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## ABSTRACT

### A GEOGRAPHICAL STUDY OF RURAL SERVICE CENTERS IN MERIDA STATE, VENEZUELA

By

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The investigation concentrates on thirty-six rural settlements in the State of Mérida, in western Venezuela. Central place theory was used as a theoretical base to examine two major problems: 1) the nature and degree of the relationship between population and functional importance of the centers, and 2) the extent to which the settlements conform to hierarchical arrangement according to their functional importance. Three hypotheses were proposed in the study:

1. There is a close and positive linear relationship between the number of central functions performed in the settlements and the size of their populations.
2. There is a close and positive linear relationship between the number of functional units found in the centers and the size of their populations.
3. A defined hierarchy of settlements can be identified from an objective classification of

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the centers according to their number of functional units.

Rural service centers were defined on the basis of the following criteria: 1) they must be capitals of rural municipios, and 2) they must have populations of less than 2,500. The centers selected ranged, thus, from 108 to 2,294 inhabitants.

Data on functional composition of the settlements were gathered through fieldwork. From thirty-eight central functions found, those of a political and administrative nature were disregarded for the following reasons: 1) they generally depend on external subsidies so that their presence in a given center depends not only upon the overall level of demand but also upon government decisions. Therefore, one cannot assume a high correlation between the number of these functions and the effective demand of a settlement, and 2) with the exception of churches, none of these functions occurred more than once in each center. Consequently, in terms of number of functional units they do not prove useful in defining the relative importance of a settlement. The final list included twenty-four central functions generated by effective demand (economic activities).

The two first hypotheses were investigated by means of simple correlation and regression analysis. The coefficients of correlation found were .959 and .937, respectively, which would be significant at .001 level if the data could be considered as a random sample. The latter hypothesis was



examined through multivariate analysis. By applying factor analysis, a grouping routine and discriminant analysis, five groups of settlements were derived. The hierarchical dimension of the groups was analyzed based upon the forms of hierarchical arrangement of settlements pointed out by Garner.<sup>1</sup> It was found that the rural service centers of Mérida State conform to a vertical hierarchy with no explicit spatial expression.

Finally, a general framework, based on the concepts of rural growth center and functional hierarchy, was proposed to select key centers for the implementation of rural development services.

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<sup>1</sup>B. J. Garner, "Models of Urban Geography and Settlement Location," in Socioeconomic Models in Geography. Edited by Richard J. Chorley and Peter Haggett. London: Methuen, 1970, pp. 303-360.

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By

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## CHAPTER I

### INTRODUCTION

The distributional pattern of human settlements varies from isolated farmsteads to large urban centers, each type having its own importance within the entire settlement network. Centralizing principles of organization and coherence are basic to settlements everywhere. Consequently, aspects of agglomeration or concentration are of vital interest in settlement geography.

The systematic study of the spatial structure of settlements on a theoretical basis was first undertaken by Walter Christaller in 1933.<sup>1</sup> He postulated a general deductive theory to explain the size, number and distribution of settlements. Since then central place theory has been an important part of geography. Although its more frequent applications are found in urban geography, it began with the study of rural centers or villages. Thus, the generalizations or laws associated with central place studies should hold not only for cities but for all sizes of centers. However,

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<sup>1</sup>Walter Christaller, Central Places in Southern Germany, trans. Carlisle W. Baskin (New Jersey: Englewood Cliffs, 1966).

most planners and scholars have neglected rural settlement studies to some extent, perhaps due to the lack of adequate data. In present day Latin America, however, the complex problems associated with heavy internal migration have necessitated comprehensive research on the structure and evolution of rural settlements.

### Problem

Central place theory is used in this study as a general framework to analyze a set of rural centers in the State of Mérida, Venezuela. Specifically, the study is concerned with two postulates implied in the theory: 1) the size of a settlement is closely associated with its functional importance, and 2) settlements can be graded in a hierarchical class system based upon functional units.

Central place theory, as presently perceived, comprises diverse facets, including the size and spacing of centers, locational patterns and grouping of retail activities, consumer travel behavior and trade areas.<sup>2</sup>

Two aspects relevant to central place theory have been investigated in this study:

1. The nature and degree of inter-relationship between the population of thirty-six rural settlements and their functional importance,

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<sup>2</sup>Brian J. L. Berry, H. Gardiner Barnum and Robert J. Tennant, "Retail Location and Consumer Behavior," Papers and Proceedings of the Regional Science Association 9 (1962): 65.

2. The extent to which the rural centers conform to a hierarchical arrangement according to their functional importance.

### Theoretical Considerations

The nature of classic central place theory has been discussed by several authors.<sup>3</sup> The cornerstone of Christaller's theory is the notion of a functional interdependence between a town and its surrounding rural area. For every central place there exists a complementary area the size of which varies according to the distance over which the surrounding rural population is willing to travel to obtain any particular good or service. This distance was termed "the range of a good." On the basis of this concept, and using economic arguments, Christaller defined an optimal spatial structure for a hierarchy of centers distributed on an isotropic surface. He stated that settlements would be regularly spaced and centrally located within hexagonal market areas (Figure 1). The hierarchical dimension in this model arises from the assumption that higher-order centers supply all the goods and services offered by lower order centers, together with a number of higher-order goods and services distinctive to themselves. The centers offering lower-order goods and services would be more numerous and less widely spaced than

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<sup>3</sup>See for example: Brian J. L. Berry, Geography of Market Centers and Retail Distribution (New Jersey: Prentice-Hall, 1967) and, John U. Marshall, The Location of Service Towns (Toronto: University of Toronto Press, 1969).

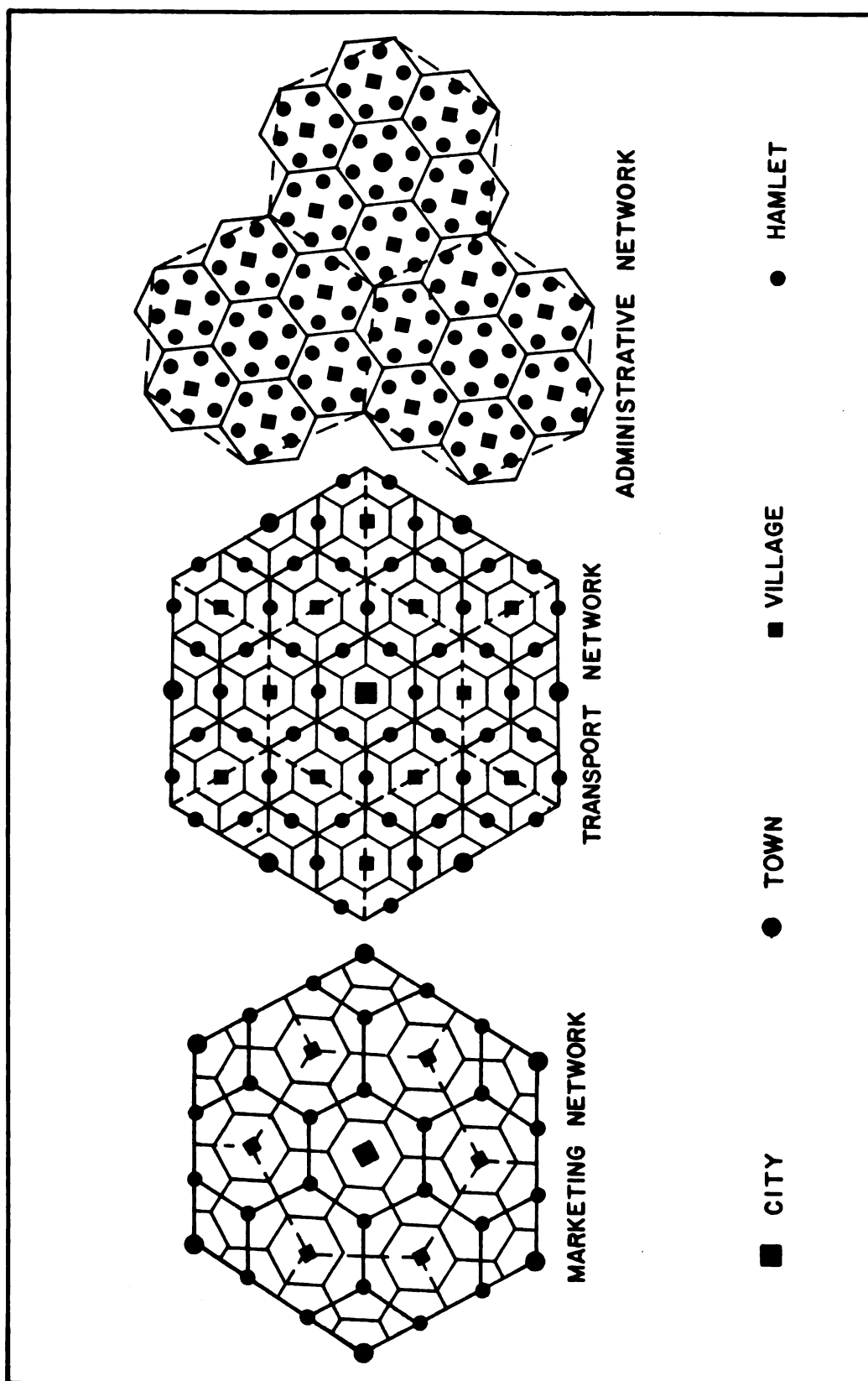


FIGURE 1. CHRISTALLER'S REGULAR LATTICE MODELS

(After John U. Marshall, pgs.21, 30 and 32 )

higher-order centers. Consequently, the position of a central place within the hierarchy would depend upon its functional structure expressed by a measure of "centrality." The pattern is such that central places with low centrality would be "nesting" within the market areas of higher-order places according to a definite rule. Christaller described this system as organized according to a "marketing principle." He also postulated two alternative hierarchies arranged according to 1) a "transport principle" which permits the hierarchy to maximize the number of centers located on major routes, and 2) an "administrative principle" requiring political-social separation of complementary areas. The interaction of the three principles generally produces the spatial structure of central places.

During the past thirty years Christaller's theory has undergone considerable modification, particularly by Lösch, in an attempt to make the spatial hierarchy less rigid. Accordingly to Lösch, centers of the same size do not necessarily have the same functions nor do the functions of large centers always subsume those of smaller centers.<sup>4</sup>

A second modification was made by Berry and Garrison, who used the concepts of range of a good and population threshold to simplify the theory in a manner that no longer

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<sup>4</sup>August Lösch, The Economics of Location, trans. William H. Woglom and Wolfgang F. Stolper (New Haven: Yale University Press, 1954).



requires the assumptions of an isotropic plain and a hexagonal shape for market areas.<sup>5</sup> The threshold population was defined as ". . .the minimum amount of purchasing power necessary to support the supply of a central good from a central place."<sup>6</sup>

In an effort to develop a central place behavior approach, Curry shifted the emphasis of investigation from its main interest in economic rationale to patterns of general behavior.<sup>7</sup> Subsequently, several probabilistic interpretations have also been introduced into the theory.<sup>8</sup>

To-date most central place research has been conducted in the more developed countries.<sup>9</sup> But, there appears to be

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<sup>5</sup>Brian J. L. Berry and William Garrison, "Recent Developments of Central Place Theory," Papers and Proceedings of the Regional Science Association 4 (1958): 107-120. See also, Brian J. L. Berry, "Ribbon Developments in the Urban Business Pattern," Annals of the Association of American Geographers 49 (1959): 145-155.

<sup>6</sup>Brian J. L. Berry and William Garrison, Recent Developments, p. 111.

<sup>7</sup>Leslie Curry, "The Geography of Service Centers Within Towns: The Elements of an Operational Approach," Land Studies in Geography, Series B, 24 (1962): 31-53.

<sup>8</sup>Edwin Thomas, "Toward an Expanded Central Place Model," Geographical Review 51 (1961): 400-441; M. F. Dacy, "A Probabilistic Model for Central Place Location," Annals of the Association of American Geographers 56 (1966): 550-568.

<sup>9</sup>Brian J. L. Berry and Allan Pred, Central Place Studies: A Bibliography of Theory and Applications (Philadelphia: Regional Science Research Institute, Bibliography Series No. 1, 1965); K. Szumeluk, Central Place Theory: A Review (London: Center for Environmental Studies, Working Papers No. 9, 1968); Mary Vance, ed., Working Notes and Bibliography on Central Place Studies, 1965-1969 (Illinois:

a real need for the investigation of the geographical arrangement of central places in developing countries where different factors might affect some theoretical postulates.

### Hypotheses

Three hypotheses derived from central place theory are proposed in this study:

1. There is a close and positive linear relationship between the number of central functions performed in the rural service centers of Mérida State and the size of the population found in these centers.
2. There is a close and positive linear relationship between the number of functional units found in the rural service centers of Mérida State and the size of their populations.
3. A defined hierarchy of the rural service centers of Mérida State will result from an objective classification of these centers according to their number of functional units.

In testing the first two hypotheses one would expect the larger centers to have more central functions and functional units supporting the larger populations. Carter et al. have stated that:

It is implicit in the central place scheme that in the equilibrium state a perfect positive correlation must exist between the population of centers and the population of their hinterlands. Since there would likewise be a perfect correlation of centers plus hinterland populations with the number of functions performed,

then there would also be a perfect correlation between the population of towns in a system and the number of functions each of them displays.<sup>10</sup>

It is clear that diverse cases may exist in which this perfect correlation does not hold in the real world. Examples include biased population estimates, characteristics of the settlement dynamics, government influences in the functional allocation, and the presence of non-central functions such as wholesale distribution and manufacturing. However, the results of various studies throughout the world show high correlations between population size and central functions. Evidence of this relationship was perhaps first published by Thomas. He found correlations of .86 for population and central functions and .95 for population and functional units.<sup>11</sup> Thomas' study was later duplicated in Illinois by Stafford with similar results.<sup>12</sup> Additional data from other studies in the United States showing comparably high correlations are given by Berry.<sup>13</sup> In Costa Rica, Ratcliffe found

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<sup>10</sup>H. Carter, H. A. Stafford and M. M. Gilbert, "Functions of Welsh Towns: Implications for Central Place Notions," Economic Geography 46 (1970): 25.

<sup>11</sup>Edwin N. Thomas, "Some Comments on the Functional Bases for Small Iowa Towns," Iowa Business Digest 31 (1960): 10-16.

<sup>12</sup>Howard A. Stafford, "The Functional Bases of Small Towns," Economic Geography 39 (1963): 165-175.

<sup>13</sup>Brian J. L. Berry, Geography of Markets, pp. 64-67.

correlations of .9230 and .9669, respectively.<sup>14</sup> In Mexico, Doherty and Hall identified a correlation of .72 between population size and central functions.<sup>15</sup> King's study revealed that "The high correlation obtained between population size and number of functional units confirms the belief that the majority of the small towns in Canterbury act as service centers."<sup>16</sup> Carter et al. hypothesized that the high correlations shown by the studies of Iowa and Illinois may have been produced by the selection of study area where the isotropic surface of the theory is most nearly reproduced and also where there is a comparatively short history of settlement. They repeated the study in Wales, an area that differs remarkably from these conditions by its mountain topography and long history of settlement, employing the same methodology used in Iowa and Illinois. The correlations were similarly high.<sup>17</sup>

According to the latter hypotheses a certain number of groups of centers arranged in a hierarchical form should be

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<sup>14</sup>Jane E. Ratcliffe, "An Examination of the Population-Economic Activities Relationship and Hierarchy of Central Places: The Costa Rican Example" (Ph.D. dissertation, Indiana University, 1970).

<sup>15</sup>Peter Doherty and John Ball, "Central Functions of Small Mexican Towns," Southeastern Geographer 11 (1971): 20-28.

<sup>16</sup>Leslie King, "The Functional Role of Small Towns in Canterbury," Proceedings of the Third New Zealand Geography Conference, Palmerston, 1961.

<sup>17</sup>H. Carter et al., Functions of Welsh Towns, p. 26.

obtained. Theory suggests that central functions fall into groups which are associated with groups of central places.<sup>18</sup> Thus, there are different levels of centers determined by the goods and services available in each and similarly different grades of central goods and services determined by the frequency of their occurrence in the different centers.

The notion of hierarchy is fundamental to central place theory. Christaller's view about the existence of a steplike hierarchy in settlement distribution has received clear support from a considerable body of literature in different parts of the world. An opposing viewpoint, however, claims that any division of centers into groups is completely arbitrary. Hence, there would not be a stepped hierarchy but a continuum in the settlement distribution. Classical, for example, is the criticism that Vining directed at Brush's central place study:<sup>19</sup>

. . . the terms hamlet, village and town are convenient modes of expression; but they do not refer to structurally distinct natural entities. . . . Clearly, it is arbitrary to divide the array into three partitions rather than into a greater or lesser number; and similarly arbitrary is the determination of where to put the dividing points separating the different classes or types.<sup>20</sup>

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<sup>18</sup>Brian J. L. Berry and William L. Garrison, "The Functional Bases of the Central Place Theory," Economic Geography 34 (1958): 149.

<sup>19</sup>John E. Brush, "The Hierarchy of Central Places in Southwestern Wisconsin," Geographical Review 43 (1953): 380-402.

<sup>20</sup>R. Vining, "A Description of Certain Spatial Aspects of an Economic System," Economic Development and Cultural

Finally, Berry et al. have observed that the solution to this controversy depends upon the scale of analysis:

Aggregative analysis, abstracting from spatial arrangements, will almost inevitably emphasize the importance of continuous functional relationship. Elemental investigations in which the spatial parameter is explicit will usually identify the hierarchy as the dominant feature. Both continuous relationships and hierarchies, and blends thereof, may be produced from the same data, and it therefore seems foolhardy to continue the arguments as to which is valid. Both exist.<sup>21</sup>

Thus, the reconciliation of the hierarchical concept and the rank-size regularity lies in the distinction between aggregative and elemental scales. When larger areas are studied, the heterogeneity is greater and inter- and intra-area differences combine to create a continuum.<sup>22</sup> Nevertheless, the controversy persists. Marshall has carried out a survey of past research on hierarchical classification of towns.<sup>23</sup> His conclusion is that the question of the existence of a well defined hierarchical structure has been left unanswered by scholars, except for Skinner's study in China.<sup>24</sup>

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Change 3 (1954-1955): 169.

<sup>21</sup>Brian J. L. Berry, et al., Retail Location, pp. 102-3.

<sup>22</sup>Brain J. L. Berry and H. Gardiner Barnum, "Aggregate Relations and Elemental Components of Central Place Systems," Journal of Regional Science 4 (1962): 35.

<sup>23</sup>John Marshall, The Location, pp. 44-67.

<sup>24</sup>G. William Skinner, "Marketing and Social Structure in Rural China: Part I," Journal of Asian Studies 24 (1964-1965): 3-43.

### Central Place Studies in Developing Countries

Central place studies have produced invaluable contributions to settlement geography, but in developing countries only a few have been conducted, most of them in India.<sup>25</sup> For Latin America a review of the literature reveals that research on settlement geography within the framework of central place theory is only beginning. Doherty and Ball studied the relationship between central functions and population size in seventy rural municipio cabeceras of Mexico.<sup>26</sup> Ratcliffe investigated some central place aspects in Costa Rica.<sup>27</sup> Gogniat and Brenes also worked in Costa Rica. By plotting the number of goods and services against the number of inhabitants in the centers five hierarchical levels were recognized.<sup>28</sup> Hanneson compared the hierarchy of twenty-one

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<sup>25</sup>Some of the most recent works include: K. M. Singh, "Spatial Patterns of Central Places in the Middle Ganges Valley," National Geographical Journal of India 12 (1966): 218-26; S. Folke, "Central Place Systems and Spatial Interaction in Milgriris and Coorg, India," Geografisk Tidsskrift 66 (1967): 161-78; A. K. Dutt, "Intra-City Hierarchy of Central Places: Calcutta as a Case Study," Professional Geographer 21 (1969): 18-22; J. O. Abiodun, "Urban Hierarchy in a Developing Country," Economic Geography 43 (1967): 347-67; D. C. Funnel, "Rural Business Centres in a Low Income Country: Some Theoretical Problems," Tidjschrift voor Econ. en Soc. Geographie 64 (1973): 86-92; M. A. H. Smout, "The Hierarchy of Central Place in Natal," Tidjschrift voor Econ. en Soc. Geographie 61 (1970): 25-31.

<sup>26</sup>Peter Doherty and John Ball, Central Functions.

<sup>27</sup>Jane E. Ratcliffe, An Examination.

<sup>28</sup>Donald A. Gogniat and Eduardo D. Brenes, Estructura Urbana regional y jerarquización de los centros poblados de Guanacaste (San José: Instituto de Fomento y Asesoría Municipal, 1974).

periodic markets with the hierarchy of central places in the Andes of Colombia. Except at the lower levels, complete correspondence was found between the two systems.<sup>29</sup> In the northern part of Nariño Department, Colombia, Symanski defined a hierarchy of five orders, although most of his work was related to market-places.<sup>30</sup> Hill, with a different approach but still within the context of central place theory, studied forty seats of municipal government in the Sabana de Bogotá, Colombia.<sup>31</sup>

In Venezuela, the first attempt at central place study was made by Hill, Silva and Hill who studied the economic and social organization of five representative rural communities.<sup>32</sup> In their study they followed the method of ecological delineation proposed by Galpin in 1915.<sup>33</sup> Chaves has discussed some

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<sup>29</sup>Bill Hanneson, "Periodic Markets and Central Places in the Chiquinquirá-Ubate Area of the Eastern Cordillera of the Colombian Andes" (Ph.D. dissertation, University of Oregon, 1969).

<sup>30</sup>Richard Symanski, "Periodic Markets of Andean Colombia" (Ph.D. dissertation, Syracuse University, 1971).

<sup>31</sup>David A. Hill, "Spatial Relations and Socioeconomic Change: A Preliminary Study of Differentiation of Places in the Sabana de Bogotá, Colombia," Professional Geographer 19 (1967): 136-43.

<sup>32</sup>George Hill, José A. Silva and Ruth O. de Hill, La vida rural en Venezuela (Caracas: Tipografia Vargas, S.Á., 1960).

<sup>33</sup>J. G. Galpin, "The Social Anatomy of an Agricultural Community," Research Bulletin 34, Agricultural Experiment Station of the University of Wisconsin, 1915. Like Christaller, Galpin chose as his focal point the functional relationship between town and country. Although quantitative formulations



spatial connections of the Chama basin settlements in three studies. Initially, he observed an ill-defined hierarchy in the Upper Chama.<sup>34</sup> Later, a five-order hierarchy was established, this time including the small basin of the Capazón River: state capital, important distrito capitals, other distrito capitals, important municipio capitals and local service centers.<sup>35</sup> In a subsequent study of the same region he recognized a dendritic system of connections based on the wholesaling influence of the larger centers.<sup>36</sup> It is interesting to note that 1) only in his second study did Chaves include retailing, together with population and public services, in the analysis, and 2) the procedures used to assign a center to any position within the classification were not specified.

#### Scope of the Present Study

This study focuses on the functional significance of thirty-six rural Andean centers according to two implications

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were not deducted, he recognized that towns offering the same level of services would be equally spaced, theoretically.

<sup>34</sup>Juan B. Castillo, et al., Estudio de los suelos de las partes altas de las cuencas de los ríos Chama y Santo Domingo, 2 vols. (Mérida, Instituto de Geografía, 1965) 2: 151-3.

<sup>35</sup>Instituto de Geografía, Estudio integral de las cuencas de los ríos Chama y Capazón, subproyecto No. 7 (Mérida, Instituto de Geografía, 1972), pp. 43-48.

<sup>36</sup>Luis F. Chaves and Carlos A. Amaya, "Sistema de ciudades," paper presented at the Local Seminar on Urban Planning, Mérida, November 1973 (Mimeographed).

of central place theory. It is far from being a study of central place system, as proposed by Berry, Davies and Marshall, since basic problems such as trade areas or consumer travel behavior lie outside the scope of the present investigation.<sup>37</sup> The hierarchical organization of the rural centers investigated is more comparable to the "vertical" arrangement of settlements proposed by Garner.<sup>38</sup>

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<sup>37</sup>Brian J. L. Berry, et al., Retail Location; Wayne K. D. Davies, "Towards an Integrated Study of Central Places: A South Wales Case Study," In Urban Essays: Studies in the Geography of Wales, eds.: M. Carter and W. K. Davies (London: Longmans, 1970), pp. 193-227; John V. Marshall, The Location, pp. 68-103.

<sup>38</sup>B. J. Garner, "Models of Urban Geography and Settlement Location," in Socioeconomic Models in Geography, eds.: Richard J. Chorley and Peter Hagget (London: Methuen, 1970), p. 306.

## CHAPTER II

### GENERAL CHARACTERISTICS OF THE STUDY AREA

The State of Mérida in Western Venezuela has an area of 11,300 square kilometers and occupies the central portion of the Cordillera de Mérida, also traditionally known as the Venezuelan Andes. Although the terrain is generally mountainous, a small area of flat land is found in the northwestern part of the state, South of Lake Maracaibo.

The state is divided administratively into eleven distritos (counties) and fifty municipios (townships), as shown in Table 1. Mérida is the capital and largest city of the state. Most of the larger distritos are so diverse with respect to physical, economic and accessibility conditions that they do not act as functional units. Alternatively, the municipios, the smallest administrative units in the country, often have closer functional ties, especially when the cabeceras (seats of local government) are centrally located in their territories.

#### Relief

The highest elevations of Venezuela are within the study area (Pico Bolívar, 5,007 meters). Here, the Sierra Nevada together with the Sierra Norte form the core of the Cordillera

de Mérida. Relief is the most outstanding feature of the landscape. In Mérida, as elsewhere in the Andes, the orientation of the sierras and valleys, steep slopes and elevation exert a marked effect on the climate, vegetation, land use, population distribution and road system (Figure 2).

TABLE 1  
ADMINISTRATIVE DIVISION OF THE  
STATE OF MERIDA, BY DISTRITOS

| Distrito        | Population<br>(Percentages) | Area<br>(Percentages) | Population<br>Density <sup>2</sup><br>(inh./km <sup>2</sup> ) |
|-----------------|-----------------------------|-----------------------|---------------------------------------------------------------|
| Campo Elías     | 9.1                         | 11.4                  | 24.6                                                          |
| Tovar           | 12.4                        | 13.1                  | 29.1                                                          |
| Justo Briceño   | 6.1                         | 13.7                  | 13.7                                                          |
| Sucre           | 6.2                         | 11.8                  | 16.2                                                          |
| Acacio Chacón   | 4.8                         | 7.9                   | 18.5                                                          |
| Libertador      | 29.9                        | 13.3                  | 68.8                                                          |
| Rangel          | 4.4                         | 9.1                   | 14.9                                                          |
| Rivas Dávila    | 4.6                         | 7.1                   | 20.1                                                          |
| Miranda         | 5.6                         | 4.5                   | 37.8                                                          |
| Alberto Adriani | 9.2                         | 3.2                   | 88.7                                                          |
| Andrés Bello    | 7.6                         | 4.9                   | 47.3                                                          |

Source: X censo nacional de población: 1971.

The intermont basins have played a prominent role in the organization of space in the region in that 1) they represent the main axes of accessibility along the rivers, and 2) they support most of the population and economic activities. The Chama basin stands out as the major area of population

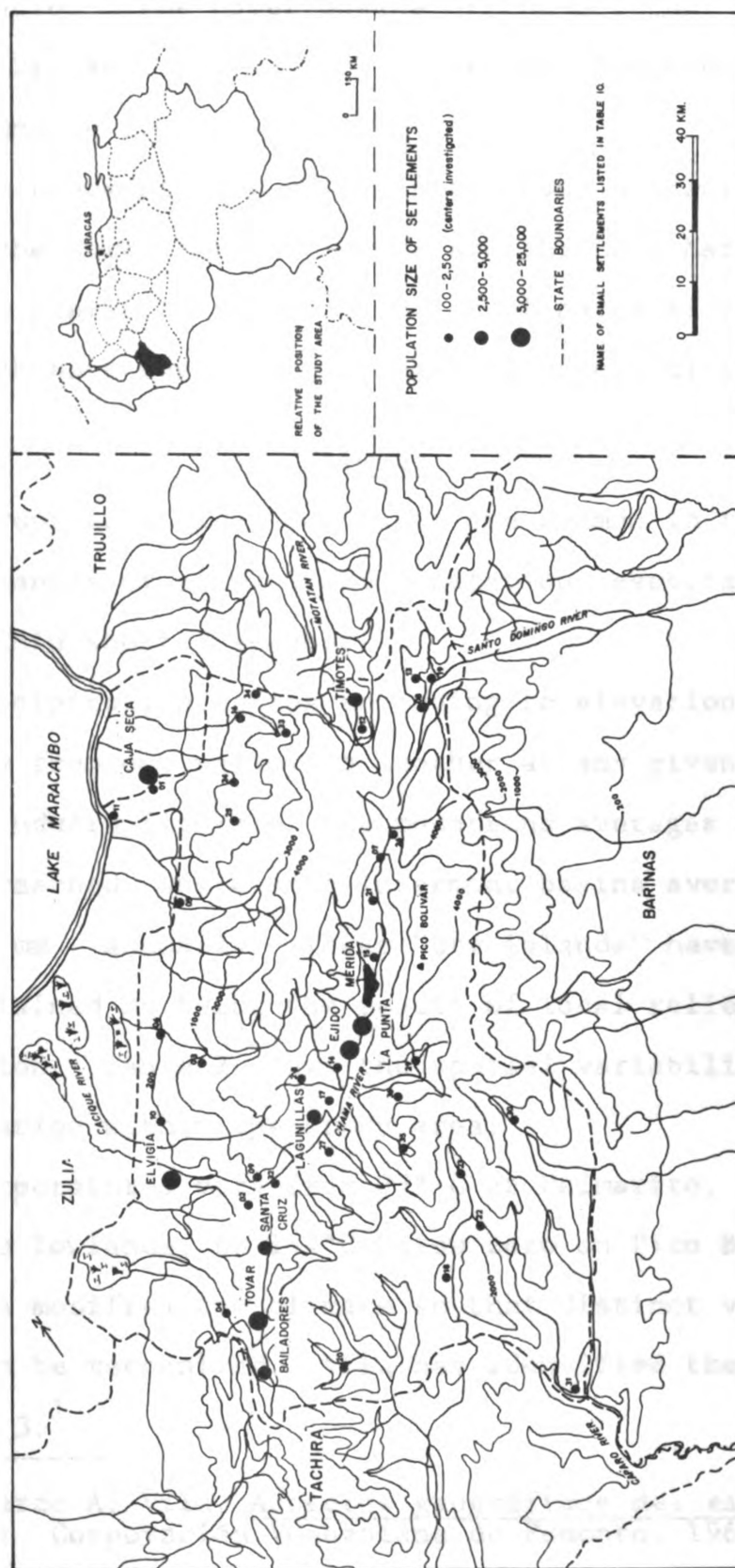


FIGURE 2. MERIDA STATE: PHYSICAL FEATURES AND SETTLEMENTS

concentration. The upper basins of the Motatán, Santo Domingo, Uribante and Caparo Rivers also function as gateways to surrounding lowlands.

The piedmont belt on the northwest, a transition area between the Cordillera de Mérida and the Lake Maracaibo lowlands, is characterized by a series of parallel alluvial fans which have been recently brought under cultivation.

### Climate

Abrupt ecological contrasts are common in the region. Marked changes of climate and vegetation, especially, can be noted within short distances.

Precipitation varies according to elevation and may also vary from one valley to another at any given elevation. On the windward flanks of the mountains averages of 2,800 mm. are reached, while some intermont basins average less than 600 mm. annually. These "dry islands" have often been explained as being the result of local relief on wind circulation. Table 2 shows the spatial variability of precipitation within the study area.

Temperatures vary from 27° C at Palmarito, in the Lake Maracaibo lowlands, to 1-4°C below zero on Pico Bolívar. Elevation modifies the climate so that distinct vertical zones can be recognized. Vila has identified the zones shown in Table 3.<sup>1</sup>

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<sup>1</sup>Marco A. Vila, Aspectos geográficos del estado Mérida (Caracas: Corporación Venezolana de Fomento, 1967), pp. 64-66.

TABLE 2

AVERAGE PRECIPITATION AT SELECTED  
LOCATIONS IN MERIDA STATE  
(IN MILLIMETERS)

| Place      | Precipitation |
|------------|---------------|
| Lagunillas | 493           |
| Mucuchíes  | 708           |
| La Azulita | 1,400         |
| Mérida     | 1,674         |

TABLE 3

VERTICAL ZONES IN THE VENEZUELAN ANDES

| Zone                          | Altitude<br>(Meters) | Mean Temperature<br>(°Centigrade) |
|-------------------------------|----------------------|-----------------------------------|
| Tropical                      | 0-800                | 27-24                             |
| Subtropical                   | 800-1,500            | 24-20                             |
| Temperate                     | 1,500-2,000          | 20-16                             |
| Cold                          | 2,000-3,600          | 16- 7.5                           |
| <u>Páramo</u> (Alpine Meadow) | 3,600-4,600          | 7.5- 4.5                          |
| <u>Gélido</u> (Barren Zone)   | 4,600-5,007          | 4.5- ?                            |

Local features such as topography, insolation and winds distort the vertical zonation pattern, particularly in the intermont basins. Chaves and Vivas consider the altitudinal ordering of landscapes within an ideal Andean basin as follows:<sup>2</sup>

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<sup>2</sup>Luis F. Chaves and Leonel Vivas, Geografía de Venezuela (Mérida: Universidad de los Andes, Instituto de Geografía, 1972), pp. 93-95.

1. Xerophytic vegetation composed by thorny shrub, hawthorn and cactus. The upper limit is variable although frequently reaches 1,000 meter level. Main crops (sugar cane and tobacco) are grown on alluvial terraces with the use of irrigation. Other crops are pineapple and fique (henequen). Goat grazing is common throughout these areas.
2. Subtropical semideciduous forest. It extends up to 1,500-1,700 meters and constitutes the coffee zone. Sugar cane is also grown on river flood plains.
3. Cloud forest. This is a transitional zone between 1,500-1,700 meters and 2,000 meters. Land use consists of pasture and diverse crops (corn, potatoes and horticulture).
4. Andean matorral (bush). It goes up to about 2,800 meters and forms the cereal zone. Potatoes and horticultural crops are also important.
5. Páramo. This zone is located above 2,800 meters. Crops are less common because of frost and hail. Extensive cattle grazing and isolated potato cultivation are the dominant land uses.

### The Settlement Process

Since Pre-Colombian times the settlement pattern has been one of heavy population concentration in the intermont basins. The unhealthy hot and wet lowlands were a source of malaria and yellow fever and also presented difficulties for agricultural activities. These are generally considered principal causes for the population to have located in the temperate lands of the Cordillera. However, James states that:

Probably the most important reason for the high degree of habitability of the Cordillera de Mérida was that the Indians depended on maize as their basic food, and this was very productive maize country. . . . Better diets, probably, rather than lower temperatures, made possible the relatively dense populations of vigorous Indians; but the lower temperatures worked



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indirectly to improve the health conditions after the arrival of European diseases, for the fever carrying insects are less numerous above the tierra caliente.<sup>3</sup>

The Andean territory was inhabited by diverse Indian groups, Timoto-Cuicas being the most important. They practiced the most advanced agriculture in the Venezuelan territory. Salas estimates an Indian population of 20,000 at the arrival of the Spaniards to the Andes in 1557.<sup>4</sup> During the last decades of the 15th century, according to Brito-Figueroa, the following characteristics of Andean settlements prevailed:<sup>5</sup>

1. High population density in the areas of irrigated agriculture. The dwellings were grouped in stabilized aldeas (hamlets).
2. Relatively high population density, but still with stabilized aldeas, in those areas of economy based upon agriculture of azada (spade agriculture).
3. Low population density associated with nomadism in the peripheral areas.

Agriculture was a fundamental factor of concentration and stabilization of the first Andean aldeas. Later, many of these aldeas grew to become villages.

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<sup>3</sup>Preston E. James, Latin America (New York: The Odyssey Press, 1969), p. 368.

<sup>4</sup>Julio C. Salas, Etnografía de Venezuela (Mérida: Universidad de los Andes, 1956), pp. 3-4.

<sup>5</sup>Federico Brito-Figueroa, Población y economía en el pasado indígena venezolano (Caracas: Tipografía Remar, 1962), p. 7.

Cardozo has classified the Andean settlements into three groups based on their origins:<sup>6</sup>

1. Villages founded directly by the Spaniards (villages of royal origin). They were established by official authorization and served as bases of operations to conquer the surrounding territory.
2. Settlements arose irregularly by a slow association of dwellings without permission of the Spanish Crown. This was the origin of most of the Andean towns.
3. Indian communities organized by the Spaniards. Most of the towns with Indian names had their origin as communities inhabited exclusively by Indians.

From the beginning the economy of Andean settlements was agriculturally oriented. Spaniards developed the native crops, especially cocoa, cotton and tobacco, and introduced wheat and sugar cane. Later, in 1777, coffee was brought to the region and became the leading crop.

Each settlement and its surrounding countryside set up a closed circuit irregularly opened to errant outside merchants, usually from Maracaibo.<sup>7</sup> Upon this structure developed a town system with weak internal relations. It was not until the beginning of petroleum exploitation in Venezuela that a small-scale commercial interchange among the larger Andean towns began.<sup>8</sup>

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<sup>6</sup>Arturo Cardozo, Proceso de la historia de los Andes (Caracas: Biblioteca de Autores y Temas Tachirenses, 1965), pp. 25-26.

<sup>7</sup>Ibid., pp. 37-38.

<sup>8</sup>Angel F. Díaz, Hacia una estrategia de desarrollo urbano para la región andina (Mérida: Instituto de Investigaciones Económicas, 1972), pp. 8-9.

At the earliest stage, competition and interaction between centers operated only on a small scale. Each center served a surrounding area despite inadequate communications. In purely theoretical terms, all settlements would therefore have identical functions. Following Webb, if one multiplies von Thünen's isolated central cities in a region no differentiation of urban functions would take place because there is no interaction and, thus, each center is like the others.<sup>9</sup>

### Spatial Distribution of Population

Recently two new factors acting together have exerted a powerful influence on the spatial distribution of the population: 1) the construction of highways and improvements of roads, and 2) the improvement of health conditions in the lowlands.

In 1955 the northwestern piedmont section of the Pan American Highway was completed. Subsequently, these lands were invaded by squatters moving downslope from the Andean highlands. This migration constituted a defined settlement thrust. Today, a process of unplanned "space filling" is occurring in the piedmont.<sup>10</sup>

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<sup>9</sup>J. W. Webb, "Basic Concepts in the Analysis of Small Urban Centers of Minnesota," Annals of the Association of American Geographers 49 (1959): 55.

<sup>10</sup>Orlando L. Venturini, "Aspectos geográficos de la colonización del piedemonte noroccidental de los Andes venezolanos," Revista Geográfica 9 (1968): 94.

The construction of the Llanos Highway along the southeastern piedmont, in 1968, encouraged out-migration of people from the southern section of the state. The construction of highways, thus, has brought about a process of rural-to-rural migration from highland to lowland. Hence, the main axes of settlement in the region are the Chama basin, in which more than 50 percent of the population is concentrated, and the northwestern piedmont. It is in the former where most of the urban centers have developed.

In 1971 the population of the state of Mérida reached a total of 347,095 (3.2 percent of the national population), of which 57.6 percent may be classified as rural.<sup>11</sup> However, a progressive increase of the urban population has occurred, as shown in Table 4.

The population growth trend is associated primarily with urban centers located along the two principal axes of settlement in the region.

#### Population Size of the Settlements

Chaves and Amaya have proposed a classification of the Andean settlements based upon a hierarchy of markets, production factors and services.<sup>12</sup> They differentiated

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<sup>11</sup>The Census Office establishes three categories of settlements: 1) urban, more than 2,500 inhabitants; 2) intermediate, between 1,000 and 2,500 inhabitants; and 3) rural, of less than 1,000 inhabitants plus the dispersed population. In this work the second category is also considered as rural.

<sup>12</sup>Luis F. Chaves and Carlos A. Amaya, Sistema de ciudades, pp. 8-10.

TABLE 4  
EVOLUTION OF URBAN POPULATION  
IN MERIDA STATE

| Year | Urban Population<br>(Percent of Total Population) |
|------|---------------------------------------------------|
| 1963 | 8.74                                              |
| 1941 | 12.47                                             |
| 1950 | 17.57                                             |
| 1961 | 28.24                                             |
| 1971 | 42.44                                             |

Source: X censo national de población: 1971.

seven categories of settlements:

1. Metropolitan areas, integrated by the largest Andean cities, their suburbs and satellites. The largest is the San Cristóbal area which supports a population of 152,239 inhabitants.
2. Intermediate cities (ciudades medias) with populations ranging from 10,000 to 25,000 inhabitants.
3. Small cities, with populations between 5,000 and 10,000.
4. Village-cities (ciudades-pueblos), as forms of transition between urban and rural settlements.
5. Villages (pueblos), between 500 and 2,000 inhabitants.
6. Village-hamlets (aldeas-pueblos), between 300 and 500 inhabitants.
7. Hamlets, with populations under 300.

Unfortunately, these categories are based largely on population size. In fact, the authors do not include any

measure of market areas, production factors or services in the classification.

Despite the "urbanizing" trends of the Mérida population, a substantial number of small settlements remain. In 1961 the national census registered 70.8 percent of the population as scattered and living in centers of fewer than 2,500 inhabitants.<sup>13</sup> The number of centers having between 100 and 999 people was of 515, whereas there were only eighteen centers with populations above 1,000. Table 5 shows the distribution of Mérida population by size of centers.

TABLE 5  
POPULATION SIZE OF SELECTED SETTLEMENT  
CATEGORIES IN MERIDA STATE

| Size          | Number of<br>Centers | Percent of Total<br>Population |
|---------------|----------------------|--------------------------------|
| 100-199       | 298                  | 15.4                           |
| 200-499       | 173                  | 18.3                           |
| 500-999       | 44                   | 10.9                           |
| 1,000-1,999   | 9                    | 4.2                            |
| 2,000-2,499   | 2                    | 1.6                            |
| 2,500-4,999   | 3                    | 3.1                            |
| 5,000-10,000  | 3                    | 8.9                            |
| 10,000-50,000 | 1                    | 17.2                           |

Source: IX censo nacional de población: 1961.

<sup>13</sup>A minimum of three grouped dwellings was the criterion used to classify a place as a populated center. Census information for 1971 regarding small centers was not available at the time of this study.

### Agriculture

The State of Merida is basically an agricultural region. In 1961, for example, 61.5 percent of the employed population was engaged in the agricultural sector. Table 6 reveals the economic structure of the state in terms of employed population.

TABLE 6  
STRUCTURE OF THE EMPLOYED  
POPULATION OF MERIDA STATE  
(PERCENTAGES)

| Sector         | Year |      |
|----------------|------|------|
|                | 1950 | 1961 |
| Agriculture    | 66.0 | 61.5 |
| Manufacture    | 4.6  | 5.3  |
| Construction   | 3.2  | 2.7  |
| Transportation | 1.3  | 2.7  |
| Commerce       | 4.7  | 7.6  |
| Services       | 19.0 | 18.2 |

Source: Universidad de los Andes,  
Instituto de Investigaciones Económicas, 1966.

With respect to agricultural land use, the 1950 and 1961 agricultural censuses classified the use of farm land as shown in Table 7.<sup>14</sup>

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<sup>14</sup>To date, the 1971 agricultural census has not been released.



TABLE 7  
FARM LAND USES IN MERIDA STATE  
(PERCENTAGES)

| Land Use                        | 1961 | 1950 |
|---------------------------------|------|------|
| Perennial crops                 | 10.0 | 8.3  |
| Annual and semi-perennial crops | 8.6  | 10.9 |
| Cultivated pastures             | 29.9 | 13.6 |
| Uncultivated pastures           | 14.4 | 20.0 |
| Fallow land                     | 14.1 | 13.4 |
| Forest                          | 18.1 | 27.0 |
| Other uses                      | 4.6  | 6.8  |

Source: III censo agropecuario: 1961.

Considering as agricultural lands those included in the first three categories, i.e., the space on which the man-land relationship is more apparent, it appears that agricultural output depends more upon the amount of land used than the intensity of use. The area of agricultural land increased from 32.8 percent in 1950 to 48.5 percent in 1961.

Because of ecological factors, comparative advantages have developed for specialized agriculture (coffee, potatoes, horticulture) in the intermont basins. In the tierra caliente (tropical zone) plantains are the most important crop, especially in the piedmont. The largest part of this production is exported from the region to national markets.

A subsistence and semi-subsistence agriculture is

practiced in the less accessible parts of the region. The tiny holdings of campesinos (peasant cultivators) occupy the areas of lowest fertility as a result of an inadequate land tenure system. From an economic and ecological viewpoint, these are critical areas characterized by a continuous process of out-migration. In 1968, for example, a survey of ninety-one migrant families living in the piedmont disclosed that fifty-eight came from the poorest areas of Mérida State.<sup>15</sup>

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<sup>15</sup>Orlando L. Venturini, Aspectos geográficos, p. 81.

## CHAPTER III

### METHODOLOGY

The basic problem faced by an investigator of rural settlements in an area such as the Andes is the lack of data and the difficulty in collecting what information is available. Data on functional composition for small centers do not appear in any directory or census, thus necessitating fieldwork. However, in a substantial number of cases, the poor accessibility, dispersion of settlements and scarce cartographical resources, to mention a few obstacles, affect the completeness of the data or sample designs in these areas. Quantitative approaches therefore must be more flexible and less inclusive than in developed regions.

#### Selection of the Centers

The rural service center is the basic unit with which this study is concerned. These settlements were defined in the following terms: 1) they must be capitals of rural municipios, and 2) they must have populations of less than 2,500 inhabitants.

The first criterion is supported by previous studies emphasizing the role of the municipio cabeceras as centers

providing goods and services for the surrounding area.<sup>1</sup>

In a broad sense the Venezuelan rural municipio constitutes a community, especially in the Andes where the typical municipio is: a territorial unit comprising a principal nucleus (cabecera) and a rural hinterland integrated by vecindarios (neighborhoods), aldeas and dispersed population. This pattern seems to be a general characteristic in rural Latin America. In Smith's words:

. . . in Latin America as a general rule the separation of state and church was slow in coming about, and even today the local government unit, designated as a municipio in most of the countries, corresponds exactly to the church parish. Furthermore, the boundaries of the municipios are almost always drawn with social and economic factors taken into consideration, so that they correspond much more closely to natural social areas than do those in the United States.<sup>2</sup>

Hill, et al. found that the cabeceras acted as true central places for the inhabitants of the municipio. The Andean community presented the strongest centralizing character. They pointed out that in the Andean community all the neighborhoods depend exclusively upon the cabecera to fulfill their economic and social needs. For instance,

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<sup>1</sup>George Hill, et al., La vida rural, pp. 126-131; Cosejo de Bienestar Rural, Problemas económicos y sociales de los Andes venezolanos, 2 vols. (Caracas: Ministerio de Agricultura y Cría, 1955), 1:75-78.

<sup>2</sup>T. Lynn Smith, "The Rural Community with Special Reference to Latin America," Rural Sociology 23 (1958): 61.

more than 85 percent of the campesinos interviewed bought clothes, food and tools and sold their products in the cabecera.<sup>3</sup>

For Colombia, Smith drew similar conclusions:

. . . the typical rural community in Colombia consists of two parts: (1) a small market, trade, religious, ceremonial and administrative center; and (2) a tributary zone of open country whose inhabitants can reach the village or town on market days and Sundays, generally on foot, and return to their dwellings before nightfall.<sup>4</sup>

It is likely that the central place character of a settlement depends appreciably upon areal extent and road system.

Small municipios with rudimentary roads may produce greater frequency of contact from the outlying area to the center than larger municipios with better roads.

The second criterion to select the centers is a compromise solution, which follows in part censal considerations, given the difficulties in establishing satisfactory population thresholds to distinguish rural from urban settlements. Whatever threshold one selects there will be "cities" with a smaller population and "villages" with a larger one. Of course, this differentiation can be approached

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<sup>3</sup>George Hill et al., La vida rural, p. 129.

<sup>4</sup>T. Lynn Smith, Colombia (Gainesville: University of Florida Press, 1967), p. 310.

in several other ways, including physical and socioeconomic characteristics. However, the population limit established for this study is believed to reflect the rurality condition of settlements in Mérida State. In total thirty-six centers were selected, of which four are also distrito capitals, with populations ranging from 108 to 2,294 inhabitants.

### Data Collection

Since data on the number of functions and functional units were not available, a field study of each center was conducted in the spring of 1974. First, a list of all central functions expected to occur was tabulated. Next, a data collection form was designed. This form is included as Appendix A. Complementary information was acquired through informal interviews with merchants of the centers. For the larger centers presidents of junta comunales (town councils) or municipio prefectos checked the data.

At the outset basic concepts were operationally defined as follows:

Central function: Any good or service provided directly by the rural center to the population of the surrounding area on a regular basis.

Functional unit: The frequency of occurrence of a given central function. For example, if small groceries appear several times in a center, the frequency of occurrence is noted under the category of functional units.

Establishment: The physical unit (building) in which or from which one or more functions are performed.

Hierarchy: An arrangement of settlements in groups of differing levels of functional importance.

Functional importance A measure of importance of a center in terms of the number of central functions and functional units it possesses compared with the number found in other centers.

Non-central function: Those functions which basically serve the population living in the center, such as piped water, or a population living outside the local trade area, such as tourism.

Table 8 lists the thirty-eight central functions performed in the centers. Fourteen functions related to administrative and political decision were not included in the analysis due to the following reasons:

1. Functions of political and administrative character generally depend upon external subsidies. Their presence in a center is determined not only by the overall level of demand but also by government decisions. For instance, agricultural extension centers, telegraph, telephone, post offices, police stations and health centers are services established by the government largely on the basis of territorial and political considerations. Hence, one cannot assume a high correlation between the number of these functions and the effective demand of a center. Likewise, the government-controlled schools are organized on an areal basis and consequently their appearance in a center does not necessarily indicate that a certain population threshold has been reached. The importance of local political leaders and political favors in obtaining such services is well known and thus ". . . the concept

of threshold may be completely meaningless when applied to them."<sup>5</sup>

2. With the exception of churches, none of these functions occurred more than once in each center. Therefore, in terms of functional units they are of little use in defining the relative importance of a center. Furthermore, these services are used very sporadically by the population living in the outlying area. During fieldwork it was evident, for example, that people preferred to send their letters and packages to the larger centers of the state directly through a private transport service (by "jeep") because it is a faster way.

To maintain consistency, the central function concept was redefined as: Any good or service provided directly by the center to the population of the surrounding area on a regular basis and whose occurrence is related to overall economic demand.

Permanent business establishments were also used as criteria in the selection of central functions. For example, itinerant barbers and dentists and short-term food stores were disregarded. Since no objective criterion was applied, the distinction of these minor activities may be considered partially subjective. The same may be said regarding th

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<sup>5</sup>H. Carter, et al., Functions of Welsh Towns, p. 26.



TABLE 8

FREQUENCY OF OCCURRENCE OF CENTRAL  
FUNCTIONS IN THE RURAL CENTERS STUDIED

| Economic<br>Functions                | Frequency | Political-Administrative<br>Functions | Frequency |
|--------------------------------------|-----------|---------------------------------------|-----------|
| Small groceries and<br>sundries      | 36        | Churches                              | 36        |
| Bars                                 | 36        | Health centers                        | 36        |
| Restaurants                          | 26        | Primary schools                       | 36        |
| Large groceries                      | 21        | Police stations                       | 36        |
| Hotels and hostels*                  | 18        | School cafeterias                     | 36        |
| Pharmacies                           | 16        | Post offices                          | 30        |
| Dry good stores                      | 15        | Telegraphs                            | 24        |
| Soda shops                           | 15        | Telephones                            | 18        |
| Gas stations                         | 15        | Agricultural extension<br>centers     | 14        |
| Butcher shops                        | 14        | Homemaking centers                    | 12        |
| Auto repair shops                    | 14        | Secondary schools                     | 9         |
| Trinket shops                        | 14        | Weekly parish movies                  | 9         |
| Tailor shops                         | 10        | Adult education centers               | 5         |
| Tire repairs                         | 10        | Community centers                     | 3         |
| Barber shops                         | 10        |                                       |           |
| Furniture and wood-<br>working shops | 9         |                                       |           |
| Hardware and building<br>supplies    | 7         |                                       |           |
| Shoe stores                          | 7         |                                       |           |
| Bakeries                             | 6         |                                       |           |
| Farm stores                          | 6         |                                       |           |
| Supermarkets                         | 5         |                                       |           |
| Lawyers                              | 3         |                                       |           |
| Electrical appliance<br>repairs      | 2         |                                       |           |
| Physicians                           | 2         |                                       |           |

\*Hotels and motels which cater primarily to tourists and traveling  
salesmen were omitted.

differentiation of several commercial functions performed in a single establishment. In this case the volume of goods in each was the criterion used.

The final list included twenty-four central functions, generated by effective demand, ranging from two in the smallest centers to twenty-four in the largest ones. Population data from the latest national census, conducted in 1971, were used in testing hypotheses.

### Data Analysis Techniques

The relationship between population size, number of central functions and number of functional units is examined by means of simple correlation and regression analysis. Population is taken as the dependent variable on the grounds that:

Christaller suggested that through the working of the income mechanism the population of a center was a function of the number of types of central goods and services the central place provided.<sup>6</sup>

To consider the qualitative differences in the level of functions that exist in the centers, functional units were weighted according to the values shown in Table 9.<sup>7</sup>

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<sup>6</sup>Brian J. L. Berry and William L. Garrison, The Functional Bases, p. 149.

<sup>7</sup>I am indebted to Professor J. Valbuena-Gómez for his comments in discussing this point.

TABLE 9

## WEIGHTING OF FUNCTIONAL UNITS OF RURAL CENTERS STUDIED

| Class I<br>W = 20                  | Class II<br>W = 15                   | Class III<br>W = 10 | Class IV<br>W = 7                     | Class V<br>W = 5 | Class VI<br>W = 3 | Class VII<br>W = 1              |
|------------------------------------|--------------------------------------|---------------------|---------------------------------------|------------------|-------------------|---------------------------------|
| Physicians                         | Supermarkets                         | Large groceries     | Hotels and<br>hostels                 | Barber shops     | Restaurants       | Small groceries<br>and sundries |
| Lawyers                            | Shoe stores                          | Pharmacies          | Auto repair<br>shops                  | Soda shops       |                   | Bars                            |
| Electrical<br>appliance<br>repairs | Bakeries                             | Dry good stores     | Tailor shops                          | Trinket<br>shops |                   |                                 |
|                                    | Gas stations                         | Butcher shops       | Tire repairs                          |                  |                   |                                 |
|                                    | Farm stores                          |                     | Furniture and<br>woodworking<br>shops |                  |                   |                                 |
|                                    | Hardware and<br>building<br>supplies |                     |                                       |                  |                   |                                 |

The weight allocation seemed necessary since it does not appear realistic to assume the same level of significance for all functional units. The success of this particular procedure depends upon the investigator as well as the relevance of the different functions in the study area. A question which may come to mind when using weight allocation is whether or not the results of the analysis will be affected by different weighting scores. Abiodun offers a tentative answer:

. . . it seems that insofar as such scores reflect the relative importance of the services in the area under study, and it is a reasonable choice of units, the results should not differ significantly.<sup>8</sup>

The functional classification of the centers has been carried out by using multivariate analysis. The objective of the classification is to obtain relatively homogeneous groups such that the appropriateness of the classification and the homogeneity of the groups can be verified.

First, weighted functional units are subjected to factor analysis and a smaller number of variables (factors or patterns) are produced from the original data.<sup>9</sup> These new

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<sup>8</sup>J. O. Abiodun, "Central Place Study in Abeokuta Province, Southwestern Nigeria," Journal of Regional Science 8 (1968): 65-66.

<sup>9</sup>Full discussion of factor analysis is found in: H. H. Harman, Modern Factor Analysis (Chicago: University of Chicago Press, 1967). A simplified explanation of this technique is presented by: R. J. Rummel, "Understanding Factor Analysis," Journal of Conflict Resolution 11 (1967): 444-480.

factors are statistically independent, and therefore each expresses a determined proportion of the functional variation not accounted for by any other factor. Several measures indicating diverse relationships are generated by factor analysis, among them factor loadings associated with variables and factor scores associated with centers. The variables having higher loadings on a factor serve to identify the composition of that particular factor. Factor scores give a reasonably good basis for the grouping of the centers into relatively homogeneous classes since 1) they contain in abbreviated form all essential information from the primary variables, and 2) they are uncorrelated and standardized so that their distribution approximates the normality assumed by linear models. In subsequent analyses factor scores are used as input data instead of the original variables.

Second, by means of hierarchical grouping centers are classified according to their functional similarity.<sup>10</sup> The purpose is to produce groups or clusters of units in which within-group variance is minimized and, by definition, between-group variance is maximized.

Third, the groups of centers obtained in the preceding step are tested by multiple discriminant analysis. It was

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<sup>10</sup>Robert I. Wittick, "Some General Statistics Programs Used in Spatial Analysis," Technical Report 71-1, Computer Institute for Social Science Research, Michigan State University, 1971, pp. 22-26.

thus possible to check not only the efficiency of grouping, but also to determine the factors most important in discriminating between the groups.<sup>11</sup>

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<sup>11</sup>Leslie J. King, Statistical Analysis in Geography (New Jersey: Prentice-Hall, 1969), pp. 204-215. The set of multivariate techniques used in the present study, has been applied by Qazi Ahmad, Indian Cities: Characteristics and Correlates (Chicago: University of Chicago, Department of Geography, Research Paper No. 102, 1965).

## CHAPTER IV

### RURAL SERVICE CENTERS OF MERIDA STATE

The thirty-six centers selected for analysis constitute only a small part of the entire web of rural service centers of the State of Mérida. Nevertheless, they do reflect much of the diversity of all these centers as well as that of rural Andean settlements generally. Certain changes are now taking place in the settlement network of the region because of diverse causes, particularly improvements in the road system and in agriculture.

The Piedmont and the Chama valley are the principal channels of circulation and distribution. Along these relief units run respective sections of the Pan-American and Trans-Andean Highways, the main routes of the region. The larger centers are located along or near these highways, whereas the smaller ones may be relatively isolated.

Between the main highways and the other roads the irregularity of terrain is such that rapid interchange is hindered. Hence, the settlements located in the southern sector of the state show a low spatial connectivity. There, steep landforms prevent frequent contacts, either between the communities or with the principal highways. The dirt

roads are inadequate for truck or bus traffic, and most of the goods and people are therefore transported by "jeeps."

The recent development of the Piedmont settlements is associated mainly with construction of a corresponding sector of the Pan-American Highway in the early 1950s. The 1941 census of population, for example, did not register the centers of Nueva Bolivia, Tucaní and Santa Elena de Arenales, but in 1971 their populations reached 2,294, 1,759 and 1,629, respectively. The city of El Vigía represents the most striking case. Its population grew from 1,688 in 1950 to 21,237 in 1971.

The construction and improvement of roads have made possible travel over longer distances, and some settlements have therefore lost their former importance. Meanwhile, others have gained greater economic activity. Mucuchíes, for instance, prior to the construction of the Trans-Andean Highway (1925) held some importance as a point of intersection for horse trails. In 1832 its population was 1,383 and by 1941 it declined to 610. In contrast, the branch road connecting La Azulita with the Pan-American Highway broadened that community's coffee economy, and its population consequently increased from 721 in 1950 to 1,628 in 1961.

Table 10 shows the population changes which occurred in the centers of this study during three ten-year periods: 1941-1950, 1950-1961 and 1961-1971. The population trend reflects a remarkable instability, and it is clear that



TABLE 10  
POPULATION CHANGES OF THE RURAL CENTERS STUDIED

| Key Number | Centers                   | 1941-1950 | 1950-1961 | 1961-1971 | Population in 1971 |
|------------|---------------------------|-----------|-----------|-----------|--------------------|
| 01         | Nueva Bolivia             | *         | 60.5      | 163.7     | 2,294              |
| 02         | Mesa Bolívar              | 222.3     | -25.7     | 78.5      | 2,279              |
| 03         | La Azulita                | 10.0      | 125.8     | 19.5      | 1,946              |
| 04         | Zea                       | 95.0      | 43.3      | 22.1      | 1,778              |
| 05         | Tucaní                    | *         | *         | 85.9      | 1,759              |
| 06         | Santa Elena de Arenales   | *         | *         | 85.9      | 1,627              |
| 07         | Mucuchies                 | 27.5      | 32.9      | 57.1      | 1,625              |
| 08         | Santo Domingo             | 38.5      | 22.4      | 102.9     | 1,518              |
| 09         | Chiguará                  | 33.5      | 16.1      | - 4.7     | 1,221              |
| 10         | Guayabones                | *         | *         | -53.2     | 1,010              |
| 11         | Palmarito                 | 6.4       | 46.6      | 9.4       | 988                |
| 12         | Chachopo                  | 34.5      | 12.8      | 47.1      | 971                |
| 13         | Pueblo Llano              | 11.2      | 38.7      | 39.6      | 941                |
| 14         | La Mesa                   | 31.1      | 33.8      | 72.3      | 913                |
| 15         | Tabay                     | 29.6      | 33.7      | 20.8      | 806                |
| 16         | San Cristóbal de Torondoy | 84.1      | 22.8      | 156.7     | 801                |
| 17         | San Juan de Lagunillas    | 2.9       | 115.1     | 27.4      | 781                |
| 18         | Libertad                  | 79.5      | 26.8      | 15.6      | 668                |
| 19         | Las Piedras               | 38.4      | 34.6      | 43.2      | 646                |
| 20         | Guaraque                  | 24.1      | -36.3     | 50.2      | 577                |
| 21         | Mucurubá                  | 11.9      | 17.9      | 26.0      | 490                |
| 22         | Mucuchachí                | 13.6      | 20.3      | 20.7      | 472                |
| 23         | Mucutuy                   | 68.8      | 36.4      | 6.7       | 432                |
| 24         | Torondoy                  | 44.9      | 51.2      | 15.8      | 424                |
| 25         | Santa Apolonia            | -14.9     | 11.5      | 12.9      | 394                |
| 26         | San Rafael de Mucuchíes   | - 9.2     | 22.7      | 24.2      | 329                |
| 27         | Pueblo Nuevo              | 23.6      | 10.7      | -27.0     | 309                |
| 28         | Jaji                      | -14.2     | -22.1     | 29.2      | 274                |
| 29         | El Morro                  | 47.8      | 57.2      | -23.4     | 242                |
| 30         | Aricagua                  | 27.7      | - 5.7     | .4        | 231                |
| 31         | Santa María de Caparo     | *         | *         | -65.0     | 230                |
| 32         | Estanques                 | 60.9      | 37.9      | 41.5      | 201                |
| 33         | Pinango                   | 2.0       | 25.5      | 0.0       | 192                |
| 34         | Palmira                   | 0.0       | - 0.7     | 11.2      | 169                |
| 35         | San José                  | 78.7      | 5.6       | - 4.0     | 145                |
| 36         | Acequias                  | -25.7     | 3.6       | 89.5      | 108                |

\*Census data not available.

Source: National Census of Population, 1950, 1961 and 1971.

population changes have not been due only to length of settlement. Although the functional composition of the centers was not recorded for the three periods, it may be assumed that significant changes in their economic functions occurred, given the hypothesized relationship between population and central functions.

Whereas there is no conclusive theoretical framework to explain the growth or decline of settlements, Hodge has summarized the results of various studies dealing with this problem, as follows:<sup>1</sup>

1. Small population centers are more susceptible to decline than larger ones.
2. Those centers offering a small range of goods and services are more likely to decline than those offering wider ranges.
3. Small centers located in proximity to large centers are less viable than if located elsewhere.
4. There are emerging two general types of trade centers: a large group of small centers serving local needs, and a small group serving specialized shopping needs over larger areas.
5. A number of other variables, such as access to improved transportation or the possession of major public facilities, are also suggested as having a bearing on the problem of trade center changes.

Finally, Hodges states that the most adequate measure of trade center change would seem to be one that measures

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<sup>1</sup>Gerald Hodge, "Do Villages Grow? Some Perspectives and Predictions," Rural Sociology 31 (1966): 185.

changes in the ability of a settlement to provide retail services, since these would be, after all, the prime raison d' être of trade centers in agricultural based regions.<sup>2</sup> From Figure 8 and Table 10 it may be concluded that with the exception of a few settlements--La Azulita, Chachopo, La Mesa and Acequias--the first, third and fifth generalizations pointed out by Hodge could be useful in explaining the population changes of rural settlements in Mérida State.

#### Functional Importance and Hierarchy of the Settlements

Numerous settlement studies suggest the existence of a close relationship between the size of a central place and the number and kind of central functions it fulfills, and that there are fewer large centers than small ones in a region. Centers of different sizes perform different functions because it is more efficient for some goods and services to be produced in small centers and others in larger ones.

#### Relationship Between Population Size and Functional Importance

To examine the relationship between population size and functional importance of the communities studied, a simple correlation and regression analysis was considered an appropriate technique. Within this context two basic questions arise: 1) Are the differences in functional

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<sup>2</sup>Ibid., p. 188.

importance related to differences of population size?

2) To what extent might there be a disruption of the expected linear relationship in such a mountainous area?

The first measure of functional importance is given by the number of central functions. It was hypothesized that a close and positive linear relationship exists between population size and number of central functions.

The coefficient of correlation ( $r$ ) found was .959. The coefficient of determination ( $r^2$ ) is, thus, .919, which indicates that nearly 92 percent of the variation in population size is associated with, or may be "explained" by, variation in number of central functions. If the data were considered as a random sample ( $n = 36$ ) from a bivariate normal distribution,  $r$  would be significantly different from zero for a .001 level of significance.

The following regression equation expresses the relationship between both variables:

$$Y_c = 92.35 + 83.75(X)$$

The variation in population size can be divided into two parts. One is "explained" by the independent variable, central functions, and another is attributed to other factors including chance.  $r^2$  reveals that a high proportion of the variation in population size is accounted for by the independent variable. Then it follows that the regression equation would be a good predictor of the settlement populations in the region.

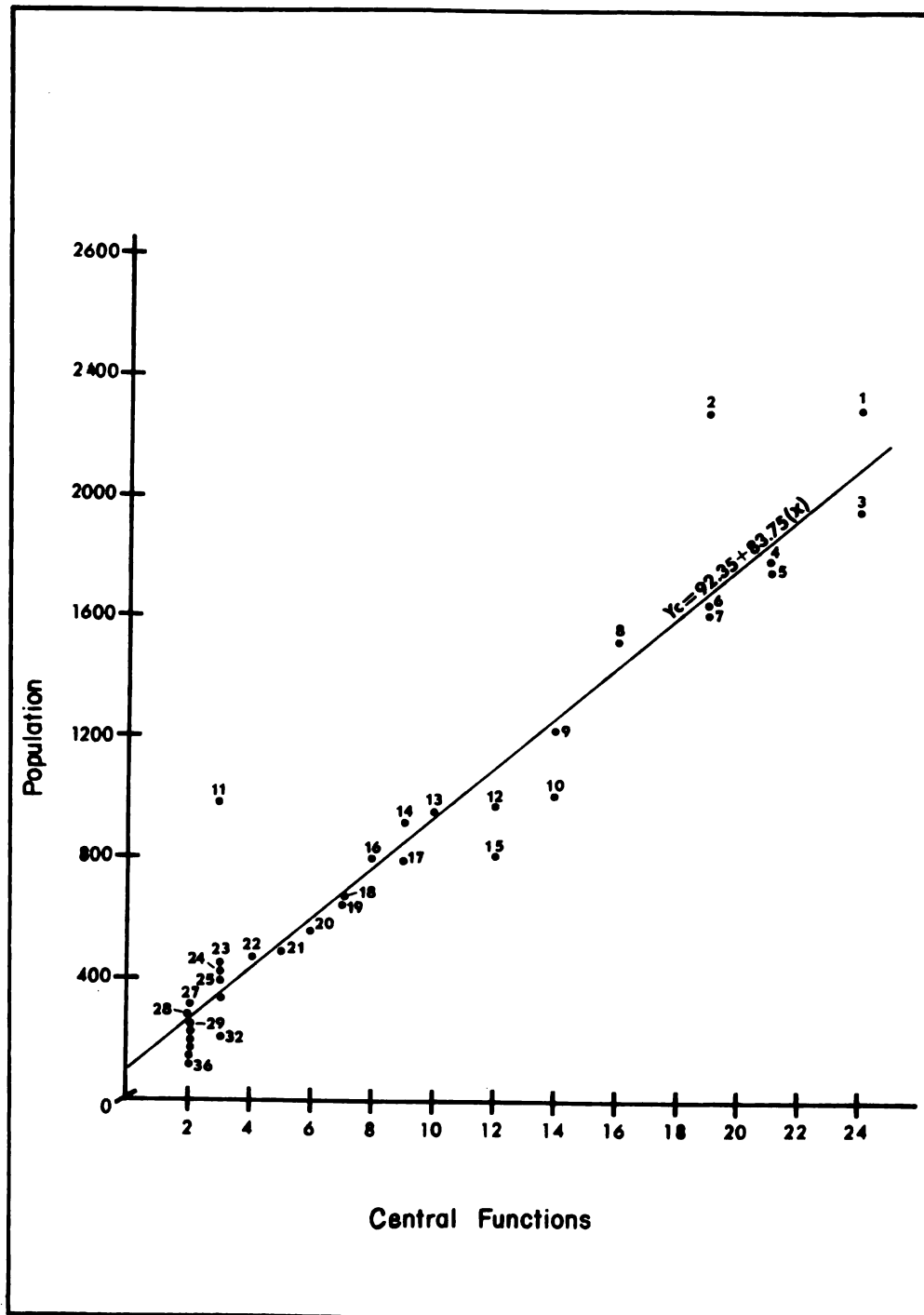
On Figure 3 centers lying to the left of the regression line may be said to have a larger population than their number of central functions would suggest, while centers to the right of the line have less population than would be expected given their number of central functions.<sup>3</sup>

Mesa Bolívar (02) and Palmarito (11) appear as extreme deviant cases, having a marked excess of population in comparison with their functional bases. Mesa Bolívar is near the cities of Santa Cruz de Mora, Tovar and El Vigía, which exert an attraction over the smaller surrounding settlements because of their wider range of goods and services. Likewise, people from Palmarito are accustomed to shopping in the larger centers of Nueva Bolivia and Caja Seca (the latter located on Zulia State), which in a practical sense act as a single center because of their physical and functional closeness. Hence, the number of functions performed in the two deviant centers are understandably less numerous than would otherwise be appropriate to serve the resident populations.

At the other extreme, Tabay (15) appears as a population deficient center in relation to its number of central

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<sup>3</sup>When dealing with a properly designed random sample, the residual cases can be established through the standard error of estimate: the average amount of computed values ( $Y_c$ ) differs from observed values ( $Y$ ) in the universe from which the sample is drawn. This measure provides an indication of the variability of the scatter of points about the regression line and further allows the construction of confidence intervals. Hubert M. Blalock, Social Statistics (New York: McGraw-Hill, 1960), p. 299.



**FIGURE 3. RURAL CENTERS OF MERIDA STATE:**  
 Relationship between population size and  
 number of central functions.

functions. This discrepancy is more difficult to explain given its proximity to the city of Mérida. Theoretically, its deviation should be in the opposite direction, since the growing dominance of Mérida might account for a comparative paucity of its central goods and services. Tabay is not a tourist center, nor is it loosing population. Neither is an important relief stop for automotive traffic. Thus, what might be suggested is that its economic functions are closely associated with the attraction exerted by administrative and religious services, or that there is a large enough population living nearby to permit the provision of a relatively large number of central functions on a regular basis.

Figure 3 also shows that the linear relationship is not consistent at the lower-order centers, those having fewer than 450 inhabitants and four central functions. This disruption may be the result of the process of depopulation or slow growth rate in these centers of low accessibility. Some functions might remain in these centers, despite their slow growth or decline, as a result of inertia.<sup>4</sup>

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<sup>4</sup>"The question posed is: In the process of growth in an area, does the population lag behind the number of services, or in an area of decreasing population, does the rate of decline for services lag behind that of the population." Stanley D. Brunn, "The Inertia Effect in Measuring Threshold Populations," Southeastern Geographer 7 (1967): 6.

Others, retailing in particular, would tend to disappear because of their sensitivity to population decrease.

The second hypothesis focuses upon the relationship between population size and number of functional units. The strength of this relationship, as expressed by  $r$ , was .937, which would be significant at the .001 level.  $r^2$  indicates that almost 88 percent of the total variation in population size can be attributed to the variation in number of functional units.

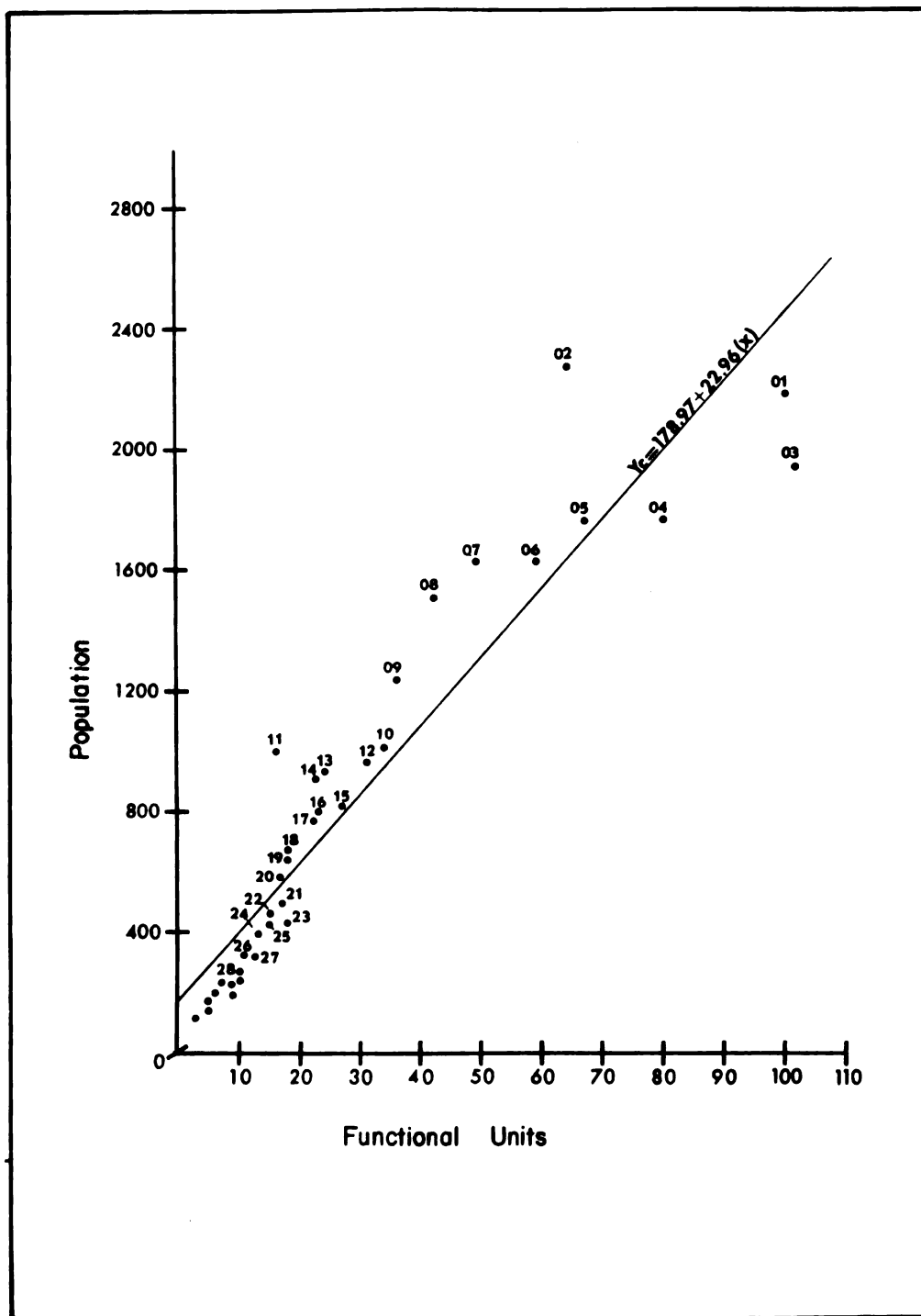
The best fit least squares regression equation takes the form:

$$Y_c = 178.97 + 22.96(X)$$

In Figure 4 some new deviant cases are noted. The most extreme is La Azulita (03) with the number of functional units greater than expected in relation to its population size. This center serves a relatively large outlying population, engaged in commercial agriculture, which is responsible for a much greater proliferation in number of commercial activities than might ordinarily be expected.

Figure 5 depicts the relationship between population size and weighted functional units. Both variables yield an  $r$  of .920 ( $r^2 = .846$ ), which is somewhat less than the preceding correlations. Again, the linear relationship does not hold for the smaller settlements and the deviation of Nueva Bolivia becomes very conspicuous. This settlement is located on a route of heavy traffic about halfway between





**FIGURE 4. RURAL CENTERS OF MERIDA STATE:**  
 Relationship between population size and  
 number of functional units.

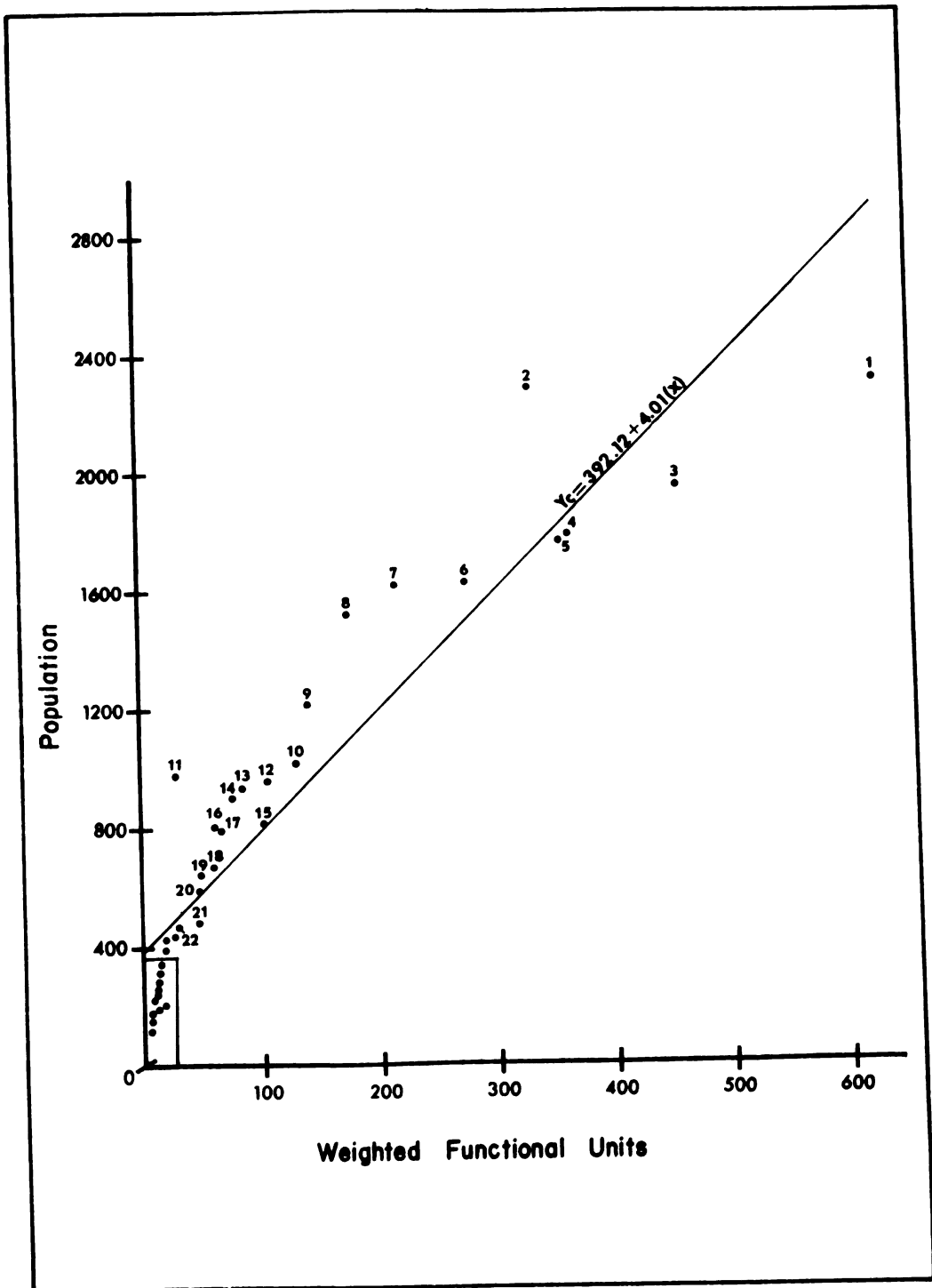


FIGURE 5. RURAL CENTERS OF MERIDA STATE:

Relationship between population size  
and weighted functional units.

El Vigía and Valera, two cities of regional importance. Consequently, its position as a major relief stop for numerous automobiles and buses that pass through this center each day has favored a certain functional specialization (restaurants and auto repair shops).

Apart from proximity to larger centers and the presence of non-central functions, other factors can be identified to explain the excess of population of some centers in relation to their functional importance. For example, in areas of low purchasing power and general lack of economic development the frequency of occurrence of a given function is smaller than in areas of higher incomes, since the demand generated is not enough to support various units of a same function. Notwithstanding these deviations, a good fit was found between the size of the settlements and their functional importance. This suggests that processes analogous to those implied by central place theory may operate within the study area: Settlements exhibit certain functional regularities irrespective of their cultural and physical setting, but the particular kinds of goods and services they provide are specific to the Andean cultural context. Findings support the hypothesis that the size of a settlement is closely related to its provisioning of central goods and services.

No single measure of centrality or "surplus importance" of places has yet been applied which is a fully comprehensive

index of the importance of a place. However, it is thought that central functions (area-serving activities) do serve as good indicators to identify central places, if it is assumed that these functions reflect movements of the outlying population to and from settlements.

### Testing for Hierarchical Structuring of Settlements

To test the hypothesis of a settlement hierarchy, weighted functional units are used as primary variables. As central place theory is most applicable to tertiary activities, particularly retailing, functional importance is assumed to represent valid data to examine this problem.

The hierarchical class-system implication is an integral part of the spatial model of central places developed by Walter Christaller, the generic base and single most important statement of central place theory.<sup>5</sup>

By classifying the settlements according to the functional units they possess it can be determined whether or not a hierarchy of centers exists, since the levels of central places are theoretically a function of the grouping requirements of certain bundles of central functions. Classification of the settlements can be achieved by applying factor analysis, a grouping procedure, and discriminant analysis.

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<sup>5</sup>Brian J. L. Berry and William L. Garrison, Functional Bases, p. 146.

Factor analysis has often been applied to central place studies.<sup>6</sup> Through this technique a reduction of the level of redundancy and identification of the major patterns of functional variation in the data can be obtained. The starting point is the raw data matrix composed by n-centers on rows and m-variables on columns. To ensure homoscedasticity the variables were transformed into their equivalent common logarithms.

From the  $n \times m$  matrix an  $m \times m$  correlative matrix was analyzed by principal axis solution to derive uncorrelated factors (patterns) with eigenvalues (roots) greater than 1.0.<sup>7</sup> Three unrotated factors were identified which account for 82.03 percent of the variation in the data (Table 11). These three factors define the most general patterns of relationships contained in the data. To distinguish clusters of relationships they were rotated to new positions by varimax rotation.

Through this rotation the factor interpretation shifts from unrotated factors delineating the most comprehensive data patterns to factors delineating the distinct groups of interrelated data.<sup>8</sup>

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<sup>6</sup>Brian J. L. Berry and H. Gardiner Barnum, Aggregate Relations; Josephine O. Abiodun, Urban Hierarchy; Jane E. Ratcliffe, An Examination.

<sup>7</sup>Most of the variables were highly correlated. Hence, changes in any one is reflected in one or several of the others. Highly interrelated variables seem to be unsatisfactory as measures of inter-center variations because of the high degree of redundancy (Appendix B).

<sup>8</sup>R. J. Rummel, Understanding, p. 474.

TABLE 11

UNROTATED FACTORS PERTAINING TO FUNCTIONAL  
UNITS OF THE RURAL CENTERS STUDIED

| Factors | Eigenvalues | Percent of Total Variance |
|---------|-------------|---------------------------|
| 1       | 16.1420     | 67.25                     |
| 2       | 2.4315      | 10.14                     |
| 3       | 1.1132      | 4.64                      |
| Total   | ---         | 82.03                     |

Table 12 presents the percentages of total variance accounted for by each of the rotated factors. Values shown in Table 12 suggest that the problem of the settlement hierarchy may be discussed in terms of these three factors with a reasonably high degree of accuracy. The degree and direction of association of each variable with each factor is indicated by factor loadings which can be interpreted as correlation coefficients. Variables with the highest loadings serve to identify the composition of a given factor.

TABLE 12

ROTATED FACTORS PERTAINING TO FUNCTIONAL UNITS  
OF THE RURAL CENTERS STUDIED

| Factors | Percent of Total Variance |
|---------|---------------------------|
| 1       | 39.88                     |
| 2       | 18.81                     |
| 3       | 23.34                     |
| Total   | 82.03                     |

The importance of each factor for each settlement is indicated by factor scores, which are standardized so that they have means of zero and standard deviations of one. The largest factor scores distinguish those centers in which a given factor is most strongly represented or lacking.

In Table 13 factor loadings greater than  $+0.7$  and less than  $-0.7$  are presented. On the basis of these values the factors may be described as follows:

Factor 1 incorporates eleven of the original twenty-four variables. It is clearly the most important single dimension of variance in the functional composition of the centers, and may be empirically termed as "lower and middle order functions" because there are no class I or class II functions.

Factor 2 is characterized by three class I services. Therefore, it may be termed "professional services."

Factor 3, the second most important pattern of variation, is composed of four class II functions which emphasize negative relationships with this factor. Because of its composition it may be labelled "commercial functions of higher-order."

Once the factors or patterns have been identified it is possible to ascertain how they are related to the various settlements. Factor scores are appropriate for this purpose. Indeed, the main objective accomplished by factor analysis in this study was the derivation of the factor score matrix, which constitutes the new data input to obtain the proposed settlement classification. Factor scores on the two most important factors were plotted on a two-axis graph (Figure 6) to discover in first approximation those centers functionally similar. By using Clark's definition of a group,

TABLE 13

HIGHEST FACTOR LOADINGS PERTAINING TO FUNCTIONAL UNITS  
OF THE RURAL CENTERS STUDIED

| Factor | Variables                      | Loadings | Class of Functions |
|--------|--------------------------------|----------|--------------------|
| 1      | Small groceries and sundries   | .7250    | VII                |
|        | Bars                           | .7353    | VII                |
|        | Restaurants                    | .7924    | VI                 |
|        | General groceries              | .8233    | III                |
|        | Dry good stores                | .8651    | III                |
|        | Hotels and hostels             | .8492    | IV                 |
|        | Butcher shops                  | .8134    | III                |
|        | Auto repair shops              | .7983    | V                  |
|        | Trinket shops                  | .7114    | V                  |
|        | Gas stations                   | .8363    | II                 |
|        | Tailor shops                   | .7093    | IV                 |
| 2      | Physician                      | .9345    | I                  |
|        | Electrical appliance repair    | .9345    | I                  |
|        | Lawyer                         | .8338    | I                  |
| 3      | Shoe stores                    | -.8325   | II                 |
|        | Hardware and building supplies | -.7938   | II                 |
|        | Farm stores                    | -.7332   | II                 |
|        | Bakeries                       | -.7351   | II                 |



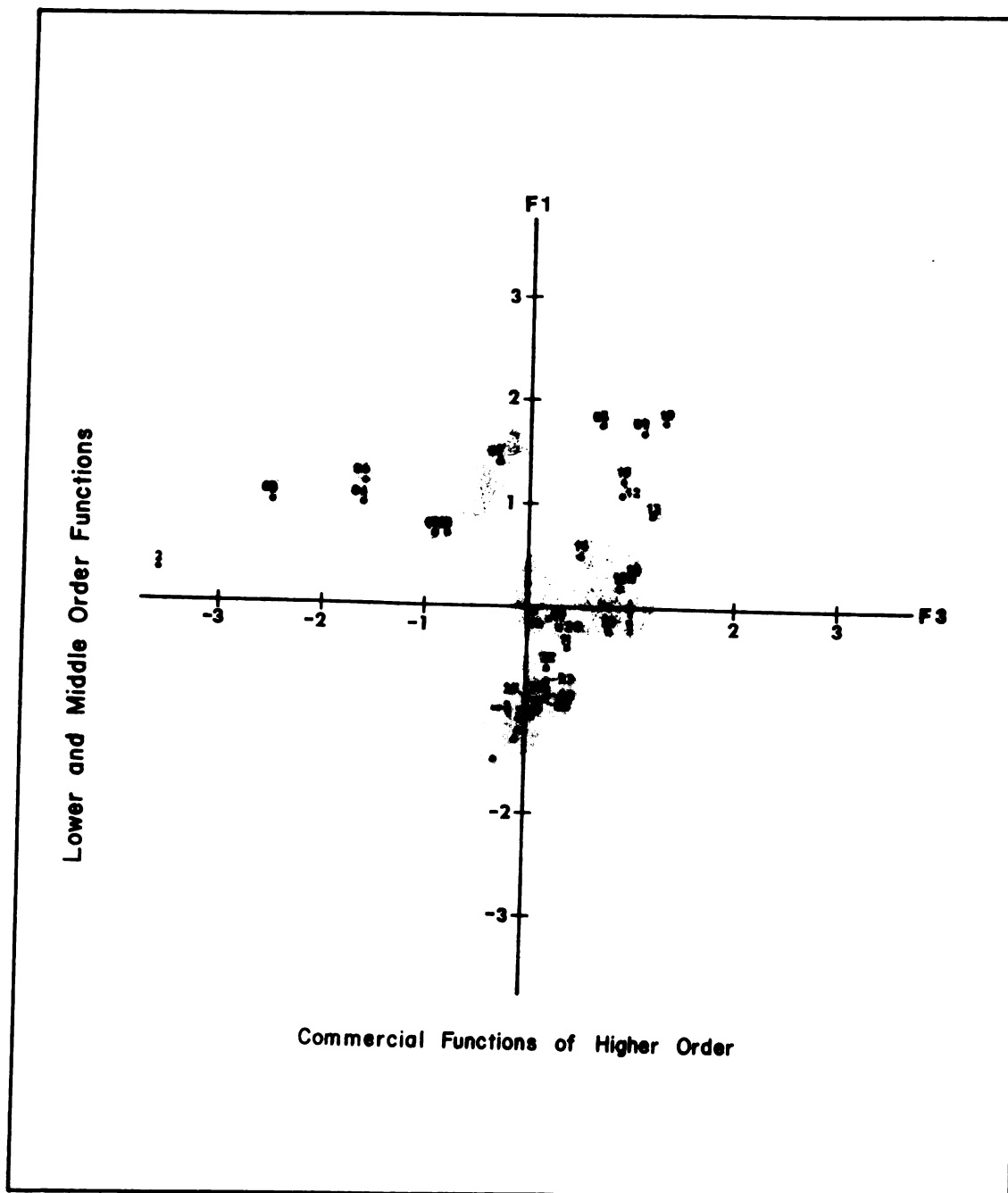


FIGURE 6. RURAL CENTERS OF MERIDA STATE:  
Factor Scores on Factors 1 and 3.

a collection of points in which each individual point is closer to some member of the collection than to any point outside of it, five groups of centers may be distinguished.<sup>9</sup> The smallest centers show a strong tendency toward clustering, but the deviant cases within other groups are so numerous as to introduce further subdivisions. A larger or smaller number of groups might be established following Clark's criterion. Thus, this concept of group does not seem appropriate to identify a settlement hierarchy.

Contiguity grouping routine (CNGRP) was the grouping measure applied to factor scores.

This program groups observations using the criterion of Euclidian proximity in a p dimensional vector space. . . . Each of the n observations consists of p variables. The original n observations are initially considered to consist of n p-dimensional groups each containing one element. The grouping procedure examines all of the squared distances among these n observations and joins the two groups separated by the minimum distance. Each step of the grouping procedure decreases by one the number of groups still to be consolidated. Each group replaces two joined groups by a new group located at the center of the mass of the pair, and thus a group then contains all of the elements of the pair. This procedure is repeated for n-1 steps, after which all observations are in one group. The minimum distance is added to the value of SUM at each step, thus providing a measure of the efficacy of each grouping.<sup>10</sup>

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<sup>9</sup>Phillip J. Clark, "Grouping in Spatial Distributions," Science 123 (1956): 373.

<sup>10</sup>Robert I. Wittrick, Some General, p. 24.

It is essential that the observations are measured on the same scale and are uncorrelated or independent. Factor scores meet these grouping requirements.

The result of the analysis is a complete "linkage tree" which shows the entire hierarchy of groups of settlements (Figure 7).

How many groups can be recognized in Figure 7? It is difficult to set up an analytical solution to this problem. A determined number of groups estimated as most desirable for a particular investigation could be selected.<sup>11</sup> However, from the "tree" it is noted that step 33 is the last step that preserves the identity of five large core groups:

First group: Nueva Bolivia and La Azulita.

Second group: Mesa Bolívar, Zea, Tucaní and Santa Elena de Arenales.

Third group: Mucuchíes, Santo Domingo, Chiguará, Guayabones, Chachopo, Pueblo Llano and Tabay.

Fourth group: Palmarito, La Mesa, San Cristóbal de Torondoy, San Juan de Lagunillas, Libertad, Las Piedras, Guaraque and Mucurubá.

Fifth group: Mucuchachí, Mucutuy, Torondoy, Santa Apolonia, San Rafael de Mucuchíes, Pueblo Nuevo, Jají, El Morro, Aricagua, Santa María de Caparo, Estanques, Piñango, Palmira, San José and Acequias.

These five groups were tested for optimality through multiple discriminant analysis (DISCR).

DISCR performs a multiple discriminant analysis in a stepwise manner. At each step one variable

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<sup>11</sup>Leslie J. King, Statistical Analysis, p. 195.

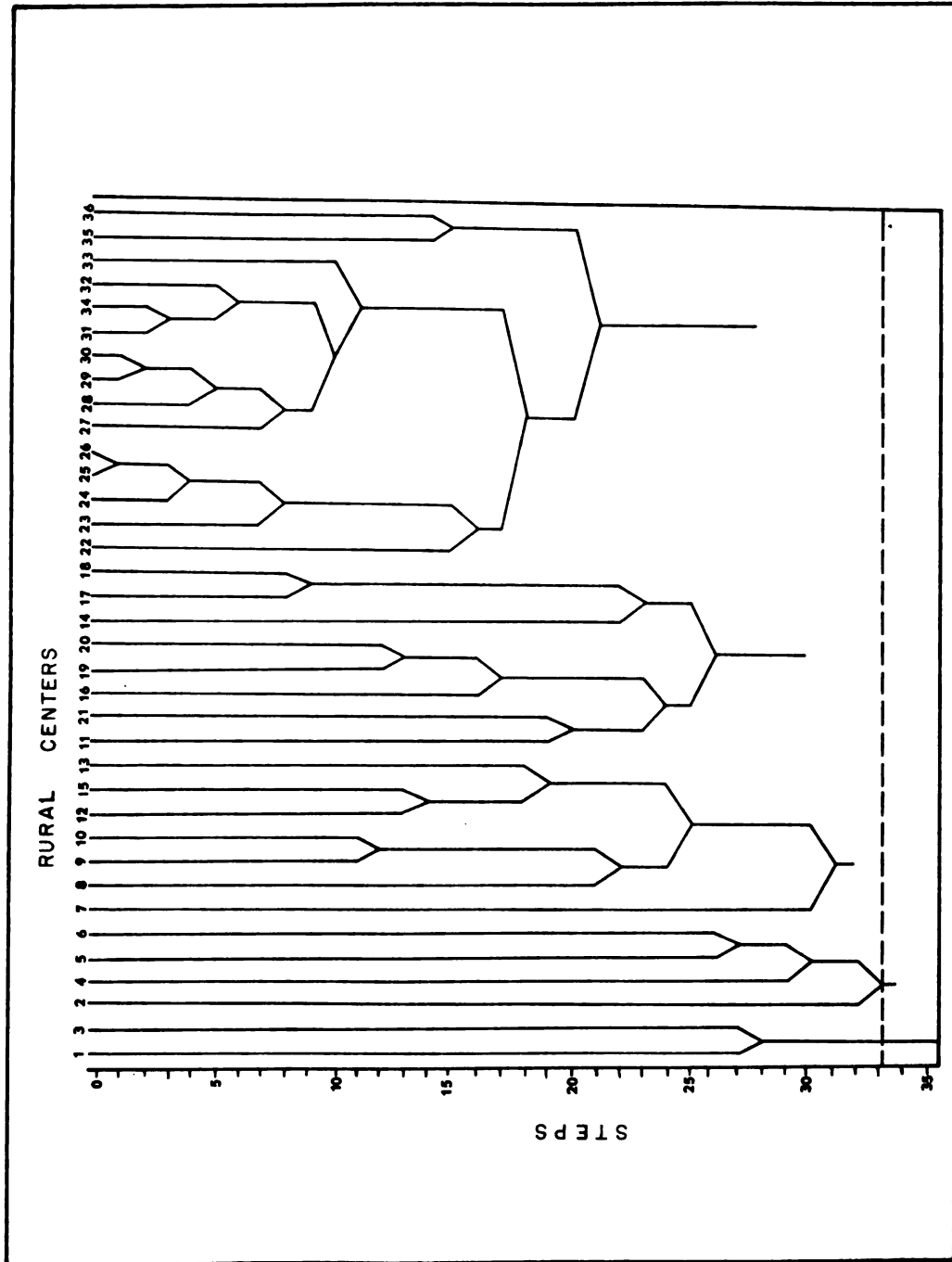


FIGURE 7. RURAL CENTERS OF MERIDA STATE: STEPWISE - GROUPING

is entered into the set of discriminating variables. The variable entered is selected by the first of the following equivalent criteria: (1) the variable with the largest F value, (2) the variable which when partialled on the previously entered variables has the highest multiple correlation with the groups, and (3) the variable which gives the greatest decrease in the ratio of within to total generalized variances.<sup>12</sup>

Discriminant analysis has been proposed as an aid to determine the position of groups in n-dimensional space by maximizing the discriminations between already defined groups. For example, settlements can be conceptualized as occupying determined spatial positions within a hierarchical structure, despite the many different criteria used to define them. The relevant point is that the groups must be predetermined.

The discriminant analysis only reallocated two centers: Pueblo Llano to the fourth group and Palmarito to the fifth group. In this manner, the groups derived by grouping analysis attained a high degree of optimality.

The coefficients of linear discriminant functions appear in Table 14. These coefficients indicate the importance of each factor in discriminating between the groups. For example, factor 2 (professional services) was the most important to distinguish the first group from the others, whereas factor 1 (lower and middle order functions) was the most important in relation to the fifth group.

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<sup>12</sup>Robert I. Wittick, Some General, p. 18.

TABLE 14

COEFFICIENTS OF LINEAR DISCRIMINANT FUNCTIONS PERTAINING  
TO FIVE GROUPS OF RURAL CENTERS AND THREE FACTORS

| Factors | Groups    |           |          |          |           |
|---------|-----------|-----------|----------|----------|-----------|
|         | 1         | 2         | 3        | 4        | 5         |
| 1       | 35.45289  | 28.45949  | 14.57660 | -4.52207 | -16.70695 |
| 2       | 77.63247  | 15.88906  | -8.37784 | -8.55342 | - 6.11656 |
| 3       | -56.79082 | -30.36550 | 4.20011  | 8.81850  | 9.00746   |

### Discussion of the Settlement Hierarchy

The distribution of rural service centers in Mérida State can be discussed on the basis of the two forms of hierarchical arrangement of settlements proposed by Garner: a horizontal organization in which the spatial parameter is explicit and a vertical organization in which the spatial parameter need not be explicit.<sup>13</sup>

. . .the essential features of the 'Horizontal' arrangement of settlements are: (H-1) they are regularly spaced to form a triangular lattice, and (H-2) they are centrally located within hexagonal shaped trade areas. 'Vertical' organization hinges on the assumption that a hierarchy of discrete groups or orders of settlements exists in which (V-1) higher order places supply all the goods of lower order places plus a number of higher order goods and services that differentiates them from, and at the same time sets them above, central places of lower order, and (V-2) higher order places offer a greater range of goods and services, have more establishments, larger populations, trade areas and trade area populations and do greater volumes of business than lower order settlements. This

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<sup>13</sup>B. J. Garner, Models of Urban, p. 306.

'vertical' organization has 'horizontal' expression in the following ways: (C-1) higher order central places are more widely spaced than lower order central places, and (C-2) lower order central places, to be provided with higher order goods and services, are contained or 'nest' within the trade areas of higher order places according to a definite rule.<sup>14</sup>

Based upon the preceding grouping analysis the thirty-six rural service centers in the study area were classified into five orders (Tables 15 and 16). The characteristics of this distribution of centers agree with some postulates of central place theory:

1. The number of centers within each group decreases as the order increases. That is, larger settlements are less frequent than small ones.
2. The functional composition of the higher-order centers consists of the goods and services of lower-order centers, plus certain higher-order functions, differentiating them from the lower-order centers.
3. Settlements differ more from one order to another than they differ within orders. Conspicuous breaks in functional composition separating the order of centers are apparent. Interpretation of the set as a continuum is clearly not supported. Thus, group members relate more with other members of the group than they relate to non-group members.
4. Since population and functional units have a high positive linear relationship, the settlements ranked by population should correspond with the levels of the functional hierarchy. This assumption is true with the exception of deviant cases: Mesa Bolívar should be in the first order; Mucuchíes in the second order; Pueblo Llano, La Mesa, and Palmarito in the third order; Tabay in the fourth and Mucurubá in the fifth order. However, discrete

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<sup>14</sup>Ibid., pp. 307-308.

TABLE 15  
FUNCTIONAL HIERARCHY OF THE RURAL CENTERS STUDIED

| Key Number                                                                                   | Centers                                                                                                                                                                                                                         | Order        | Population                                                                                                   | Weighted Functional Units                                                              | Differentiating Central Functions                                     |
|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 01<br>03                                                                                     | Nueva Bolivia<br>La Azulita                                                                                                                                                                                                     | First order  | 2254<br>1946                                                                                                 | 624<br>454                                                                             | Physicians, electrical appliance repairs.<br>plus:                    |
| 02<br>04<br>05<br>06                                                                         | Mesa Bolívar<br>Zea<br>Tucaní<br>Santa Elena de Arenales                                                                                                                                                                        | Second order | 2279<br>1778<br>1759<br>1627                                                                                 | 330<br>360<br>354<br>275                                                               | Supermarkets, Lawyers.<br>plus:                                       |
| 07<br>08<br>09<br>10<br>12<br>15                                                             | Mucuchíes<br>Santo Domingo<br>Chiguará<br>Guayabones<br>Chachopo<br>Tabay                                                                                                                                                       | Third order  | 1625<br>1518<br>1221<br>1010<br>971<br>806                                                                   | 216<br>173<br>139<br>131<br>106<br>102                                                 | Shoe stores, Hardware and building supplies, farm stores.<br>plus:    |
| 13<br>14<br>16<br>17<br>18<br>19<br>20<br>21                                                 | Pueblo Llano<br>La Mesa<br>San Cristóbal de Torondoy<br>San Juan de Lagunillas<br>Libertad<br>Las Piedras<br>Guaraque<br>Mucurubá                                                                                               | Fourth order | 941<br>913<br>801<br>781<br>668<br>646<br>577<br>490                                                         | 83<br>71<br>59<br>65<br>58<br>48<br>42<br>42                                           | Gas stations, Trinket shops, Hotels and hostels, Pharmacies.<br>plus: |
| 11<br>22<br>23<br>24<br>25<br>26<br>27<br>28<br>29<br>30<br>31<br>32<br>33<br>34<br>35<br>36 | Palmarito<br>Mucuchachí<br>Mucutuy<br>Torondoy<br>Santa Apolonia<br>San Rafael de Mucuchíes<br>Pueblo Nuevo<br>Jají<br>El Morro<br>Aricagua<br>Santa María de Caparo<br>Estanques<br>Piñango<br>Palmira<br>San José<br>Acequias | Fifth order  | 988<br>472<br>432<br>424<br>394<br>329<br>309<br>274<br>242<br>231<br>230<br>201<br>192<br>169<br>145<br>108 | 27<br>26<br>20<br>17<br>15<br>13<br>12<br>10<br>10<br>9<br>7<br>15<br>9<br>5<br>5<br>3 | Small groceries and sundries, Bars, Restaurants.                      |



grouping of population levels does not seem to be a necessary condition for a hierarchy of settlements since the population variable can be treated meaningfully as a continuous unimodal one.<sup>15</sup>

TABLE 16

MEAN VALUES OF POPULATION SIZE AND FUNCTIONAL IMPORTANCE OF THE HIERARCHY OF RURAL CENTERS STUDIED

| Order of Centers | Number of Centers | Population Mean | Mean of Functional Units | Mean of Central Functions |
|------------------|-------------------|-----------------|--------------------------|---------------------------|
| 1                | 2                 | 2,120           | 539                      | 24                        |
| 2                | 4                 | 1,861           | 330                      | 20                        |
| 3                | 6                 | 1,192           | 145                      | 15                        |
| 4                | 8                 | 727             | 59                       | 8                         |
| 5                | 16                | 321             | 13                       | 3                         |

In terms of the spatial pattern of these settlements, nothing remotely similar to a hexagonal structure was found (Figure 8). Since the settlement distribution is not uniform in the study area a hierarchical arrangement different from the theoretical one should be expected, especially in view of the considerable changes in population of the centers through time and the varied degree of accessibility in the region.<sup>16</sup> Furthermore, higher-order centers are not more

<sup>15</sup>Leslie J. King, "Central Place Theory and the Spacing of Towns in the United States," in Land and Livelihood: Essays in Honor of George Jobberns, ed.: Murray McCaskill (Christchurch: New Zealand Geographical Society, 1962), pp. 248-249; Edward N. Thomas, Toward an Expanded, pp. 400-411.

<sup>16</sup>As viewed in this study, the accessibility concept is closely related to types of roads and transportation.

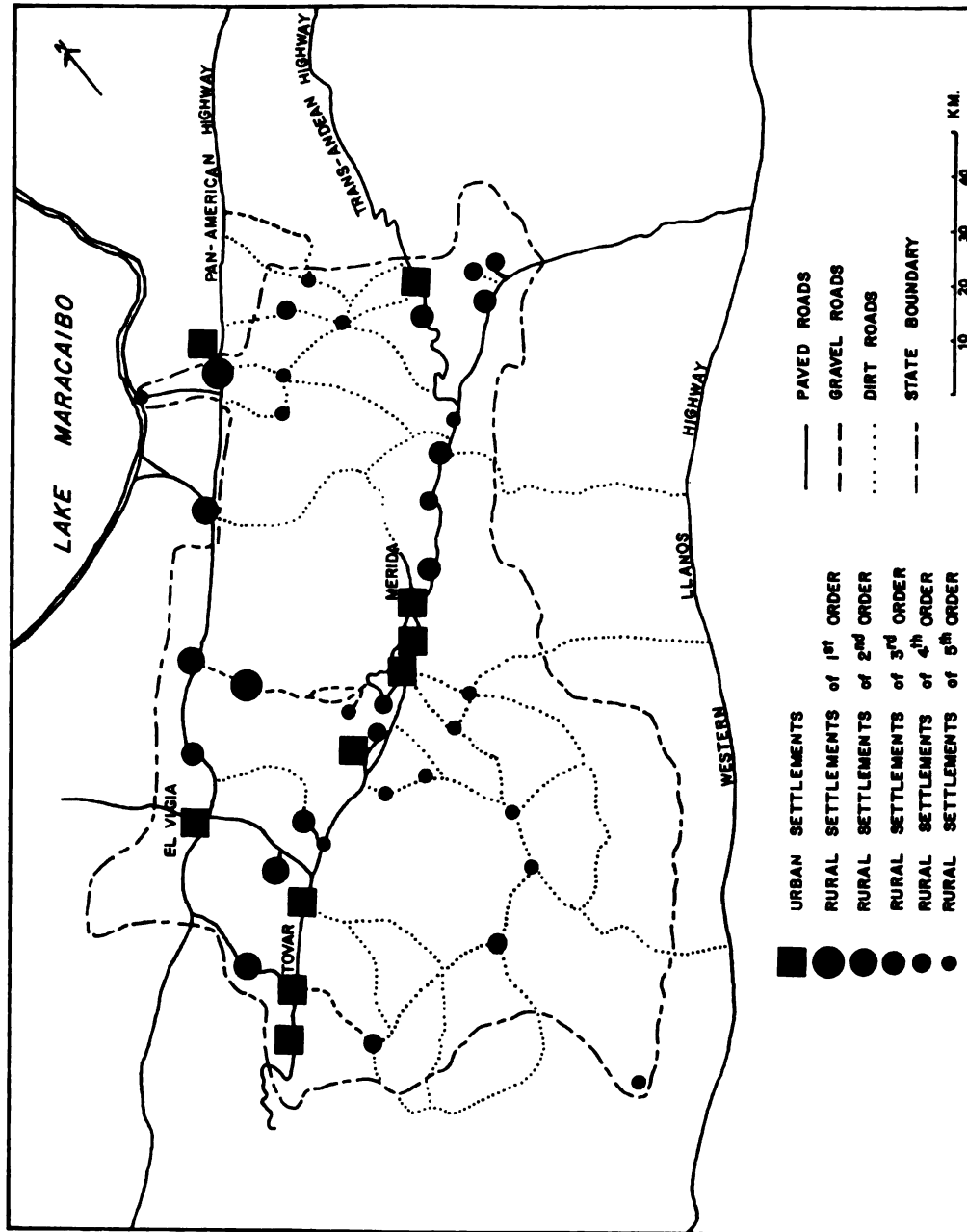


FIGURE 8. MERIDA STATE: HIERARCHY OF SETTLEMENTS

widely spaced than lower-order centers, nor are the latter clearly "nesting" within the hinterlands of the former.<sup>17</sup>

Thus, it can be stated that the service centers of Mérida State conform to a vertical hierarchy, but without an explicit spatial expression. The distribution of settlements is governed largely by the road system, which therefore constitutes a primary factor in the location and growth of the centers. There is a conspicuous relationship between type of roads and orders of the hierarchy: Higher-order centers form linear patterns along the main highways, whereas lower-order centers scatter in the less accessible parts of the region.

It should be stressed that the spatial dimension of a settlement net must be viewed according to the set of interactions and interchanges within a marketing system.

Ultimately it is the decision about where the consumer spends his money (as well as the amount of money that is available) that forms the ultimate determinant of any central place system. Consequently it is appropriate that the spatial analysis of consumer spending patterns, not in one center, but with reference to a set or system of places forms the current frontier of central place studies.<sup>18</sup>

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<sup>17</sup> Averages of linear distance (Km) from each of the centers to all other centers in each order, are as follows:  
 First order = 61  
 Second order = 51  
 Third order = 58  
 Fourth order = 73  
 Fifth order = 50

<sup>18</sup> Wayne K. D. Davies, Towards an Integrated, p. 195.

In this context, only a technique involving interviews in the countryside can directly identify the linkages which define the areal extent of a central place system. It should be expected that trade area size for a particular function increases with the order of centers, and the maximum distance consumers are willing to travel (range of that function) would consequently depend on the level of the hierarchy.

Could a hierarchical spatial expression be found for the settlements of Mérida State by examining the threshold populations and the range of goods and services? Or, to the contrary, do larger centers absorb functions which should be performed by lower-order centers? These questions remain to be answered.

Chaves and Amaya examined the wholesale flows within the settlement system of the "region of Mérida," which was defined generally as the Chama basin between Estanques and San Rafael de Mucuchíes. They found that with the exception of Mucuchíes and Ejido, whose supply of goods was provided in part by extraregional cities, Mérida dominated wholesale distribution on the bottom of the valley, along the Trans-Andean Highway. On the other hand, the small cities of Ejido and Lagunillas did not exert their wholesaling influence on the centers closest to them along the highway but on the less accessible slope-located aldeas.<sup>19</sup> Based upon Mintz's

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<sup>19</sup>Luis F. Chaves and Carlos A. Amaya, Sistema de Ciudades, pp. 12-17.

concepts of "horizontal exchange" and "vertical exchange," it was concluded that the Mérida region, and presumably the whole Venezuelan Andes, is a typical example of a regional dendritic system (Figure 9).<sup>20</sup>

Figure 9 is described by Johnson in the following terms:

Goods destined for export (e.g., coffee, sisal) and a wide variety of provisions for the urban population (e.g., pork, beef, poultry, eggs, pulses, grain) are gathered up in or near rural markets, bulked or processed in a few "strategic" markets, and moved to port-cities by migrant traders (révâdèz). Conversely, consumer goods which peasant-community artisans cannot produce move from port-cities through strategic (whole-sale) markets to local markets.<sup>21</sup>

An important aspect of Mintz's model is that the organization of the marketing system is strongly linked to social groups with marked economic and social differentiation. When the exchange of goods and services ends in their consumption by class equals, there is a horizontal exchange. Goods passing from the importer, wholesaler or factory owner to the peasantry indicates a downward vertical exchange. Fresh vegetables and

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<sup>20</sup>Sidney W. Mintz, "Internal Market Systems as Mechanisms of Social Articulation," Proceedings of the American Ethnological Society, Seattle 1959, pp. 20-30. See also: "A Tentative Typology of Eight Haitian Market Places," Revista de Ciencias Sociales 4 (1960): 15-57; "Pratik: Haitian Personal Economic Relationships," Proceedings of the American Ethnological Society, Seattle 1961, pp. 54-63; "The Role of the Middleman in the Internal Distribution System of a Caribbean Peasant Economy," Human Organization 15 (1956): 18-23.

<sup>21</sup>E. A. J. Johnson, The Organization of Space in Developing Countries (Cambridge: Harvard University Press, 1970), p. 85.

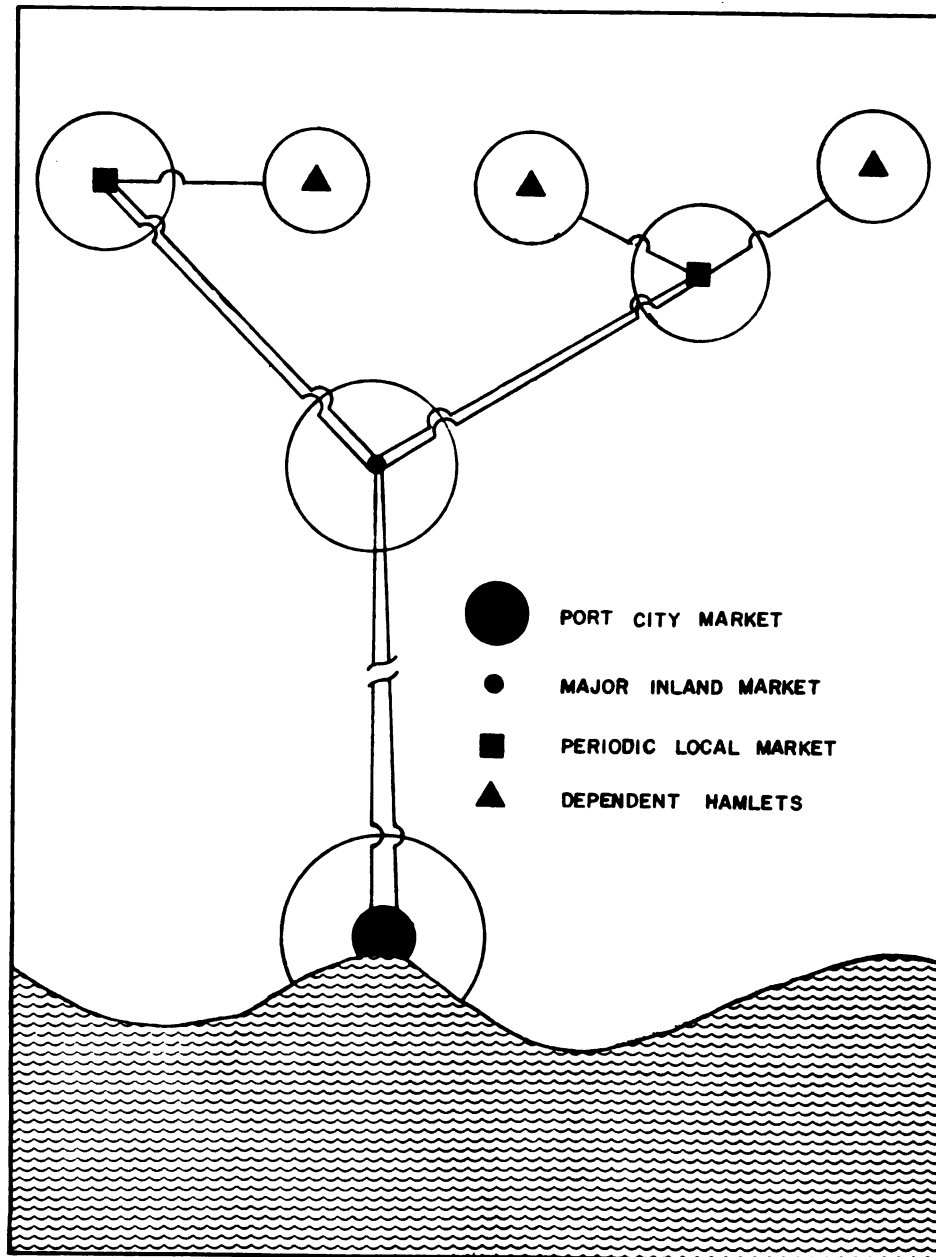


FIGURE 9. ELEMENTS OF A DENDRITIC MARKET SYSTEM  
(after E. A. J. Johnson, pg. 86)

craft goods, for example, passing from the peasantry to the upper classes illustrates upward vertical exchange.<sup>22</sup>

It seems that the two models attempt to explain the spatial component of the rural market system at different levels. From the description above, it can be concluded that dendritic schema is based upon inter-center linkages, taking basically into account wholesale distribution through different socio-economic groups. On the other hand, central place, as classically viewed, is a demand-oriented model centered on the retail transactions that a central place performs for its surrounding dependent population. From this viewpoint, it seems unlikely that peasants living in areas surrounding San Rafael de Mucuchíes, for instance, travel to the city of Mérida frequently to purchase their goods because 1) most of these peasants do not live in nucleated settlements but in scattered and poorly communicated farmsteads, and 2) due to a low income economy their consumer behavior is greatly restricted to subsistence goods. Therefore, the scattered rural population probably resorts to the nearest rural market to buy its frequent-use farm and household items.

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<sup>22</sup>Sydney W. Mintz, Internal Markets, p. 21. Thus the Chaves and Amaya study concentrated mainly on "downward" flows.

## CHAPTER V

### CONCLUSIONS: PERSPECTIVES FOR A RURAL SETTLEMENT DEVELOPMENT FRAMEWORK

A growing interest is apparent in integrated settlement planning, particularly in rural areas of developing countries. Such plans are of great importance for the future development of these areas, since they permit a rationalization in the provision of infrastructural services. This is especially important with respect to roads, schools and public health facilities, which largely influence the extent of rural development. Not only are the quantity and quality of services critical, but also their spatial distribution since it provides the physical framework within which socioeconomic relationships take place.

The planning process demands a flexible methodology and a set of criteria upon which it is based. These criteria differ from region to region, but there are basic elements which must be taken into account in all planning policy.

#### General Considerations

The spatial structure of services can be understood by the way facilities are distributed in an area relative to the user-population. Assuming that in most of these areas



there are insufficient services to guarantee an improvement in living conditions, and considering that several of the rural centers are losing population, a geographic problem arises: What are the best locations for the provision of these services? This is the main question with which this chapter is concerned.

A relevant spatial principle behind the planned development of services is the agglomeration of activities in nuclei to take advantage of scale economies. In fact, the costs of providing public services for a dispersed population living in isolated hamlets and farmsteads are particularly high.<sup>1</sup> Advantages derived from implementation of this principle include the following:

1. Farmers visiting such service centers can make use of several facilities at one time. For example, they might be inclined to call more frequently at the agricultural office and the health center than if they had to make separate trips to acquire these services.
2. Fewer objections will probably be received from professional staff (teachers, physicians, agricultural engineers) appointed to certain rural centers if clusters of services exist.
3. Agricultural institutions (cooperatives, farmer associations, rural credit agencies) function more efficiently when they are placed within a satisfactory infrastructure of services.

Such policies in rural areas involve selecting a limited number of settlements where population may be

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<sup>1</sup>A. Anderson, "Space as a Social Cost," Journal of Farm Economics 32 (1950): 411-430.

increased and the range of service provision extended, and designating the remainder for future stability or even contraction.<sup>2</sup>

The concentration policy maintains that provision of services should not be made in declining population settlements, unless the services can be provided at relatively low cost. Otherwise, such centers should be allowed to run down and their populations encouraged to move. The point is that these centers are not in themselves viable and, therefore, it would be a waste of resources to improve their viability if they will eventually become depopulated and derelict.

Green has noted that:

Building up larger rural communities, located farther apart, would be a continuation of a trend that has been apparent in the history of rural settlements as one form of transportation has replaced another.<sup>3</sup>

Similar points of view have been put forward by Kovalev and Clawson.<sup>4</sup>

Some problems associated with this approach should also be considered, such as the following:

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<sup>2</sup>Hugh D. Clout, Rural Geography (Oxford: Pergamon Press, 1972), pp. 140-141.

<sup>3</sup>R. J. Green, "The Remote Countryside: A Plan for Contraction," Planning Outlook 1 (1966): 34.

<sup>4</sup>S. A. Kovalev, "Problems in the Soviet Geography of Rural Settlements," Soviet Geography 9 (1965): 641-650. Also, "Transformation of Rural Settlements in the Soviet Union," Geoforum 9 (1972): 33-34; M. Clawson, "Factors and Forces Affecting the Optimum Rural Settlement Pattern of the United States," Economic Geography 42 (1966): 283-293.

1. It necessitates certain compulsory action, since otherwise there would be a residual population that would choose to remain and for these people some basic services would have to be provided.
2. The capital which already exists in declining centers plus the costs of re-settling the population must be set against the costs of maintaining and improving existing services.
3. To deny the growth or accelerate the decline of non-viable settlements is a difficult planning decision.

If small settlements are not only declining relatively but are really dying out, their deterioration cannot be reversed rapidly by the infusion of new functions. Therefore, a realistic decision is to plan their fast abandonment to prevent the social damage inherent in an underpopulated center.<sup>5</sup> Indeed, residual economies, settlements and populations become a real problem.

#### The Proposed Framework

Any discussion of rural center development must be conceived within the broad context of regional policy and strategy. Therefore, the scheme here proposed assumes the following decisions in regional policy as a basis of exposition:

1. Investment of resources is to be directed toward selected locations to achieve both a concentration of investments and a maximum diffusion of benefits (agglomeration advantages).
2. There is need to strengthen small and medium-sized settlements to intercept the population drift out

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<sup>5</sup>David H. K. Amiran, "The Structure of Settlement: Needed Adaptations to Change," Geographica Helvetica 26 (1971): 3.

of the region, and this can be achieved at least partially by an improved provision of services.

3. The policy of settlement development will be well integrated into the social, economic, political and cultural strategy. No capital will be allocated to a given project without reference to all other projects in the area.
4. Effective combined action between government planning offices, private enterprise, local administration and community leaders is to be expected.

Setting aside the major problems of regional development, the question to be faced is how to select objectively "key centers" which efficiently serve their hinterlands in a region with conditions of depopulation, stagnation and a general low level of services. Central place hierarchy, associated with the notion of rural growth center, is proposed as a methodological base from which to deal with this problem.

A rural growth center is defined as one that has undergone economic and demographic growth or that has potential capacity to grow rapidly under induced socioeconomic changes. Positive changes in a wide range of relevant variables is crucial to the concept of growth center. Unfortunately, temporal data are generally lacking in these regions.

### Functional Hierarchy of the Settlements

A hierarchy of settlements based upon central functions permits an evaluation of their functional importance or "centrality" as providers of goods and services in excess of those demanded by their own inhabitants. If there exist data

on central functions for different time periods, temporal changes of the settlements in the hierarchy can be analyzed to facilitate the evaluation of key centers. This analysis would indicate which centers are showing a strong tendency toward increasing their centrality through time.

It is essential to stress the difference in kind of central functions for it is on the existence of higher-order activities that the higher status of a place depends. It follows that a system of "weights" must be designed to account for the differential significance of functions. The hierarchical organization is therefore conspicuous as the first supporting element in the selection of growth centers.

#### Selection of Rural Growth Centers

Depending upon the scope of the planning policy and the total number of settlements investigated, a certain number of higher-order centers is chosen from the ranked hierarchy. In this respect, Johnson favors a "saturation" of one or more portions of the better areas, while randomly chosen growth points would be used as "pilot projects" in the more backward portions.<sup>6</sup> However, the initial number of selected settlements is tentative, since complementary indicators must be evaluated and quantified. Among these are:

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<sup>6</sup>E. A. J. Johnson, The Organization of Space, p. 218.

1. Physical accessibility. Their geographic location should be such that accessibility, real and potential, between these foci and the other points of the settlement network is maximized. Travel distance or cost distance may be estimated to measure this variable. Accessibility is one of the most important factors in the attraction-diffusion impact of a center.
2. Population trends. It is necessary to examine population changes of the centers, particularly relative growth, since a given settlement may increase its population in absolute number even though its rate of growth is decreasing.
3. Existing public services and political-administrative structure (urbanization complex). In economic terms, the development process is less costly if the settlements are selected with consideration of their present urbanization infrastructure.<sup>7</sup> Scale of operation, number of employees or budget level may be used as surrogate measures.
4. Demographic and economic characteristics of surrounding areas. An evaluation of present and potential land use, density and distribution of population, agricultural productivity and tourist potential of the municipios in which centers are located is useful to determine the demographic and economic characteristics of areas surrounding a selected central place. Harrison has emphasized the importance of potential agricultural capacity in this kind of investigation.<sup>8</sup>

Functional hierarchy permits the evaluation of settlement characteristics to be reduced to those centers selected on the basis of their centrality. Otherwise, an evaluation of all centers should be required. Functional importance is

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<sup>7</sup>Tarun B. Lahiri, "Urbanization Potential of Villages," Geographical Review of India 28 (1966): 30.

<sup>8</sup>Bennett Harrison, Rural Growth Centers: A Strategy for the Rural Development of Low-Income Countries (Washington: United States Agency for International Development, 1967), p. 2.

an outstanding criterion for pre-selection of places, since it is theoretically an accurate measure of the drawing power of a central place. Actually, central functions are the activities forming the economic base of these settlements.

Once complementary indicators have been quantified, the data may be summarized in some sort of index. The following index  $I_j$  is proposed. The larger the value of  $I_j$  the greater the importance of complementary indicators in a given center.

$$I_i = \frac{T_{pi,ji}}{k} \cdot 100$$

$I_i$  = Relative importance of a particular indicator  $p_i$ .

$T_{pi,ji}$  = Total value of a particular  $p_i$  for all  $j_i$  centers in the study area.

$k$  = Total value of all indicators  $p_i$  for all  $j_i$  centers in the study area.

$$I_j = \sum_{i=1}^m (p_{1,j_1} \cdot I_1 + p_{2,j_1} \cdot I_2 + p_{3,j_1} \cdot I_3 + \dots + p_m, j_n \cdot I_m)$$

$I_j$  = Index of complementary indicators for a particular center  $j$ .

First, an index of importance for each indicator is calculated  $I_i$ . By multiplying these indices by the value of the indicator in each place, and adding these products, an index  $I_j$  for each center is obtained. The objective is to show which of the existing concentrations of complementary indicators qualify for the functioning of a rural growth center. The results of the analysis may be ordered in a matrix as shown

in Table 17. By comparing the indices of complementary indicators with centrality of the settlements, a conclusive number of rural growth centers can be selected. Again, this is a decision of regional policy.

TABLE 17  
DATA MATRIX FOR SELECTION OF RURAL GROWTH CENTERS

| Ranking of<br>Preselected<br>Centers<br>(Centrality) | Complementary Indicators       |                                |                                                                     |                | I <sub>j</sub>  |
|------------------------------------------------------|--------------------------------|--------------------------------|---------------------------------------------------------------------|----------------|-----------------|
|                                                      | P <sub>1</sub>                 | P <sub>2</sub>                 | P <sub>3</sub>                                                      | P <sub>m</sub> |                 |
| j <sub>1</sub>                                       | P <sub>1</sub> ,j <sub>1</sub> | P <sub>2</sub> ,j <sub>1</sub> | P <sub>3</sub> ,j <sub>1</sub> . . . P <sub>m</sub> ,j <sub>1</sub> |                | I <sub>j1</sub> |
| j <sub>2</sub>                                       | P <sub>1</sub> ,j <sub>2</sub> | P <sub>2</sub> ,j <sub>2</sub> | P <sub>3</sub> ,j <sub>2</sub> . . . P <sub>m</sub> ,j <sub>2</sub> |                | I <sub>j2</sub> |
| j <sub>3</sub>                                       | P <sub>1</sub> ,j <sub>3</sub> | P <sub>2</sub> ,j <sub>3</sub> | P <sub>3</sub> ,j <sub>3</sub> . . . P <sub>m</sub> ,j <sub>3</sub> |                | I <sub>j3</sub> |
| .                                                    | .                              | .                              | .                                                                   | .              | .               |
| .                                                    | .                              | .                              | .                                                                   | .              | .               |
| .                                                    | .                              | .                              | .                                                                   | .              | .               |
| j <sub>n</sub>                                       | P <sub>1</sub> ,j <sub>n</sub> | P <sub>2</sub> ,j <sub>n</sub> | P <sub>3</sub> ,j <sub>n</sub> . . . P <sub>m</sub> ,j <sub>n</sub> |                | I <sub>jn</sub> |

### Implementation of Services

The implementation of the service infrastructure for rural growth centers can be made according to the concepts of population threshold and range of a good. Range of a good would be defined as the maximum distance a population might travel to obtain that good, and population threshold as the minimum population needed to support that good.



Central place studies in diverse parts of the world have shown some regularities: 1) the proportion of population which patronizes a particular center tends to decrease with distance from that center, 2) the number of people who resort to a central place is directly related to the number of goods and services available in that center, 3) the service area for any given center increases with the size of the center, and 4) the service area is not fixed but is a demand surface, the slope of which varies for each function.

Typically, influence areas of centers are delimited through interviews carried out in the center itself or in the countryside. Respective tributary areas are identified for a variety of particular goods and services and single mean boundaries drawn. Gravitational models have also been used to identify points of consumer indifference between two competing centers. These models employ only data on the magnitude of the centers (generally population) and the distance between them and do not consider actual movements of goods and people.<sup>9</sup> A simple probabilistic model has been developed by Huff based upon a measure of the relative size of the center and time involved in traveling to that center.<sup>10</sup>

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<sup>9</sup>For example the breaking-point formula is expressed as:  $D_b = D_{ab} / (1 + \sqrt{P_a/P_b})$ . Where  $D_b$  = the breaking-point between centers  $a$  and  $b$  measured in miles from  $b$ ;  $D_{ab}$  = distance from  $a$  to  $b$ ;  $P_a$  = population of  $a$  and  $P_b$  = population of  $b$ . P. D. Converse, "New Laws of Retail Gravitation," Journal of Marketing 14 (1949): 379-384.

<sup>10</sup>David Huff, "Defining and Estimating a Trade Area," Journal of Marketing 28 (1964): 34-38.

It is believed that a technique involving interviews is most promising to define the service area of a settlement. Ideally this technique would reveal how countryside people use the functions of the center. But interviewing a settled rural population or isolated hamlets is extremely time-consuming. The problem may be tackled by interviewing within the center itself and asking for the frequency of visits to acquire each of the higher-order services. The frequencies can be ranked and the flows mapped. In this way, the amount of interaction between centers, and between centers and countryside, may be evaluated. In investigating service areas, effects of travel time or travel cost on various kinds of services emerge as fundamental variables for the construction of consumer behavior surfaces.

For center-based interviewing certain constraints should be observed: 1) it is important to stratify establishments in terms of kind and size and to randomly select units from each stratum, 2) interviews should be carried out throughout a number of randomly selected sample days, and 3) a sampling decision has to be made with respect to people entering the selected units of services.

Haggett and Gunawardena have suggested that the population threshold of any function is the middle point of its "entry zone," i.e., the population value which divides the ranked list of centers in such a way that the number of centers lacking the function above the division is equal to

the number of centers possessing the function below the division.<sup>11</sup>

Thresholds empirically established in the present situation are of relative value given that, as was expressed earlier, the main planning aim is to reinforce the service scale of key centers to serve their tributary population efficiently. Potential thresholds deserve greater attention because:

When new and better services are introduced, new needs will be created. Satisfying these needs may then be one of the incentives for a rural population to make greater efforts towards achieving the developments planned for their area.<sup>12</sup>

The establishment of potential thresholds provides one element upon which to base the decision as to what new services are to be installed and what existing services must be improved, taking into consideration the present and future population of both the centers and their service areas. In a broad sense, it implies an examination of national targets set by central planning offices with regard to certain services such as education and health. Deciding the minimum population for the effective functioning of a center will depend largely on the population

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<sup>11</sup>Peter Haggett and K. A. Gunawardena, "Determination of Population Thresholds for Settlements Functions by the Reed-Muench Method," Professional Geographer 16 (1964): 6-9.

<sup>12</sup>D.B.W.M. Van Dusseldorp, Planning of Service Centers in Rural Areas of Developing Countries (Wageningen: International Institute for Land Reclamation and Improvement, Publication 15, 1971), p. 22.

thresholds for the center's higher-order goods and services. A conclusion must be reached in relation to the number of inhabitants that may be expected when all the potential development in a center and its service area has been realized.

In fixing threshold populations and service areas sufficient attention must be given to the accessibility and population distribution in the area. These two factors may make it desirable or necessary to adjust established estimates. Whether or not the service equipment functions satisfactorily will be determined to a large extent by the communication and transport system.

Through this framework it is possible to arrive at a proposal for rationalization in the provision of services in each settlement according to the level to which it was assigned in the hierarchy of rural growth centers. This can help foster a more balanced system for services throughout the region. Rural growth centers of different sizes, along with their service areas, would form the planning units for the implementation of rural development programs. The proposed framework thus permits the selection of growth centers in terms of areas with a viable economic base and a population large enough to support a package of economic and social services to sustain and accelerate the process of development through time.

## APPENDICES

# Appendix A. Data Collection Form

## Michigan State University

Name and Number of Settlement: \_\_\_\_\_

Total Population: \_\_\_\_\_

Municipio: \_\_\_\_\_

Date: \_\_\_\_\_

[illegible]

Total Central Functions:

Total Functional Units : \_\_\_\_\_

APPENDIX B. CORRELATION MATRIX OF CENTRAL FUNCTIONS

| 01    | 02     | 03     | 04     | 05     | 06     | 07     | 08     | 09     | 10     | 11     | 12     | 13     |                                 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------------------------|
| 1.000 | .5693  | .8124  | .6804  | .7552  | .7558  | .7664  | .6928  | .7361  | .7359  | .6229  | .7379  | .6877  | 01 Small groceries and sundries |
|       | 1.0000 | .8353  | .6605  | .7656  | .7047  | .7658  | .5994  | .7608  | .7102  | .6386  | .6892  | .7852  | 02 Bars                         |
|       |        | 1.0000 | .7106  | .7838  | .7454  | .7823  | .6776  | .7797  | .7224  | .6623  | .7396  | .8256  | 03 Restaurants                  |
|       |        |        | 1.0000 | .8089  | .8837  | .7844  | .7346  | .7564  | .7838  | .6544  | .6846  | .6994  | 04 Large groceries              |
|       |        |        |        | 1.0000 | .8877  | .9536  | .6166  | .8635  | .8078  | .7005  | .7958  | .5798  | 05 Dry good stores              |
|       |        |        |        |        | 1.0000 | .8610  | .7208  | .7742  | .7838  | .6737  | .7130  | .7905  | 06 Hotels and hostels           |
|       |        |        |        |        |        | 1.0000 | .6484  | .8968  | .7661  | .7679  | .8296  | .9333  | 07 Butcher shops                |
|       |        |        |        |        |        |        | 1.0000 | .6259  | .7258  | .6082  | .7040  | .5821  | 08 Pharmacies                   |
|       |        |        |        |        |        |        |        | 1.0000 | .8207  | .8323  | .8123  | .8407  | 09 Auto repair shops            |
|       |        |        |        |        |        |        |        |        | 1.0000 | .6160  | .8213  | .6870  | 10 Trinket shops                |
|       |        |        |        |        |        |        |        |        |        | 1.0000 | .5683  | .6189  | 11 Gas stations                 |
|       |        |        |        |        |        |        |        |        |        |        | 1.0000 | .7532  | 12 Barber shops                 |
|       |        |        |        |        |        |        |        |        |        |        |        | 1.0000 | 13 Soda shops                   |

## Appendix B. Continued

| 14     | 15     | 16     | 17     | 18     | 19     | 20     | 21     | 22     | 23     | 24     |                                    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------------------------------|
| .6909  | .6628  | .6825  | .5659  | .6898  | .6356  | .6641  | .5967  | .5515  | .4720  | .4270  | 01 Small groceries and sundries    |
| .6517  | .6556  | .6984  | .5853  | .6624  | .5981  | .6411  | .5899  | .5430  | .4763  | .4763  | 02 Bars                            |
| .6732  | .7231  | .7217  | .6215  | .6610  | .5727  | .6225  | .5001  | .4310  | .4367  | .4367  | 03 Restaurants                     |
| .6173  | .6331  | .6454  | .5021  | .6044  | .5455  | .5640  | .4359  | .3644  | .2809  | .2809  | 04 Large groceries                 |
| .7207  | .8036  | .7798  | .5691  | .7004  | .6293  | .6291  | .5218  | .4317  | .3472  | .3472  | 05 Dry good stores                 |
| .6783  | .6777  | .7257  | .5199  | .6450  | .5917  | .5939  | .4918  | .4359  | .3393  | .3393  | 06 Hotels and hostels              |
| .7088  | .7701  | .8300  | .6460  | .7726  | .7145  | .7193  | .5907  | .5086  | .4159  | .4159  | 07 Butcher shops                   |
| .5177  | .6669  | .5427  | .5228  | .6242  | .5926  | .5992  | .4884  | .4559  | .3667  | .3667  | 08 Pharmacies                      |
| .7263  | .8070  | .8245  | .6630  | .7464  | .6414  | .7120  | .6461  | .5818  | .5166  | .5166  | 09 Auto repair shops               |
| .7164  | .7598  | .7539  | .6538  | .7513  | .6666  | .7267  | .5752  | .4908  | .3498  | .3498  | 10 Trinket shops                   |
| .4568  | .7077  | .6044  | .3806  | .4960  | .3973  | .4024  | .4829  | .3897  | .3340  | .3340  | 11 Gas stations                    |
| .8092  | .8349  | .7548  | .7982  | .9116  | .8084  | .8783  | .7108  | .6177  | .5146  | .5146  | 12 Barber shops                    |
| .6760  | .6768  | .7945  | .6318  | .6759  | .6373  | .6670  | .5116  | .4839  | .4633  | .4633  | 13 Soda shops                      |
| 1.0000 | .6059  | .8303  | .7600  | .7609  | .6710  | .8484  | .7195  | .6826  | .5849  | .5849  | 14 Furniture and woodworking shops |
|        | 1.0000 | .6539  | .5591  | .7169  | .5940  | .6028  | .6548  | .5789  | .4980  | .4980  | 15 Tailor shops                    |
|        |        | 1.0000 | .7476  | .7171  | .6179  | .7956  | .6425  | .5329  | .4796  | .4796  | 16 Tire repairs                    |
|        |        |        | 1.0000 | .8415  | .6322  | .9106  | .6677  | .5267  | .6566  | .6566  | 17 Farm stores                     |
|        |        |        |        | 1.0000 | .8995  | .9133  | .7616  | .6320  | .5258  | .5258  | 18 Hardware and building supplies  |
|        |        |        |        |        | 1.0000 | .7830  | .7235  | .6308  | .4623  | .4623  | 19 Bakeries                        |
|        |        |        |        |        |        | 1.0000 | .7716  | .6745  | .5684  | .5684  | 20 Shoe stores                     |
|        |        |        |        |        |        |        | 1.0000 | .8728  | .7334  | .7334  | 21 Supermarkets                    |
|        |        |        |        |        |        |        |        | 1.0000 | .8362  | .8362  | 22 Lawyers                         |
|        |        |        |        |        |        |        |        |        | 1.0000 | .7816  | 23 Electrical appliance repairs    |
|        |        |        |        |        |        |        |        |        |        | 1.0000 | 24 Physicians                      |



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