daniel P. Reminiscencias e Viagens e Permanencia no Brasil (Provincias do Norte). Tradução de Moacir N. Vasconcelos. Sao Paulo: Livraria Martins, 1943.

Knight, Melvin M.; Barnes, Harry Elmer; and Flügel, Felix. Economic History of Europe. Boston: Houghton Mifflin Company, 1928.

- Koster, Henry. Travels in Brazil. Edited and with an Introduction by C. Harvey Gardiner. Carbondale: Southern Illinois University Press, 1966.
- Krzymowski, Richard. "Graphical Presentations of Thünen's Theory of Intensity". Journal of Farm Economics 10 (1928): 461-482.
- Kuhlmann, Edgar. "Vegetacao". In Geografia do Brasil. Vol. 2. Regiao Nordeste, pp. 85-110. Rio de Janeiro: SERGRAF/Fundacao IBGE, 1977.
- Lambert, Jacques. Os Dois Brasis. 10a. ed. Sao Paulo: Ed. Nacional, 1978.
- Leaman, J. Harold and Conkling, E.C. "Transport Change and Agricultural Specialization". Annals of the Association of American Geographers 65 (1975): 425-432.
- Leao, Sônia de Oliveira. "A Atividade Comercial nas Pequenas 'Cidades' Petrolíferas do Recôncavo Baiano". Tese de Mestrado, Universidade Federal da Bahia, 1971.
- _____. "A Evolucao da Pecuaria na Bahia: O Exemplo de Itapetinga". Tese de Professor Assistente, Universidade Federal da Bahia, 1973.
- Leff, Nathaniel. "Export Stagnation and Autarkic Development in Brazil". Quarterly Journal of Economics 81 (1967): 286-301.
- _____. "Long-Term Brazilian Economic Development". Journal of Economic History 29 (1969): 473-493.
- Leigh, Arthur H. "Von Thünen's Theory of Distribution and the Advent of Marginal Analysis". Journal of Political Economy 54 (1946): 481-502.
- Leite, Jose de Oliveira. Diagnostico Socio-Econômico da Regiao Cacaueira. Vol. 3. Dinâmica do Uso do Solo. Ilheus: IICA/CEPLAC, 1976.
- Leite, Riserio. "Politica de Fomento da Producao Animal". Bahia Rural 6 (1951): 12-13.
- Lekachman, Robert. A History of Economic Ideas. New York: McGraw-Hill Book Company, 1959.
- Lemon, James T. The Best Poor Man's Country: A Geographical Study of Early Southeastern Pennsylvania. Baltimore: Johns Hopkins Press, 1972.
- Lifschitz, F. "Die Methoden der Wirtschaftswissenschaft bei Johann Heinrich von Thünen". In Jahrbücher für Nationalökonomie und Statistik, pp. 812-820. 3. Folge. Vol. 25. Jena: 1903.

- Lindley, Thomas. Narrativa de uma Viagem ao Brasil. Tradução de Thomáz Newlands Neto. São Paulo: Ed. Nacional, 1969.
- Lippmann, E.O. Geschichte des Zuckers. 2a. ed. Berlim: 1929.
- Livermore, H.V. A History of Portugal. Cambridge: Cambridge University Press, 1947.
- Lösch, August. The Economics of Location. Translated by William H. Woglom and Wolfgang F. Stolper. New Haven: Yale University Press, 1954.
- Ludwig, Armin K. and Taylor, Harry W. Brazil's New Agrarian Reform: An Evaluation of its Property Classification and Tax System. New York: Frederick A. Praeger, Inc., 1969.
- Macêdo, Nilda Guerra and Erdens, Antônia Dea. "A Vida Rural dentro da Cidade do Salvador". Boletim Baiano de Geografia 10 (1970): 67-77.
- Maciel, Affonso Glycerio da Cunha. "Memoria Historica e Descritiva da Tram-road de Nazaréth". Revista do Instituto Geografico e Historico da Bahia 52 (1926): 319-381.
- Magalhaes, Basilio de. Expansao Geografica do Brasil Colonial. 2 ed. São Paulo: Ed. Nacional, 1935.
- Marble, D. and Anderson, B.H. "Land Use: A Computer Program for Laboratory Use in Economic Geography Courses". Geography Technical Papers Series 8, Annals of the Association of American Geographers, 1972.
- Mariani, Jose Bonifacio de Abreu. "O Povoamento da Bahia: Seculo XVI". Salvador, n.d. (Mimeographed).
- Mark, David M. and Peucker, Thomas K. "Regression Analysis and Geographic Models". Canadian Geographer 22 (1978): 51-64.
- Marques, A.H. de Oliveira. History of Portugal. Vol. 1. From Lusitania to Empire. New York: Columbia University Press, 1972.
- Marques, Antonio Nonato. Geografia do Fumo na Bahia. Salvador: Imprensa Vitória, 1950.
- Mattoso, Katia M. de Queiros. Bahia: A Cidade do Salvador e seu Mercado no Seculo XIX. São Paulo: HUCITEC, 1978.
- Mauro, Frederic. Le Portugal et L'Atlantique au XVIIe Siecle (1570-1670). Etudes Economique. Paris: S.E.V.P.E.N., 1960.
- Mawe, John. Viagens ao Interior do Brasil. Tradução de Selena Benevides Viana, Introdução e Notas de Clado Ribeira Lessa. Belo Horizonte: Ed. Itatiaia, 1978.

- Melamid, A. "Some Applications of Thünen's Model in Regional Analysis of Economic Growth". Papers of Regional Science Association 1 (1955): 135-138.
- Mesquita, Olíndina Vianna. "O Modelo de von Thünen: Uma Discussão". Tese de Mestrado, Universidade Federal do Rio de Janeiro, 1978.
- Metcalf, David. The Economics of Agriculture. Middlesex, England: Penguin Book, 1969.
- Ministerio da Educacao e Cultura and Universidade Federal da Bahia. Programa de Desenvolvimento Integrado da Cidade Monumento de Cachoeira. Seccao II: Plano Diretor. Salvador: 1976.
- Mont'Alegre, Omer. "Um Seculo na Historia do Acucar (Brasil - Cuba 1760-1860)". Brasil Acucareiro 73 (1969): 22-66.
- Moreno, Diogo de Campos. Livro que da Razao do Estado do Brasil, 1612. Recife: Arquivo Publico Estadual, 1955.
- Morgan, W.B. "The Doctrine of the Rings". Geography 58 (1973): 301-312.
- Morley, Samuel A. "Inflation and Stagnation in Brazil". Economic Development and Cultural Change 19 (1971): 184-203.
- Moryadas, Lowe. The Geography of Movement. Boston: Houghton Mifflin, 1975.
- Muller, Peter O. "Further Thoughts on Thünian Analysis". Annals of the Association of American Geographers 60 (1970): 601-602.
- _____. "Rejoinder to Comment on von Thünen and Population Density". The Professional Geographer 27 (1973): 120-121.
- _____. "Trend Surfaces of American Agricultural Patterns: A Macro-Thünian Analysis". Economic Geography 49 (1973): 228-242.
- Muller, Peter O. and Diaz, Gregory J. "Von Thünen and Population Density". The Professional Geographer 25 (1973): 239-241.
- Muth, Richard F. "Economic Change and Rural-Urban Land Conversions". Econometrica 29 (1961): 1-23.
- Nachmias, David and Nachmias, Chava. Research Methods in the Social Sciences. New York: St. Martin's Press, 1976.
- Nicholls, William H. "The Transformation of Agriculture in a Semi-Industrialized Country: The Case of Brazil". In The Role of Agriculture in Economic Development, pp. 311-378. Edited by Erik Thorbecke. New York: National Bureau of Economic Research, 1970.
- _____. "The Brazilian Food Supply: Problem and Prospects". Economic Development and Cultural Change 19 (1971): 378-390.

Nie, Norman H.; Hull, C. Hadlai; Jenkins, Jean G.; Steinbrenner, Karin; and Bent, Dale H. Statistical Package for the Social Sciences. 2nd. ed. New York: McGraw-Hill Book Company, 1975.

Nimer, Edmon. "Clima". In Geografia do Brasil. Vol. 2. Regiao Nordeste, pp. 47-84. Rio de Janeiro: SERGRAF/Fundacao IBGE, 1977.

Nobrega, Manuel da, Pe. Cartas do Brasil, 1549-1560. Rio de Janeiro: n.p., 1931.

Normano, J.F. Brazil, a Study of Economic Types. Chapel Hill: The University of North Carolina Press, 1935.

Norton, William and Conkling, E.C. "Land Use Theory and the Pioneering Economy". Geografiska Annaler 56B (1974): 44-56.

Novais, Fernando A. "O Brasil nos Quadros do Antigo Sistema Colonial". In Brasil em Perspectiva, pp. 47-63. Organizacao e Introducao de Carlos Guilherme Mota. 8a. ed. Rio de Janeiro: DIFEL, 1977.

Nowell, Charles E. The Great Discoveries and the First Colonial Empires. Ithaca: Cornell University Press, 1954.

_____. Portugal. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1973.

Obst, Erich. Zeitschrift fur Geopolitik. Vol. 1. n.p., 1926.

Ohlin, Bertil. "Some Aspects of the Theory of Rent: von Thünen vs. Ricardo". In Economics, Sociology and the Modern World: Essays in Honor of T.N. Carver, pp. 171-183. Edited by Norman E. Himes. Cambridge Mass.: Harvard University Press, 1935.

Oiticica, Francisco da Rosa. "O Açúcar na Economia Colonial". Brasil Acucareiro 3 (1942): 82-91.

Okafor, Francis Chukwudum. "Intensity of Agricultural Land Use in Canada: von Thünen's Model Extended". M.A. thesis, University of Western Ontario, 1975.

Oliveira, Mario Martins de. Arterias do Brasil, Estado da Bahia. Salvador: Universitaria, 1950.

Passow, Richard. "Die Methode der Nationalökonomischen Forschungen Johann Heinrichs von Thünen". In Zeitschrift für die Gesamte Staatswissenschaft, p. 25. Tübingen: n.p. 1902.

Patrick, George F. Desenvolvimento Agrícola do Nordeste. Rio de Janeiro: IPEA/INPES, 1972.

Peet, J. Richard. "The Present Pertinence of von Thunen Theory". Annals of the Association of American Geographers 57 (1967): 810-811.

_____. "The Spatial Expansion of Commercial Agriculture in the Nineteenth Century: A von Thünen Interpretation". Economic Geography 45 (1969): 283-301.

_____. "The Dynamics of the Agricultural Expansion": Explorations in Economic History 8 (1970-1971): 181-201.

_____. "Influence of the British Market on Agriculture and Related Economic Development in Europe before 1860". Transactions Papers 56 (1972): 1-20.

Petersen, Asmus. Thünens Isolierter Staat: Die Landwirtschaft als Glied der Volkswirtschaft. Berlin: P. Pauly, 1944.

Peucker, Thomas K. "Thünen's Theory and the Problem of Developing Countries". In 21st International Geographical Congress, India 1968, pp. 208-211. Calcutta: National Committee for Geography, 1970.

Pinho, Wanderley de. Historia de um Engenho do Recôncavo (1552-1944). Rio de Janeiro: Ed. Zélio Valverde, 1946.

Pinto, Maria Novais. "Contribuicao ao Estudo da Influência da Lavoura Especulativa do Sisal no Estado da Bahia". Revista Brasileira de Geografia 31 (1969): 3-102.

Pinto, Virgilio Noya. "Balanco das Transformacoes Econômicas no Seculo XIX". In Brasil em Perspectiva, pp. 126-145. Organizacao e Introducao de Carlos Guilherme Mota. 8a. ed. Rio de Janeiro: DIFEL, 1977.

Pluijms, Theodore van Der. "A Policy Analysis of Brazil's Agriculture: Is the Long Term Strategy Jeopardized at Last?" Tijdschrift voor Economische en Sociale Geografie 69 (1978): 258-269.

Ponsard, C. Economie et Espace. n.p., 1955.

Poppino, Rollie E. Feira de Santana. Tradução de Arquimedes Pereira Guimaraes. Salvador: Itapua, 1968.

Prado, Caio, Jr. Formacao do Brasil Contemporâneo. 6a. ed. Sao Paulo: Ed. Brasiliense, 1961.

_____. Historia Econômica do Brasil. 7a. ed. Sao Paulo: Ed. Brasiliense, 1962.

Prado, J.F. de Almeida. A Bahia e as Capitancias do Centro do Brasil (1530-1626). 2 Vols. Sao Paulo: Ed. Nacional, 1945.

Predohl, A. "The Theory of Location in its Relation to General Economics". Journal of Political Economy 36 (1928): 371-390.

- Ramon, Ma. D. Garcia. "Valor Actual del Modelo de von Thünen y dos Comprobaciones Empíricas". Revista de Geografia 10 (1976): 11-31.
- Ritz, Armin. "As Exportações Internacionais e Interregionais no Desenvolvimento Econômico da Bahia (1950-1969)". Dissertação de Doutorado. Instituto de Scienze Sociali da Pontificia Universitas Gregoriana, Roma, 1972.
- Robock, Stefan H. Brazil's Developing Northeast, a Study of Regional Planning and Foreign Aid. Washington, D.C.: The Brookings Institution, 1963.
- Rocha, Lindolpho. "Zona Desconhecida no Interior da Bahia": Revista do Instituto Geografico e Historico da Bahia 34 (1908): 141-159.
- Rodell, Michael Joseph. "City Growth and Regional Development: Salvador and Bahia in Northeastern Brazil, 1940 to 1970". Ph.D. dissertation, University of California, 1975.
- Rodrigues, F. Contreiras. Tracos da Economia Social e Politica do Brasil Colonial. Rio de Janeiro: Ariel, 1935.
- Rodrigues, Jose Honorio. "O Acucar Segundo o Depoimento de Jose da Silva Lisboa". Brasil Acucareiro 25 (1945): 45-53.
- _____. "Alguns Reformadores da Economia Acucareira no Seculo XIX". Brasil Acucareiro 27 (1946): 81-84.
- _____. "A Revolucao Industrial Acucareira Os Engenhos Centrais, I". Brasil Acucareiro 27 (1946): 81-89.
- _____. "A Revolucao Industrial Acucareira Os Engenhos Centrais, II". Brasil Acucareiro 27 (1946): 35-39.
- Roscher, Wilhelm. Archiv der Politischen Oekonomie und Polizeiwissenschaft. Edited by K.H. Rau. Neue Folge. 7 vols. Heidelberg: n.p., 1845.
- _____. Das Nationale System der Politischen Oekonomie. Tübingen: n.p., 1851.
- _____. Geschichte der Nationaloekonomie in Deutschland. München: R. Oldenbourg, 1874.
- _____. Nationaloekonomie des Ackerbaus und der Verwandten Urproduktion. Ann. 3. n.p., 1859.
- Rouen, Forth. "A Bahia em 1847". Revista do Instituto Geografico e Historico da Bahia 57 (1931): 533-547.
- Rulliere, Gilbert. Localisations et Rythmes de L'activite Agricole: Essai d'Analyse Economique de la Notion de Structure Agricole. Paris: Armand Colin, 1956.

- Rutherford, John. "Comments on von Thünen and Population Density". The Professional Geographer 27 (1975): 119-120.
- Salin, Edgard. "Der Isolierte Staat 1826-1926". In Zeitschrift für die Gesamte Staatswissenschaft, 415. Tübingen: n.p., 1926.
- Salvador, Vicente do, Frei. Historia do Brasil 1500-1627. 5a. ed. Sao Paulo: Melhoramentos, 1965.
- Sampaio, Jose Luis Pamponet; Meira, Mercia Maria Lima; Lins, Yara Cecy Falcon; and Nascimento, Maria de Fatima. "Algodao e Textil na Bahia". In A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889. Vol. 2. Atividades Produtivas, pp. 181-242.. Salvador: SEPLANTEC/CPE, 1978.
- Sampaio, Jose Luis Pamponet and Silva, Tania Maria Bomfim da Silva. "Industria". In A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889. Vol. 2. Atividades Produtivas, pp. 243-298. Salvador: SEPLANTEC/CPE, 1978.
- Sanceau, Elaine. Captains of Brazil. Porto: Livraria Civilizacao, 1965.
- Santos, Luiz Chateaubriand C. dos and Dultra, Hermano Jose Thomy. "Cafe". In A Insercao da Bahia na Evolucao Nacional 1a. Etapa: 1850-1889. Vol. 2. Atividades Produtivas, pp. 127-160. Salvador: SEPLANTEC/CPE, 1978.
- Santos, Mario Augusto da Silva. "Associacao Comercial da Bahia na Primeira Republica: Um Grupo de Pressao". Tese de Mestrado. Universidade Federal da Bahia, 1973.
- _____. "Formacao Economica da Bahia". Salvador, 1976. (Mimeographed).
- Santos, Milton. O Povoamento da Bahia, suas Causas Economicas. Salvador: Imprensa Oficial da Bahia, 1948.
- _____. Zona do Cacau, Introducao ao Estudo Geografico. Salvador: S.A. Artes Graficas, 1955.
- _____. "Itubera, Porto Cacaueiro Rejuvenescido pela Industria". In Anais da Associacao dos Geografos Brasileiros 10 (1955-1957): 119-131.
- _____. "A Baixa dos Sapateiros". Revista do Instituto Geografico e Historico da Bahia 81 (1957): 71-79.
- Sapper, Karl. Allgemeine Wirtschaftsund Verkehrsgeographie. Berlin: n.p., 1925.
- Schlebecker, John T. "The World Metropolis and the History of American Agriculture". Journal of Economic History 20 (1960): 187-208.

Schlesinger, Hugo. Geografia Industrial do Brasil. 2a. ed. atualizada. Sao Paulo: Ed. Atlas S.A., 1958.

Schmidt, P.H. Wirtschaftsforschung und Geographie. Iena: n.p., 1925.

Schneider, Erich. "Johann Heinrich von Thünen". Econometrica 2 (1934): 1-12.

Schwartz, Stuart B. "Free Labor in a Slave Economy: The Lavradores de Cana of Colonial Bahia". In Colonial Roots of Modern Brazil: Papers of the Newberry Library Conference, pp. 147-197. Edited by Dauril Alden. Berkeley: University of California Press, 1973.

Scully, William. Brazil; its Provinces and Chief Cities; the Manners & Customs of the People; Agricultural, Commercial, and Other Statistics, Taken from the Latest Official Documents; with a Variety of Useful and Entertaining Knowledge, Both for the Merchant and the Emigrant. London: Murray & Co., 1866.

Seligsohn, Otto E. Caçau da Bahia Historia e Problematica. Salvador: IPESA, n.d.

Sheridan, Richard B. Sugar and Slavery: An Economic History of the British West Indies, 1623-1775. Barbados: Caribbean University Press, 1974.

Siddle, David J. "Location Theory and the Subsistence Economy: The Spacing of Rural Settlements in Sierra Leone". The Journal of Tropical Geography 31 (1970): 79-90.

Sierra, Juan Lopes. A Governor and his Image in Baroque Brazil, the Funeral Eulogy of Afonso Furtado de Castro do Rio de Mendonça. Edited by Stuart B. Schwartz. Translated by Euth E. Jones. Minneapolis: University of Minnesota Press, 1979.

Silva, Inacio Accioli de Cerqueira. Memorias Historicas e Politicas da Provincia da Bahia. 5 vols. Bahia: Imprensa Oficial, 1937.

Silva, Maria Auxiliadora da. "Les Migrations pour le 'Reconcavo' du Petrole (Etat de Bahia, Bresil)". These de Doctorat de 3e Cycle, Universite Louis Pasteur, Strasbourg, 1972.

Silva, Sylvio Carlos Bandeira de Mello e. "L'Organisation Regionale du Reconcavo Sud, Bahia". These de Doctorat de Troisieme Cycle, Universite de Toulouse, 1969.

. "Urbanizacao e Desenvolvimento Regional no Estado da Bahia: Uma Visao Sistêmica". Tese para Professor Titular, Universidade Federal da Bahia, 1975.

Simonsen, Roberto C. Historia Economica do Brasil (1500/1820). 7a. ed. Sao Paulo: Comp. Ed. Nacional/MEC, 1977.

Sinclair, Robert. "Von Thünen and Urban Sprawl". Annals of the Association of American Geographers 57 (1967): 72-87.

_____. "Comment in Reply". Annals of the Association of American Geographers 57 (1967): 812-815.

Sistema Nacional de Centrais de Abastecimento. Relatorio Anual de 1973, Ceasa-Ba. Salvador, 1974.

Sjo, John. Economics for Agriculturalists: A Beginning Text in Agricultural Economics. Columbus: Grid, Inc., 1976.

Smith, T. Lynn. "Demographic Factors Related to Economic Growth in Brazil". In Economic Growth: Brazil, India, Japan, pp. 241-262. Edited by Simon Kuznets, Wilbert E. Moore, and Joseph J. Spengler. Durham, N.C.: Duke University Press, 1955.

Sodre, Nelson Werneck. Formação Historica do Brasil. 2a. ed. Sao Paulo: Ed. Brasiliense, 1963.

Southey, Robert. History of Brazil. 3 vols. 2nd. ed. London: Longman, Hurst, Rees, Orme, Brown & Green, 1822.

Souza, Regina Celeste de Almeida. "A Fragilidade da Agricultura Alimentar no Recôncavo: O Exemplo de Candeias". Dissertação de Mestrado, Universidade Federal da Bahia, 1971.

Souza, Gabriel Soares de. Tratado Descritivo do Brasil em 1587. 3a. ed. Sao Paulo: Ed. Nacional, 1938.

Spencer, J.E. and Horvath, Ronald J. "How Does an Agricultural Region Originate?". Annals of the Association of American Geographers 53 (1963): 74-92.

Spix, J.B. von and Martius, C.F.P. von. Viagem pelo Brasil. Tradução de Lucia Furquim Lahmeyer. Revisão de B.F. Râmiz e Anotações de Basilio de Magalhães. 2 vols. Rio de Janeiro: Imprensa Nacional, 1938.

Stein, Stanley J. "The Brazilian Cotton Textile Industry, 1850-1950". In Economic Growth: Brazil, India, Japan, pp. 430-447. Edited by Simon Kuznets, Wilbert E. Moore, and Joseph J. Spengler. Durham, N.C.: Duke University Press, 1955.

Stephens, H. Morse. Portugal. 2nd. ed. London: T. Fisher Unwin, 1899.

Stevens, Benjamin H. "Linear Programming and Location Rent". Journal of Regional Science 2 (1961): 15-26.

_____. "Location Theory and Programming Models: The von Thünen Case". Papers of the Regional Science Association 21 (1968): 19-34.

- Stevens, Richard and Lee, Yuk. "A Spatial Analysis of Agricultural Intensity in a Basotho Village of Southern Africa". The Professional Geographer 31 (1979): 177-183.
- o Taaffe, Edward J.; Morrill, Richard L.; and Gould, Peter R. "Transportation Expansion in Underdeveloped Countries: A Comparative Analysis". Geographical Review 53 (1963): 503-529.
- Taaffe, Edward J. and Gauthier, Howard L., Jr. Geography of Transportation. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1973.
- Tarquínio, Mario. "Vias de Comunicação e Meio de Transporte no Estado da Bahia". Revista do Instituto Geográfico e Histórico da Bahia 60 (1934): 325-444.
- Taunay, Affonso de E. Pequena História do Café no Brasil (1727-1937). Rio de Janeiro: Departamento Nacional do Café, 1945.
- História do Café no Brasil Imperial, 1822-1872. Vol. IV, Tomo II. Rio de Janeiro: Departamento Nacional do Café, 1939.
- Tavares, Lucía Maria T.; Purificação, Vera Maria P. da; and Nascimento, Maria de Fátima. "Cana-de-Açúcar". In A Inserção da Bahia na Evolução Nacional 1ª. Etapa: 1850-1889. Vol. 2. Atividades Produtivas, pp. 7-46. Salvador: SEPLANTEC/CPE, 1978.
- Tavares, Luis Henrique Dias. História da Bahia. 4a. ed. Salvador: Ed. Itapoa, 1969.
- Tavares, Maria da Conceição. Da Substituição de Importação ao Capitalismo Financeiro, Ensaio sobre Economia Brasileira. 6a. ed. Rio de Janeiro: Zahar Editores, 1977.
- Taylor, Kit Sims. Sugar and the Underdevelopment of Northeastern Brazil, 1500-1970. Gainesville: The University Press of Florida, 1978.
- Taylor, Peter, J. Quantitative Methods in Geography: an Introduction to Spatial Analysis. Boston: Houghton Mifflin Company, 1977.
- Thompson, Edgar T. "The Plantation Cycle and Problems of Typology". In Caribbean Studies: A Symposium, pp. 29-33. Edited by Vera Rubin. Seattle: University of Washington Press, 1960.
- [Thünen, Johann Heinrich von]. Von Thünen's Isolated State [Der Isolierte Staat]. Edited with an Introduction by Peter Hall. Translated by Carla M. Wartenberg. Oxford: Pergamon Press, 1966.
- Troughton, Michael J. An Atlas of Canadian Agriculture Portfolio of Maps Based on the 1971 Census of Agriculture. London: University of Western Ontario.
- Vargas, Carmen. "A História do Açúcar no Brasil (III)". Brasil Açucareiro 80 (1972): 45-48.

_____. "A Historia do Acucar no Brasil (IV)". Brasil Acucareiro 80 (1972): 30-40.

Vargas, Carmen, ed. Economia Acucareira do Brasil no Sec. XIX: Cartas de Felisberto Caldeira Brant Pontes, Margues de Barbacena. Rio de Janeiro: M.I.C./I.A.A., 1976.

Varnhagen, Francisco Adolpho de [Visconde de Porto Seguro]. Historia Geral do Brasil, Antes da sua Separacao e Independencia de Portugal. 5 vols. 4a. ed. Saõ Paulo: Comp Melhoramentos. Ann Arbor, Mich.: University Microfilms, 1970.

Vasconcelos, Simao de, Pe. Crônicas da Companhia de Jesus. n.p., n.d.

Viacao Ferreira Federal Leste Brasileiro. Relatorio do Exercício de 1936. Bahia: Cia. Ed. e Graphica da Bahia, 1937.

_____. Relatorio do Exercício de 1941. Bahia: Tipografia da Leste, 1942.

_____. Relatorio do Exercício de 1944. Bahia: Tipografia da Leste, 1945.

_____. Guia Informativo em Comemoracao as 10. Centenario 1860-1960. Salvador: Oficinas Graficas da Leste, 1960.

Viana Filho, Luis. "Intendente Câmara, Senhor de Engenho". Brasil Acucareiro 25 (1945): 65-68.

_____. "A Missao Carson e o Melhoramento dos Engenhos Baianos". Brasil Acucareiro 27 (1946): 66-68.

Vianna, Francisco Vicente. Memoria sobre o Estado da Bahia. Bahia: Typographia e Encadernação do Diario da Bahia, 1893.

Vieira, Antonio, Padre. Por Brasil e Portugal (Sermoes comentados por Pedro Calmon). Sao Paulo: Ed. Nacional, 1938.

Vilhena, Luis dos Santos. A Bahia no Seculo XVIII. Notas e Comentarios de Braz do Amaral. 3 vols. Salvador: Itapoa, 1967.

Waibel, Leo. "Die Wirtschaftsgeographische Gliederung Mexikos". In Festschrift für Alfred Philippson, pp. 32-55. Leipzig: n.p., 1930.

_____. "A Forma Econômica da 'Plantage' Tropical". In Capitulos de Geografia Tropical e do Brasil, pp. 31-50. Rio de Janeiro: IBGE, 1958.

_____. "A Lei de Thünen e a sua Significacao para a Geografia Agraria". In Capitulos de Geografia Tropical e do Brasil, pp. 69-98. Rio de Janeiro: IBGE, 1958.

- . "A Teoria de von Thünen sobre a Influencia da Distancia do Mercado Relativamente a Utilizacao da Terra". In Capitulos de Geografia Tropical e do Brasil, pp. 99-129. Rio de Janeiro: IBGE, 1958.
- Ward, Joe H., Jr. "Hierarchical Grouping to Optimize an Objective Function". Journal of the American Statistical Association 58 (1963): 236-244.
- Warntz, William and Wolff, Peter. Breakthroughs in Geography. New York: New American Library, 1971.
- Webb, Kempton E. The Changing Face of Northeast Brazil. New York: Columbia University Press, 1974.
- Weber, Alfred. Theory of the Location of Industries. Translated by C.J. Friedrich. Chicago: University of Chicago Press, 1929.
- Whittlesey, Derwent. "Major Agricultural Regions of the Earth". Annals of the Association of American Geographers 26 (1936): 199-240.
- Williams, Eric. From Columbus to Castro: The History of the Caribbean 1492-1969. London: Andre Deutsch, 1970.
- Wishart, D. Clustan User Manual, Cluster Analysis Package. 3rd. ed. Edinburg: Program Library Unit of Edinburg University, 1978.
- Wiskeman, Heinrich. Die Antike Landwirtschaft und das Thünische Gesetz-Preisschriften Gekrönt und Herausgegeben von der Fürstlich Jablonowskischen Gesellschaft zu Leipzig. n.p., 1859.
- Wythe, George. "Brazil: Trends in Industrial Development". In Economic Growth: Brazil, India, Japan, pp. 29-77. Edited by Simon Kuznets, Wilbert E. Moore, and Joseph J. Spengler. Durham, N.C.: Duke University Press, 1955.
- Wythe, George; Wight, Royce A.; and Midkiff, Harold M. Brazil - an Expanding Economy. New York: Greenwood Press, 1968.
- Yokeno, Nobumichi. "Thünen's Structure in the Agriculture of Japan". Sophia Economic Review 3 (1956): 12-22.
- Youngblood and Cox. "An Economic Study of a Typical Ranching Area on the Edwards Plateau of Texas". Bulletin 295 Texas Agricultural Experiment Station (1922).

APPENDIX A

AMOUNT OF STARCH FOOD ENTERING SALVADOR'S CELEIRO PUBLICO, 1785-1821

| YEAR | MANIOC FLOUR | | RICE | | CORN | | BEANS | |
|------|--------------|-------|-----------|-------|-----------|-------|-----------|-------|
| | ALQUEIRE* | INDEX | ALQUEIRE* | INDEX | ALQUEIRE* | INDEX | ALQUEIRE* | INDEX |
| 1785 | 83,949 | 100 | 6,003 | 100 | 8,522 | 100 | 1,973 | 100 |
| 1787 | 230,060 | 274 | 18,169 | 303 | 24,539 | 288 | 7,575 | 384 |
| 1789 | 269,992 | 322 | 7,247 | 121 | 28,840 | 338 | 5,856 | 297 |
| 1791 | 289,648 | 345 | 11,157 | 186 | 10,581 | 124 | 6,745 | 342 |
| 1793 | 257,502 | 307 | 10,067 | 168 | 2,621 | 31 | 5,513 | 279 |
| 1795 | 282,244 | 336 | 7,416 | 124 | 21,416 | 251 | 5,967 | 302 |
| 1796 | 300,292 | 358 | 10,649 | 177 | 19,376 | 227 | 4,285 | 217 |
| 1797 | 289,087 | 344 | 7,077 | 118 | 18,497 | 217 | 7,954 | 403 |
| 1799 | 288,611 | 344 | 10,248 | 171 | 24,006 | 282 | 6,375 | 323 |
| 1801 | 279,908 | 333 | 5,610 | 93 | 5,299 | 62 | 5,299 | 268 |
| 1803 | 302,031 | 360 | 9,641 | 161 | 25,797 | 303 | 6,472 | 328 |
| 1805 | 287,181 | 342 | 17,407 | 290 | 21,216 | 249 | 3,316 | 168 |
| 1807 | 391,807 | 467 | 38,168 | 636 | 28,056 | 329 | 7,104 | 360 |
| 1809 | 290,703 | 346 | 20,146 | 336 | 34,335 | 403 | 7,142 | 362 |
| 1811 | 363,671 | 433 | 23,363 | 389 | 28,046 | 329 | 6,712 | 340 |
| 1813 | 346,567 | 413 | 34,360 | 577 | 29,029 | 341 | 6,791 | 344 |
| 1815 | 336,349 | 401 | 69,562 | 1,159 | 39,658 | 465 | 4,572 | 232 |
| 1817 | 447,133 | 533 | 28,824 | 480 | 32,992 | 387 | 8,579 | 435 |
| 1819 | 409,438 | 488 | 25,486 | 424 | 32,510 | 381 | 7,895 | 400 |
| 1821 | 440,259 | 524 | 13,780 | 230 | 29,921 | 351 | 5,652 | 286 |

SOURCE: Luis Amaral, Historia Geral da Agricultura Brasileira, 3 vols. (Sao Paulo: Ed. Nacional, 1939-1940), 2: 300.

* 1 alqueire = 36.27 litres.

APPENDIX B

YEARLY AVERAGE PRICES OF FOODSTUFFS IN THE SALVADOR MARKET, 1785-1821
(IN REIS)

| YEAR | SUGAR | | MANIOC FLOUR | | RICE | | BEANS | |
|------|-----------|-----------|--------------|-----------|-----------|-----------|-----------|-----------|
| | KG | INDEX | L | INDEX | KG | INDEX | KG | INDEX |
| 1785 | 0.196 | 100 | 0.14 | 100 | 0.56 | 100 | 0.44 | 100 |
| 1787 | data n.a. | data n.a. | 0.19 | 136 | 0.40 | 71 | 0.66 | 150 |
| 1789 | 0.109 | 113 | 0.13 | 93 | 0.53 | 95 | 0.51 | 116 |
| 1791 | 0.125 | 130 | 0.10 | 71 | 0.51 | 91 | 0.38 | 86 |
| 1793 | 0.182 | 190 | 0.15 | 107 | 0.55 | 98 | 0.58 | 132 |
| 1795 | 0.136 | 142 | 0.19 | 136 | 0.55 | 98 | 0.55 | 125 |
| 1796 | 0.143 | 149 | 0.20 | 143 | 0.49 | 88 | 0.55 | 125 |
| 1797 | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. | data n.a. |
| 1799 | data n.a. | data n.a. | 0.32 | 228 | 0.80 | 143 | 0.70 | 159 |
| 1801 | 0.159 | 166 | 0.19 | 136 | 0.98 | 177 | 0.70 | 159 |
| 1803 | 0.142 | 148 | 0.23 | 164 | 0.65 | 116 | 0.67 | 152 |
| 1805 | 0.174 | 181 | 0.12 | 86 | 0.73 | 130 | 0.73 | 166 |
| 1807 | 0.110 | 114 | 0.20 | 143 | 0.58 | 104 | 0.59 | 134 |
| 1809 | 0.111 | 116 | 0.11 | 78 | 0.62 | 111 | 0.35 | 80 |
| 1811 | 0.107 | 111 | 0.21 | 150 | 0.73 | 130 | 0.80 | 182 |
| 1813 | 0.101 | 105 | 0.18 | 128 | 0.75 | 134 | 0.57 | 130 |
| 1815 | 0.191 | 199 | 0.20 | 143 | 0.64 | 114 | 0.53 | 120 |
| 1817 | 0.159 | 166 | 0.45 | 321 | 0.84 | 150 | 0.101 | 230 |
| 1819 | 0.135 | 141 | 0.19 | 136 | 0.69 | 123 | 0.91 | 207 |
| 1821 | 0.120 | 125 | 0.20 | 143 | 0.78 | 139 | 0.89 | 202 |

SOURCE: Katia M. de Queiros Mattoso, Bahia: A Cidade do Salvador e seu Mercado no Seculo XIX (Sao Paulo: HUCITEC, 1978), pp. 303, 311, 313, 314 (Data provided by the author).

APPENDIX C

COMPARISON OF BEEF PRICES AND NUMBER OF CATTLE
SLAUGHTERED IN THE SALVADOR MARKET, 1791-1811

| YEAR | SLAUGHTERED ^a UNITS | INDEX | AVERAGE PRICE ^b REIS/KG | INDEX |
|------|-----------------------------------|-------|---------------------------------------|-----------|
| 1791 | 21,044 | 100 | .41 | 100 |
| 1792 | 15,698 | 75 | .41 | 100 |
| 1793 | 14,852 | 70 | .46 | 112 |
| 1794 | 17,022 | 81 | .54 | 132 |
| 1795 | 14,503 | 69 | .54 | 132 |
| 1796 | 17,201 | 82 | .56 | 137 |
| 1797 | 14,958 | 71 | data n.a. | data n.a. |
| 1798 | 19,626 | 93 | .79 | 193 |
| 1799 | 20,838 | 99 | .82 | 200 |
| 1800 | 17,213 | 82 | .82 | 200 |
| 1801 | 21,522 | 102 | .88 | 215 |
| 1802 | 23,500 | 112 | .86 | 210 |
| 1803 | 19,301 | 92 | .85 | 207 |
| 1804 | 22,019 | 105 | .81 | 198 |
| 1805 | 21,078 | 100 | .84 | 205 |
| 1806 | 21,408 | 102 | .84 | 205 |
| 1807 | 19,010 | 90 | .95 | 232 |
| 1808 | 17,598 | 84 | .84 | 205 |
| 1809 | 19,658 | 93 | .75 | 183 |
| 1810 | 22,637 | 108 | .68 | 166 |
| 1811 | 18,327 | 87 | .87 | 212 |

SOURCE: a) Thales de Azevedo, Povoamento da Cidade do Salvador (Salvador: Itapoa, 1969), p. 331; and b) Katia M. de Queiros Mattoso, Bahia: A Cidade do Salvador e seu Mercado no Seculo XIX (Sao Paulo: HUCITEC, 1978), p. 312 (Data provided by the author).

APPENDIX D

POPULATION DENSITY OF BAHIA, 1872-1920

| MUNICIPIOS | 1872 | 1890 | 1920 |
|--------------------------|-----------|-----------|--------|
| 1. Alagoinhas | 14.89 | 20.04 | 25.10 |
| 2. Alcobaça | 0.67 | 0.90 | 1.56 |
| 3. Amargosa | 6.90 | 9.14 | 29.12 |
| 4. Andaraí | 1.85 | 2.49 | 2.94 |
| 5. Angical | 1.50 | 2.02 | 2.65 |
| 6. Araci | 1.52 | 2.06 | 3.91 |
| 7. Aratuípe | 16.67 | 22.43 | 52.20 |
| 8. Baixa Grande | 4.02 | 5.32 | 11.16 |
| 9. Barra | 0.60 | 0.78 | 1.35 |
| 10. Barra da Estiva | 2.50 | 3.36 | 5.20 |
| 11. Barreiras | 0.16 | 0.22 | 1.07 |
| 12. Belmonte | 1.21 | 1.63 | 5.54 |
| 13. Bom Jesus da Lapa | 2.47 | 3.32 | 1.67 |
| 14. Boninal* | data n.a. | data n.a. | 12.64 |
| 15. Brotas de Macaúbas | 2.70 | 3.64 | 5.23 |
| 16. Brumado | 2.22 | 2.99 | 6.00 |
| 17. Cachoeira | 21.71 | 29.26 | 47.53 |
| 18. Caculé | data n.a. | data n.a. | 7.92 |
| 19. Cairu | 6.09 | 8.14 | 14.92 |
| 20. Gaitite | 2.99 | 4.03 | 9.72 |
| 21. Camamu ^a | 7.13 | 9.66 | 16.25 |
| 22. Camacari | 8.43 | 11.33 | 18.35 |
| 23. Campo Formoso | 0.38 | 0.50 | 3.65 |
| 24. Canavieiras | 0.58 | 0.78 | 3.46 |
| 25. Caravelas | 1.04 | 1.40 | 2.58 |
| 26. Carinhanha | 0.44 | 0.59 | 1.15 |
| 27. Casa Nova | 0.41 | 0.55 | 2.28 |
| 28. Castro Alves | 5.60 | 7.53 | 12.78 |
| 29. Catu | 11.24 | 15.11 | 34.28 |
| 30. Chorrocho* | data n.a. | data n.a. | 2.03 |
| 31. Cicero Dantas | 4.36 | 5.89 | 12.28 |
| 32. Conceição do Almeida | 82.13 | 110.67 | 144.75 |
| 33. Conceição do Coite | 2.27 | 3.00 | 9.33 |
| 34. Conde | 7.02 | 9.45 | 10.96 |
| 35. Condeubá | 2.90 | 3.90 | 8.32 |
| 36. Coração de Maria | 22.22 | 29.43 | 49.31 |
| 37. Correntina | 0.29 | 0.39 | 0.74 |
| 38. Cotejipe | 0.61 | 0.82 | 0.95 |
| 39. Cruz das Almas* | data n.a. | data n.a. | 73.76 |
| 40. Crisópolis* | data n.a. | data n.a. | 35.25 |
| 41. Curaca | 0.88 | 1.19 | 2.46 |
| 42. Entre Rios | 6.97 | 9.38 | 14.03 |
| 43. Euclides da Cunha* | data n.a. | data n.a. | 2.45 |
| 44. Feira de Santana | 15.14 | 20.37 | 36.04 |
| 45. Gentio do Ouro | 0.77 | 1.03 | 2.14 |

APPENDIX D (CONT'D)

| | MUNICIPIOS | 1872 | 1890 | 1920 |
|-----|------------------------|-----------|-----------|-------|
| 46. | Gloria | 0.47 | 1.63 | 1.80 |
| 47. | Guanambi* | data n.a. | data n.a. | 5.56 |
| 48. | Ibitiara | 1.41 | 1.86 | 7.60 |
| 49. | Ilheus | 1.03 | 1.38 | 17.70 |
| 50. | Inhambupe | 4.31 | 7.12 | 13.07 |
| 51. | Ipira | 2.68 | 3.60 | 16.63 |
| 52. | Irara | 27.51 | 37.03 | 31.24 |
| 53. | Itaberaba | 1.33 | 1.79 | 3.89 |
| 54. | Itabuna* | data n.a. | data n.a. | 10.43 |
| 55. | Itacare | 2.33 | 3.12 | 15.70 |
| 56. | Itaparica | 46.54 | 62.61 | 64.32 |
| 57. | Itapicuru | 4.68 | 6.30 | 5.97 |
| 58. | Ituacu | 1.72 | 2.31 | 5.25 |
| 59. | Itubera | 3.70 | 4.96 | 11.34 |
| 60. | Jacaraci | 11.10 | 14.99 | 12.16 |
| 61. | Jacobina | 2.39 | 3.20 | 5.99 |
| 62. | Jaguaripe | 7.10 | 9.54 | 13.21 |
| 63. | Jandaíra | 8.23 | 10.85 | 11.12 |
| 64. | Jequié* | data n.a. | data n.a. | 8.21 |
| 65. | Jequirica | 9.57 | 12.84 | 50.41 |
| 66. | Jeremoabo | 2.23 | 3.00 | 2.03 |
| 67. | Juazeiro | 1.13 | 1.52 | 3.50 |
| 68. | Laje* | data n.a. | data n.a. | 28.90 |
| 69. | Lencois | 7.68 | 10.35 | 5.70 |
| 70. | Macaubas | 3.02 | 4.06 | 5.99 |
| 71. | Macajuba* | data n.a. | data n.a. | 12.07 |
| 72. | Mairi | 6.83 | 9.18 | 20.37 |
| 73. | Maracas | 0.83 | 1.12 | 5.58 |
| 74. | Maragogipe | 27.64 | 36.69 | 65.02 |
| 75. | Marau | 3.39 | 4.53 | 22.84 |
| 76. | Mata de Sao Joao | 16.17 | 21.92 | 15.00 |
| 77. | Monte Santo | 0.71 | 0.95 | 3.72 |
| 78. | Morro do Chapéu | 0.52 | 0.70 | 2.87 |
| 79. | Mucuje | 4.78 | 6.43 | 4.14 |
| 80. | Mucufi | 1.23 | 1.64 | 14.40 |
| 81. | Mundo Novo | 1.31 | 1.75 | 9.64 |
| 82. | Muritiba* | data n.a. | data n.a. | 51.08 |
| 83. | Nazare | 40.65 | 54.68 | 73.66 |
| 84. | Nilo Peçanha | 2.03 | 2.71 | 12.26 |
| 85. | Nova Soure | 9.08 | 12.20 | 11.48 |
| 86. | Oliveira dos Brejinhos | 1.34 | 1.80 | 3.74 |
| 87. | Palmas de Monte Alto | 1.91 | 2.57 | 2.96 |
| 88. | Palmeiras | 3.25 | 4.35 | 11.84 |
| 89. | Paramirim | 4.54 | 6.11 | 8.49 |
| 90. | Paratinga | 4.45 | 5.99 | 4.46 |
| 91. | Paripiranga | 11.64 | 15.43 | 14.31 |
| 92. | Piata | 9.37 | 12.61 | 11.78 |
| 93. | Pilão Arcado | 1.48 | 1.99 | 1.53 |
| 94. | Poços | 0.65 | 0.87 | 2.35 |

APPENDIX D (CONT'D)

| MUNICIPIOS | 1872 | 1890 | 1920 |
|-------------------------------|-----------|-----------|--------|
| 95. Pojuca* | data n.a. | data n.a. | 34.84 |
| 96. Porto Seguro ^b | 0.86 | 1.09 | 1.00 |
| 97. Prado | 0.39 | 0.87 | 2.00 |
| 98. Queimadas | 0.56 | 0.76 | 4.18 |
| 99. Remanso | 0.74 | 0.99 | 3.11 |
| 100. Riachao do Jacuipe | 1.93 | 2.59 | 5.14 |
| 101. Riacho de Santana | 1.67 | 2.56 | 5.07 |
| 102. Ribeira do Amparo | 3.30 | 4.42 | 7.52 |
| 103. Ribeira do Pombal | 4.10 | 5.49 | 12.50 |
| 104. Rio de Contas | 4.60 | 6.19 | 9.43 |
| 105. Rio Real | 12.35 | 16.72 | 17.64 |
| 106. Rui Barbosa* | data n.a. | data n.a. | 8.65 |
| 107. Salvador | 150.65 | 203.51 | 330.71 |
| 108. Santa Cruz de Cabralia | 0.50 | 0.67 | 1.23 |
| 109. Santa Maria da Vitoria | 1.81 | 2.43 | 2.60 |
| 110. Santa Rita de Cassia | 0.65 | 0.88 | 0.73 |
| 111. Santana | 1.34 | 1.80 | 5.50 |
| 112. Santa Terezinha | 3.51 | 4.73 | 8.22 |
| 113. Santo Amaro | 40.49 | 53.49 | 68.71 |
| 114. Santo Antonio de Jesus | 28.90 | 38.85 | 73.78 |
| 115. Sao Felipe | 45.30 | 60.03 | 87.64 |
| 116. Sao Felix | 42.02 | 56.57 | 88.97 |
| 117. Sao Francisco do Conde | 23.36 | 31.46 | 42.77 |
| 118. Sao Goncalo dos Campos | 29.79 | 39.89 | 45.88 |
| 119. Sao Miguel das Matas | 32.87 | 44.20 | 56.62 |
| 120. Saude* | data n.a. | data n.a. | 4.48 |
| 121. Seabra | 1.65 | 2.22 | 6.28 |
| 122. Senhor do Bonfim | 2.37 | 3.40 | 7.63 |
| 123. Sento Se | 0.48 | 0.64 | 1.52 |
| 124. Serrinha | 1.96 | 2.62 | 15.30 |
| 125. Taperoa | 5.33 | 4.55 | 12.87 |
| 126. Tucano | 1.58 | 2.12 | 4.06 |
| 127. Ubaira | 6.82 | 9.19 | 23.35 |
| 128. Una | 1.82 | 2.44 | 3.46 |
| 129. Urandi | 2.68 | 3.60 | 9.92 |
| 130. Valenca | 8.10 | 10.83 | 12.70 |
| 131. Vicosa | 2.93 | 3.93 | 6.08 |
| 132. Vitoria da Conquista | 0.76 | 0.90 | 5.64 |
| 133. Wagner* | data n.a. | data n.a. | 7.16 |
| 134. Xique-Xique | 1.38 | 1.84 | 1.73 |
| BAHIA | 2.46 | 3.43 | 5.95 |

SOURCE: Francisco Vicente Vianna, Memoria sobre o Estado da Bahia (Bahia: Typographia e Encadernacao do Diario da Bahia, 1893), pp. 102-104 and Brasil, Diretoria Geral de Estatistica do Ministerio da Agricultura, Industria e Comercio, Recenseamento Geral do Brasil, 1920, vol. 4, 4a. Parte (Rio de Janeiro: IBGE), pp. 502-536.

APPENDIX D (CONT'D)

* Municipio aggregated to other municipio in 1872 and 1890.

^a Igrapiuna municipio is aggregated.

^b Trancoso municipio is aggregated.

APPENDIX E

LOCATION QUOTIENT INDICES, 1920

| MUNICIPIOS | CATTLE DENSITY INDEX | CROPPED AREA INDEX |
|--------------------------|----------------------|--------------------|
| 1. Alagoinhas | 2.60 | 0.50 |
| 2. Alcobaça | 0.40 | 0.60 |
| 3. Amargosa | 2.60 | 1.36 |
| 4. Andaraí | 0.20 | 0.02 |
| 5. Angical | 1.20 | 0.46 |
| 6. Araçá | 1.80 | 0.12 |
| 7. Aratuípe | 1.40 | 0.56 |
| 8. Baixa Grande | 3.20 | 1.32 |
| 9. Barra | 0.40 | 0.04 |
| 10. Barra da Estiva | 0.80 | 1.16 |
| 11. Barreiras | 0.17 | 0.30 |
| 12. Belmonte | 0.60 | 3.92 |
| 13. Bom Jesus da Lapa | 0.80 | 0.04 |
| 14. Boninal | 0.40 | 0.10 |
| 15. Brotas de Macaúras | 0.80 | 1.08 |
| 16. Brumado | 1.80 | 3.16 |
| 17. Cachoeira | 3.40 | 0.66 |
| 18. Caculé | 1.80 | 0.40 |
| 19. Cairu | 0.60 | 5.74 |
| 20. Caitite | 1.40 | 0.34 |
| 21. Camamu | 0.80 | 3.02 |
| 22. Camacari | 1.60 | 1.18 |
| 23. Campo Formoso | 0.60 | 0.80 |
| 24. Canavieiras | 0.20 | 4.18 |
| 25. Caravelas | 0.20 | 1.42 |
| 26. Carinhanha | 0.60 | 0.20 |
| 27. Casa Nova | 0.40 | 0.08 |
| 28. Castro Alves | 1.60 | 0.64 |
| 29. Catu | 5.40 | 0.86 |
| 30. Chorrocho | 0.80 | 0.22 |
| 31. Cicero Dantas | 3.00 | 2.88 |
| 32. Conceicao do Almeida | 5.40 | 1.40 |
| 33. Conceicao do Coite | 2.20 | 0.50 |
| 34. Conde | 1.00 | 0.34 |
| 35. Condeuba | 1.40 | 0.70 |
| 36. Coracao de Maria | 3.60 | 1.36 |
| 37. Correntina | 0.00 | 0.52 |
| 38. Cotejipe | 0.80 | 0.10 |
| 39. Cruz das Almas | 2.80 | 7.56 |
| 40. Crisópolis | 5.20 | 0.50 |
| 41. Curaca | 1.40 | 0.14 |
| 42. Entre Rios | 1.80 | 0.22 |
| 43. Euclides da Cunha | 0.80 | 0.96 |
| 44. Feira de Santana | 5.00 | 1.20 |
| 45. Gentio do Ouro | 0.80 | 0.98 |
| 46. Gloria | 1.00 | 0.04 |
| 47. Guanambi | 1.80 | 2.22 |

APPENDIX E (CONT'D)

| MUNICIPIOS | CATTLE DENSITY INDEX | CROPPED AREA INDEX |
|-------------------------------|----------------------|--------------------|
| 48. Ibitiara | 0.40 | 0.18 |
| 49. Ilheus | 0.40 | 6.10 |
| 50. Inhambupe | 1.80 | 0.48 |
| 51. Ipira | 2.20 | 0.10 |
| 52. Irara | 5.60 | 1.72 |
| 53. Itaberaba | 1.40 | 0.30 |
| 54. Itabuna | 0.20 | 5.90 |
| 55. Itacare | 0.60 | 3.36 |
| 56. Itaparica | 1.40 | 0.96 |
| 57. Itapicuru | 1.40 | 0.24 |
| 58. Ituacu | 1.40 | 0.50 |
| 59. Itubera | 0.20 | 3.22 |
| 60. Jacaraci | 0.80 | 0.58 |
| 61. Jacobina | 1.20 | 0.44 |
| 62. Jaguaripe | 0.40 | 0.28 |
| 63. Jandaira | 0.60 | 0.80 |
| 64. Jequie | 0.60 | 1.82 |
| 65. Jequirica | 1.60 | 1.00 |
| 66. Jeremoabo | 1.00 | 0.20 |
| 67. Juazeiro | 0.80 | 0.02 |
| 68. Laje | 0.91 | 0.28 |
| 69. Lencois | 0.18 | 0.16 |
| 70. Macaubas | 1.00 | 1.52 |
| 71. Macajuba | 6.00 | 0.32 |
| 72. Mairi | 4.60 | 0.26 |
| 73. Maracas | 1.60 | 1.42 |
| 74. Maragogipe | 4.60 | 2.08 |
| 75. Marau | 2.40 | 3.80 |
| 76. Mata de Sao Joao | 1.20 | 0.48 |
| 77. Monte Santo | 1.20 | 0.18 |
| 78. Morro do Chapcu | 0.60 | 0.72 |
| 79. Mucujê | 0.20 | 0.30 |
| 80. Mucuri | 0.40 | 0.98 |
| 81. Mundo Novo | 3.80 | 0.28 |
| 82. Muritiba | 4.20 | 3.24 |
| 83. Nazare | 1.40 | 0.48 |
| 84. Nilo Pecanha | 0.40 | 2.42 |
| 85. Nova Soure | 3.60 | 1.46 |
| 86. Oliveira dos Brejinhos | 1.20 | 2.40 |
| 87. Palmas de Monte Alto | 1.00 | 0.52 |
| 88. Palmeiras | 1.00 | 3.88 |
| 89. Paramirim | 2.40 | 4.40 |
| 90. Paratinga | 1.80 | 0.14 |
| 91. Paripiranga | 1.40 | 3.68 |
| 92. Piata | 1.20 | 4.64 |
| 93. Pilao Arcado | 0.20 | 1.68 |
| 94. Pócoes | 0.10 | 0.44 |
| 95. Pojuçã | 5.20 | 0.66 |
| 96. Porto Seguro ^b | 0.00 | 0.52 |
| 97. Prado | 0.20 | 0.80 |

APPENDIX E (CONT'D)

| MUNICIPIOS | CATTLE DENSITY INDEX | CROPPED AREA INDEX |
|-----------------------------|-----------------------------------|---|
| 98. Queimadas | 1.60 | 0.04 |
| 99. Remanso | 0.80 | 0.20 |
| 100. Riachao do Jacuipé | 2.20 | 0.80 |
| 101. Riacho de Santana | 2.20 | 0.60 |
| 102. Ribeira do Amparo | 2.60 | 7.00 |
| 103. Ribeira do Pombal | 6.00 | 3.80 |
| 104. Rio de Contas | 1.00 | 1.22 |
| 105. Rio Real | 2.80 | 2.40 |
| 106. Rui Barbosa | 2.60 | 0.60 |
| 107. Salvador | 3.20 | 1.40 |
| 108. Santa Cruz de Cabralia | 0.00 | 0.80 |
| 109. Santa Maria da Vitória | 0.20 | 0.92 |
| 110. Santa Rita de Cassia | 0.40 | 0.06 |
| 111. Santana | 0.60 | 0.12 |
| 112. Santa Terezinha | 1.20 | 0.60 |
| 113. Santo Amaro | 6.00 | 1.60 |
| 114. Santo Antônio de Jesus | 3.20 | 3.40 |
| 115. São Felipe | 5.60 | 3.80 |
| 116. São Felix | 6.40 | 2.80 |
| 117. São Francisco do Conde | 6.40 | 1.20 |
| 118. São Gonçalo dos Campos | 5.80 | 1.20 |
| 119. São Miguel das Matas | 2.00 | 2.40 |
| 120. Saude | 0.60 | 2.00 |
| 121. Seabra | 0.40 | 1.40 |
| 122. Senhor do Bonfim | 1.00 | 0.20 |
| 123. Sento Sê | 0.80 | 2.40 |
| 124. Serrinha | 2.40 | 1.60 |
| 125. Taperoá | 0.40 | 5.80 |
| 126. Tucano | 0.60 | 0.40 |
| 127. Ubaira | 2.20 | 1.80 |
| 128. Una ^a | 0.00 | 3.00 |
| 129. Urandi ^b | 2.20 | 0.46 |
| 130. Valença | 0.60 | 4.00 |
| 131. Vicosa | 1.40 | 2.20 |
| 132. Vitória da Conquista | 1.60 | 0.12 |
| 133. Wagner | 1.40 | 0.40 |
| 134. Xique-Xique | 0.80 | 0.60 |
| BAHIA | Cattle density: 5/km ² | Proportion of cropped area to total farm land: 5% |

SOURCE: Brasil, Diretoria Geral de Estatística do Ministerio da Agricultura, Industria e Comercio, Recenseamento Geral do Brasil, 1920, vol. 3, tomo 1 2a. Parte (Rio de Janeiro: IBGE), pp. 250-259, 390-394.

^a Igrapiuna município is aggregated.

^b Trancoso município is aggregated.

APPENDIX F1

SUMMARY RESULTS FOR THE STEPWISE REGRESSION MODEL

PERENNIAL CROPS (Y₀)

| STATISTICS | 1940 | | | 1950 | | | 1960 | | | 1970 | | |
|-------------------|-----------------------|----------------------|--|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|----------------------|
| | AAR (x ₂) | FS (x ₃) | | AAR (x ₂) | FS (x ₃) | DSL (x ₁) | AAR (x ₂) | FS (x ₃) | DSL (x ₁) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) |
| N | 56.01** | 56.63 | | 53.81** | 54.96 | 55.02 | 51.39** | 51.50 | 51.54 | 54.44** | 55.24 | 55.39 |
| R ² | 31.37** | 32.07 | | 28.95** | 30.20 | 30.27 | 26.41** | 26.52 | 26.57 | 29.64** | 30.51 | 30.68 |
| b | 0.022** | -0.002 | | 0.022** | -0.008 | 0.002 | 0.024** | -0.003 | -0.003 | 0.021** | -0.010 | 0.006 |
| Std. err. | 0.002 | 0.001 | | 0.003 | 0.005 | 0.007 | 0.003 | 0.009 | 0.009 | 0.003 | 0.008 | 0.009 |
| Beta ¹ | 0.557 | -0.083 | | 0.557 | -0.118 | 0.031 | 0.500 | -0.025 | -0.027 | 0.488 | -0.100 | -0.041 |
| a | -9.413 | | | | -12.143 | | | -9.818 | | | -6.398 | |

** Significant on the 99 percent level.

* Significant on the 95 percent level.

¹ Standardized regression coefficient.

APPENDIX F2
 SUMMARY RESULTS FOR THE STEPWISE REGRESSION MODEL
 TEMPORARY CROPS (y₁)

| STATISTICS | 1940 | | | 1950 | | | 1960 | | | 1970 | | |
|-------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|
| | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) |
| R | 21.73** | 28.57* | 28.73 | 34.96** | 44.52** | 45.48 | 42.09** | 59.98* | 46.81** | 56.31** | 57.31 | 56.31** |
| R ² | 4.72** | 8.16* | 8.25 | 12.22** | 19.82** | 20.68 | 17.71** | 35.98* | 21.91** | 31.71** | 32.85 | 31.71** |
| b | -0.005** | -0.008* | -0.003 | -0.025** | -0.008** | 0.010 | -0.064** | -0.007* | -0.060** | 0.020** | -0.004 | 0.020** |
| Std. err. | 0.002 | 0.003 | 0.009 | 0.005 | 0.003 | 0.008 | 0.008 | 0.003 | 0.007 | 0.006 | 0.002 | 0.006 |
| Beta ₁ | -0.218 | -0.205 | -0.036 | -0.369 | -0.213 | 0.114 | -0.502 | -0.108 | -0.525 | 0.250 | -0.126 | 0.250 |
| a | | 38.130 | | | 31.415 | | | 28.120 | | 23.021 | | 23.021 |

** Significant on the 99 percent level.
 * Significant on the 95 percent level.
 Standardized regression coefficient.

APPENDIX F3
 SUMMARY RESULTS FOR THE STEPWISE REGRESSION MODEL
 MIXED PASTURE (y₂)

| STATISTICS | 1940 | | | 1950 | | | 1960 | | | 1970 | | |
|-------------------|-----------------------|----------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|
| | AAR (x ₂) | FS (x ₃) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) |
| R | 29.57** | 38.55** | 38.64 | 36.06** | 42.78** | 43.82 | 34.56** | 39.23** | 43.17** | 39.45** | 49.64** | 50.09 |
| -R ² | 8.74** | 14.86** | 14.92 | 13.00** | 18.30** | 19.20 | 11.94** | 15.39** | 18.63** | 15.56** | 24.64** | 25.09 |
| b | -0.013** | 0.007** | 0.003 | 0.034** | -0.014** | -0.013 | 0.068** | -0.016** | -0.030** | 0.066** | -0.174** | -0.009 |
| Std. err. | 0.004 | 0.002 | 0.011 | 0.006 | 0.004 | 0.010 | 0.014 | 0.004 | 0.011 | 0.011 | 0.003 | 0.009 |
| Beta ¹ | -0.268 | 0.241 | 0.032 | 0.391 | 0.293 | -0.116 | 0.411 | -0.308 | -0.225 | 0.391 | -0.344 | -0.081 |
| a | | 71.306 | | | 80.728 | | | 81.698 | | | 83.377 | |

** Significant on the 99 percent level.

* Significant on the 95 percent level.

¹ Standardized regression coefficient.

APPENDIX F4

SUMMARY RESULTS FOR THE STEPWISE REGRESSION MODEL

IMPROVED PASTURE (Y₃)

| | 1950 | | | 1960 | | | 1970 | | |
|-------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|
| STATISTICS | AAR (x ₂) | FS (x ₃) | DSL (x ₁) | AAR (x ₂) | FS (x ₃) | DSL (x ₁) | AAR (x ₂) | FS (x ₃) | DSL (x ₁) |
| R | 13.53 | 19.04 | 19.11 | 42.85 | 42.55** | 42.87 | 27.52 | 22.66** | 27.30* |
| R ² | 1.83 | 3.62 | 3.65 | 18.36 | 18.11** | 18.38 | 7.57 | 5.13** | 7.45* |
| b | -0.096 | 0.011 | 0.002 | -0.002 | 0.061** | 0.001 | -0.002 | 0.035** | 0.017* |
| Std. err. | 0.004 | 0.007 | 0.011 | 0.003 | 0.010 | 0.009 | 0.004 | 0.013 | 0.011 |
| Beta ₁ | -0.127 | 0.129 | 0.019 | -0.041 | 0.422 | 0.015 | -0.040 | 0.197 | 0.133 |
| a | 32.712 | | | 20.527 | | | 22.630 | | |

** Significant on the 99 percent level.

* Significant on the 95 percent level.

† Standardized regression coefficient.

APPENDIX F5

SUMMARY RESULTS FOR THE STEPWISE REGRESSION MODEL

| STATISTICS | 1950 | | | 1960 | | | 1970 | | |
|----------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|--------------------------|--------------------------|-------------------------|
| | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) | AAR (x ₂) | DSL (x ₁) | FS (x ₃) |
| R | 19.97** | 21.52 | 23.58 | 15.34* | 25.36* | 25.77 | 18.96* | 24.07* | 29.81* |
| R ² | 3.99* | 4.63 | 5.56 | 2.35* | 6.43* | 6.64 | 3.59* | 5.79* | 8.88* |
| b | 0.023** | -0.008 | -0.015 | -0.014* | -0.031* | 0.007 | -0.015* | -0.026* | 0.030* |
| Std. err. | 0.008 | 0.005 | 0.012 | 0.004 | 0.011 | 0.001 | 0.004 | 0.010 | 0.012 |
| Beta1 | 0.228 | -0.144 | -0.118 | -0.291 | -0.257 | 0.048 | -0.295 | -0.217 | 0.179 |
| a | | 48.016 | | | 61.170 | | | 60.746 | |

** Significant on the 99 percent level.

* Significant on the 95 percent level.

1 Standardized regression coefficient.

SOURCES on which the computer outputs are based: Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola: Estado da Bahia, 1940 (Rio de Janeiro: IBGE), pp. 41-43, 127-276; Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola 1950, Bahia (Rio de Janeiro: IBGE), pp. 42-53, 63-65; Brasil, Instituto Brasileiro de Geografia e Estatística, Censo Agrícola de 1960, Bahia (Rio de Janeiro: IBGE), pp. 34-63; Brasil, Fundação Instituto Brasileiro de Geografia e Estatística, Censo Agropecuario: Bahia, 1970 (Rio de Janeiro: DECEN), pp. 156-185; Bahia, Secretaria do Planejamento Ciência e Tecnologia/DGE, Anuario Estatístico da Bahia, 1973, vol. 2, t. 1 (Salvador: 1975), pp. 16-22; and Bahia, Secretaria do Planejamento Ciência e Tecnologia/CEPLAB, Atlas Climatológico do Estado da Bahia, doc. 2: Análise Espacial da Pluviosidade (Salvador: CEPLAB, 1976), pp. 77-151.

APPENDIX G

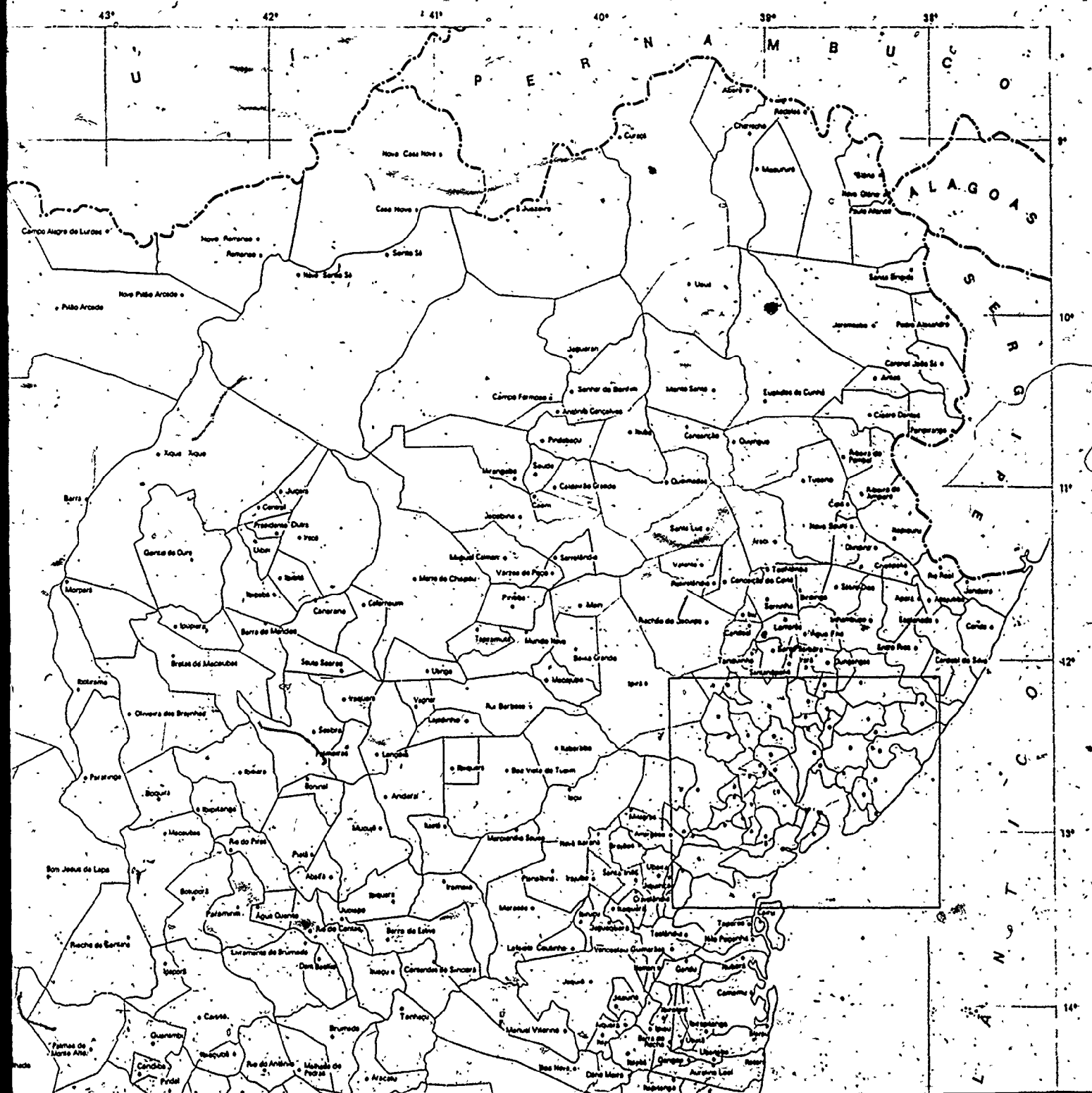
GLOSSARY OF PORTUGUESE TERMS

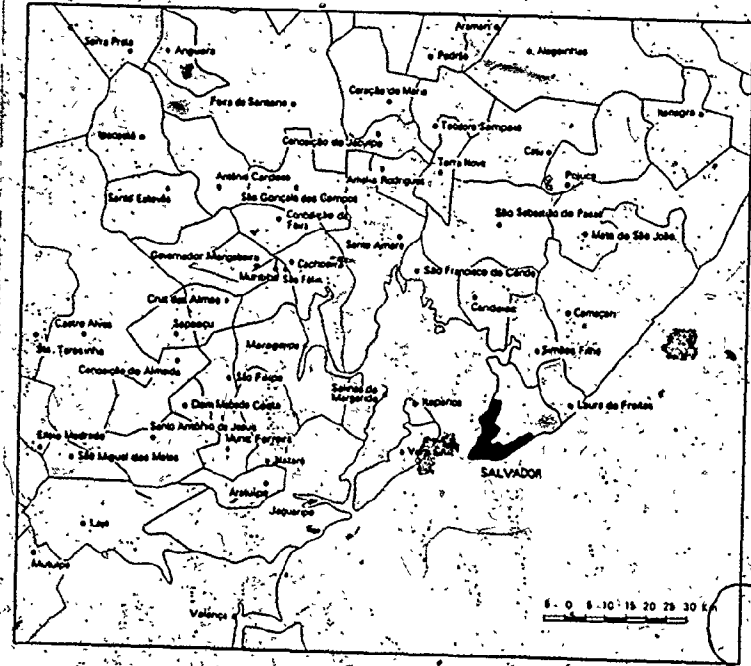
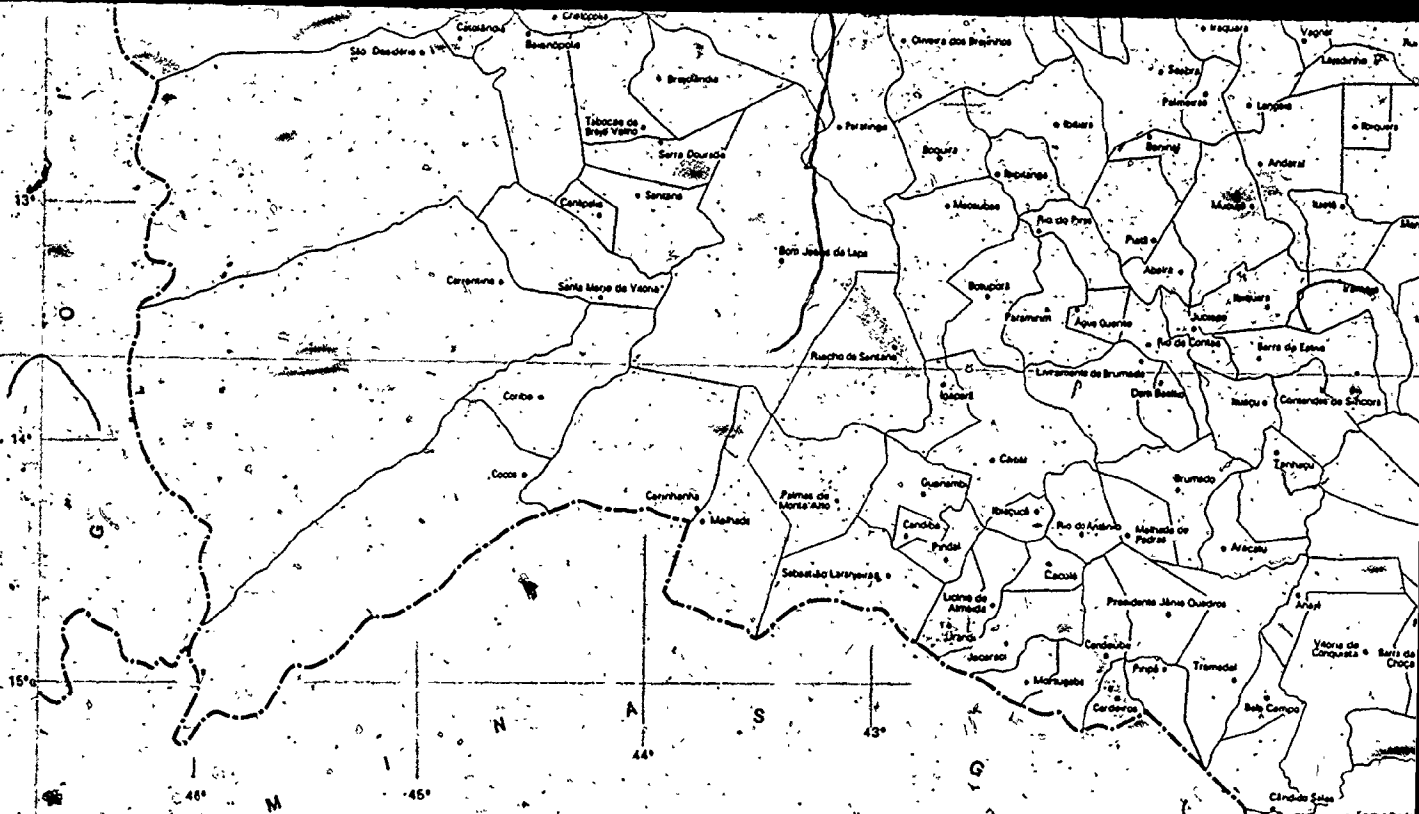
- AGREGADO, peasant living on ranch under the condition of working free for the landlord once or twice a week.
- AGRESTE, transition vegetation characterized by the loss of leaves during the dry season and the dominance of species without thorns.
- ARROBA, Brazilian measure of weight equivalent to 14.75 kilograms.
- BANGUE, small animal-driven sugar mill.
- BARCACA, platform to ferment and dry cocoa seeds.
- CAATINGA, thorn-scrub forest characterized by xerophilous species not higher than three meters.
- CANTEIRO, small manured area to plant tobacco.
- CERRADO, type of savanna characterized by short and twisted trees, less than two meters in height and a sparse cover of grasses and other bushes less than half a meter high.
- CONTO, Brazilian old currency equivalent to 1,000,000 of reis.
- CONTRATISTA, special type of tenant hired to plant cocoa trees.
- CURRAL, manured field to plant tobacco.
- DIZIMO, tax equivalent to one-tenth of revenue.
- DONATARIO, owner of a captaincy.
- ENGENHO DE ACUCAR, sugar mill.
- ENGENHO DE TRES PAUS, sugar mill having three upright rollers.
- ENGENHO REAL, water-driven sugar mill.
- ENGENHOCA, see BANGUE.
- FARINHA DE PAU, flour made of manioc.
- FAZENDA, farm.
- FORNECEDOR DE CANA, sugar cane supplier of sugar factory.
- FORO, annual taxation of a property.
- INVERNADA, area of commercial transhumance to fatten cattle.
- LAVRADOR DE CANA, sugar cane planter.

- MASSAPE, heavy dark clay soil of Cretaceous origin.
- MATA, Brazilian popular term for forest.
- MIL REIS, Brazilian currency before 1940s..
- MUNICIPIO, a political unit roughly equivalent to an American county.
- PARTIDO, sugar cane field having a square shape.
- POSSEIRO, squatter.
- QUINTO, tax equivalent to one-fifth of a revenue.
- REDIZIMO, tax equivalent to one-twentieth of revenue.
- RESOCA, sugar cane ratoon of second year.
- ROCA, Brazilian farming method of land rotation.
- SALAO, light reddish soil of lower fertility used to grow sugar cane.
- SENHOR DE ENHENHO, mill owner.
- SERTAO, place farther away from the coastline.
- SESMARIA, individual land grant smaller than a captaincy usually measuring between 10,000 and 13,000 hectares.
- SESMEIRO, owner of sesmaria (see sesmaria).
- SITIO, small farm.
- SOCA, sugar cane ratoon of first year.
- TABULEIRO, flat-topped plateau landform.
- TABULEIRO SOIL, sandy and porous soil used to grow tobacco, manioc, cereals, etc.
- TAREFA, Brazilian measure of area equivalent to 0.44 hectare.
- TRAPICHE, animal-driven sugar mill.
- VAQUEIRO, cowboy.
- VARZEA, flood plain land.
- VINTENA, tax equivalent to one-twentieth of the sale of brazilwood.
- USINA, sugar factory.
- USINEIRO, sugar factory owner.
- ZEBU, Indian cattle breed.

IVA

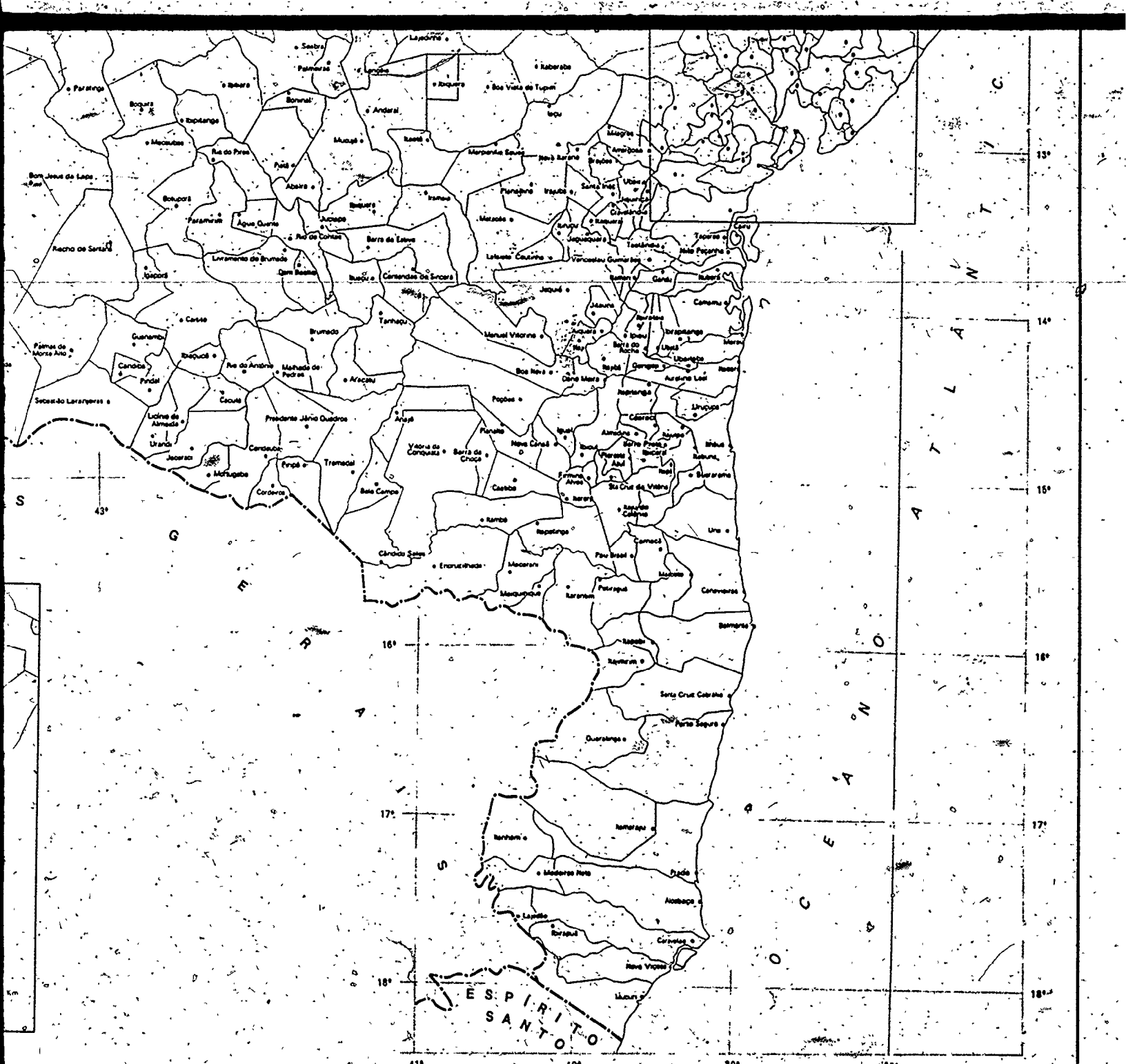
ATLAS DO ESTADO DA BAHIA





S.E.P.L.A.N.T.E.C.
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