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URBAN FUNCTIONS IN RURAL DEVELOPMENT

THE CASE OF THE POTOSI REGION IN BOLIVIA

Part I: Concepts, Methods and Application

Project No.
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by
Hugh Evans

United States Agency for International Development
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Office of Multisectoral Development
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Cover photo: approaching the town of Vitichi on market day.

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The author: Hugh Evans was resident adviser to CORDEPO, the Regional Development Corporation of Potosi, Bolivia, under a program funded by the United States Agency for International Development.

PREFACE

In 1975, the United States Agency for International Development (USAID) started a series of projects entitled "Urban Functions in Rural Development", which were designed to help improve the contribution of urban centers to rural development. The project began with an AID-sponsored state-of-the-art paper by Dennis Rondinelli and Kenneth Ruddle which was published by Praeger in 1978 as *Urbanization and Rural Development: A Spatial Policy for Equitable Growth*. The study substantiated the basic tenet of the project, that the regional planning and development field had been greatly enriched during the 1950s and 1960s and was ready to be applied in developing countries seeking to strengthen the constructive interdependence between urban and rural areas. A series of pilot applications was launched to demonstrate the concept, and to further develop and refine it through experience in a variety of field conditions. The first application was in the Bicol River Basin of the Philippines, followed by applications in Bolivia, Upper Volta, Cameroon, Guatemala and Indonesia. All but the Indonesian demonstration have been completed and the entire experience is being evaluated and synthesized by AID to be shared through several volumes which will be available early in 1984.

The Bolivia application in the highlands Department of Potosi (a Department is a geopolitical region equivalent to a province or state) is perhaps the richest of the "Urban Functions in Rural Development" field experiences to date. It drew upon and applied lessons learned in some of the other demonstrations, and was an integral part of a larger rural development planning program. It was executed by an exceptionally dedicated team of Bolivians at the Departmental and Ministerial levels; a very able group of ex-patriate advisors, including Hugh Evans, the author of this report who served as full-time field adviser, and Dennis Rondinelli who served as a senior consultant; a competent and dedicated USAID Mission staff, among them the program coordinator Kevin Kelly; and others mentioned elsewhere in this report.

This volume, the first of a two-part study, is an excellent account of the approaches and methodologies applied in Potosi. It should be a useful guide to field practitioners and students of regional and rural development. The second volume evaluates the Potosi "Urban Functions in Rural Development" experience in a larger context, discussing its potential for adaptation in other settings and countries, and recommending ways to further strengthen the overall framework and methodology.

Eric Chetwynd, Jr.
Division Chief
Regional and Rural Development Division
Office of Multisectoral Development
Bureau for Science and Technology
Agency for International Development

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To spend two years as a resident adviser to CORDEPO, the Regional Development Corporation of Potosi, in Bolivia, for the purpose of carrying out a pilot application of the Urban Functions in Rural Development Project (UFRD), was an unusual professional opportunity and a stimulating challenge. Although I cannot mention them all by name, I would like to use this chance to acknowledge the help I received from the great many people with whom I worked in the course of this assignment, and from whom I learnt a great deal.

In the first instance, the fact that such good progress has been achieved in Potosi is due quite simply to the people who have been primarily responsible for the project in the field; namely, the President and staff of CORDEPO. Since the idea was first mooted in 1978, the Corporation has shown enthusiastic cooperation, and done all they could to support it. For this, credit is due to Ing. Gil Vilegas, President of the Corporation at the time the project began, and particularly to his successor, Cnl. DAEN Victor Lopez, who has vigorously pursued negotiations with several international aid agencies in search of the means to implement proposals that have emerged as a result of the UFRD studies.

My task of introducing new concepts and methods, was made a great deal easier by the very positive support I received from the chief architect of CORDEPO's Regional Development Plan, Lic. Alfredo Bellott. He quickly appreciated the goals of the project, and took the initiative in advocating the adoption of a policy of integrated regional development, and carrying through the transformation of the Corporation's planning process in order to accommodate the UFRD approach. In the administration of the project, I was able to leave most of the work to Lic. Braulio Ore, Chief of Planning, who efficiently and resourcefully solved many of the day to day problems that arose.

However, the major credit for the work that was done is due to the ten full-time members of the study team: Lic. Luis Davalos, Lic. Alfredo Heredia, Sra. Silvia Perez, and Sr. Hugo Solis, from CORDEPO's planning department; the four

assistants recruited from the University of Tomas Frias while it was closed for several months following the events of July 1980 - Srs. Hernan Herrera, Mario Lopez, Mario Pereira, and Victor Serrudo; and the two draughtsmen, Remy Martinez and Martir Alachi. It was they who effectively did all the real work involved in the field surveys, the gathering of information, the long and sometimes tedious analysis of data, the drawing of many maps and figures, and the arduous task of preparing the reports. One measure of their achievement is the acclaim they received in presenting this material at a national seminar in La Paz in September last year.

Apart from myself, many other people were involved in providing technical assistance for the project. Among them, Dr. Ray Bromley from the University of Wales in Swansea gave advice on the survey of markets; Dr. John Dickey of Virginia Polytechnic Institute designed the accessibility model; Roger McEvoy came out to make a training film on UFRD; and Dr. Dennis Rondinelli from the University of Syracuse, co-author of the original paper which gave its name to the project, helped devise the plan of work and tried to keep us all more or less on the right track. Their visits to Potosi were much appreciated by all.

The UFRD project was administered in Bolivia as part of a larger one entitled the Rural Development Planning Project, which was managed initially by Practical Concepts Incorporated of Washington, DC, and later by the USAID Mission in La Paz. There were ten of us on the original P.C.I. long term team, and it was a pleasure for me to work with them. I owe special thanks to P.C.I.'s capable administrators, Ms. Martha Lamborn de Pacheco and Ms. Nancy Berge, who provided invaluable logistical support and helped to keep the show on the road when things got difficult.

Finally, a word of appreciation to three people in particular: to Eric Chetwynd, formerly from AID's Office of Urban Development and now chief of the Regional and Rural Development Division, who set up the Potosi project in the first place; to Sam Daines, the director of the rural development planning program, who offered me this challenging opportunity; to Dennis Rondinelli, who has given me constant intellectual support; and to all three for their continuing encouragement along the way.

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INTRODUCTION

Urban Functions in Rural Development (UFRD) is a project of the United States Agency for International Development (USAID), which was designed to test concepts and methods of planning integrated regional development through pilot applications in three countries. This report is one of two which provide an account of the application in the Potosi region of Bolivia. It summarises the results of the studies that were made, and describes the plans, policies and projects that have emerged or are in the process of emerging. A companion volume assesses the impact of the UFRD methodology on the regional planning process in the Department of Potosi.

Origins of the Urban Functions in Rural Development Project.

The origins of the UFRD project in AID's Office of Urban Development date back to the mid 1970s and stem from the rejection of earlier policies for regional development which had not been noticeably successful. During the 1960s the problem which tended to attract most attention in developing countries was the unprecedented growth of the leading cities, associated with massive migration of population from rural areas. Policy-makers sought ways to alleviate the pressure on metropolitan centers by diverting the stream of migrants to other cities. This gave rise to the widespread adoption of growth pole policies, aimed at creating new cities or expanding existing ones to act as counter-magnets for the migrants. These strategies attempted to create a nucleus of large scale industries in one, perhaps two, specially selected locations, which were expected to generate a host of related manufacturing and commercial activities, and to be followed by a gradual trickle-down of benefits throughout the surrounding region.¹

In practice, things did not quite work out that way. The search for dynamic propulsive industries tended to lead to capital intensive activities employing modern technology. Such industries, however, which were so essential for creating employment opportunities, were slow to establish themselves in these growth poles. Similarly, by stressing export-oriented manufacturing, which faced stiff competition in foreign markets, multiplier effects tended to be smaller than expected and confined largely to the immediate urban area. The anticipated demand for complementary products from the rural hinterlands failed to materialise, while most of the benefits accrued to firms and communities outside the targeted region. But perhaps the main reason why growth-

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pole policies rarely achieved their goals is that they are politically difficult to sustain. The strategy requires large investments over an extended period of time in the one or two favored locations, which inevitably provokes widespread opposition from less favored regions.²

Conscious of the limitations of growth-pole policies, and in response to new directives from Congress, USAID's Office of Urban Development began to search for alternative approaches to regional development that would contribute instead to a more widespread and equitable pattern of development, and would benefit not just those living in the largest cities, but more particularly the poor majority in rural areas. Recognizing the important role played by market centers, small towns and villages in the rural economy, they looked for ways to strengthen the system of settlements and to link them with their surrounding areas in such a way as to provide better access for the rural population to markets, farm supplies, social services and other necessary urban based facilities.

The UFRD Approach.

Out of this search emerged the concept of integrated regional development, which Dennis Rondinelli and Kenneth Ruddle set down in a paper for the Office of Urban Development entitled "Urban Functions in Rural Development", whence came the name for the subsequent project.³ Three characteristics collectively distinguish this approach to regional planning from others. First, it focusses on the spatial dimensions of the regional economy rather than the sectoral dimensions, which is conventionally the case. Second, UFRD avoids the often arbitrary distinction between the urban and rural sectors, and instead treats the two as mutually reinforcing elements of a regional economy. Third, the UFRD approach incorporates a detailed methodology for bridging the gap between idea and action, for translating the concept of integrated regional development into specific plans and projects.

Conventionally, regional development plans tend to be made up of sectoral components, for agriculture for example, industry, road-building, or education. All too often those engaged in the preparation of plans for one sector are largely unaware of what is being discussed in another sector. But even where a so-called integrated development project calls for inter-sectoral planning and coordination, it is rare that the anything more than superficial attention is paid to the urban-rural system, and the geographical location of

projects. The Urban Functions approach, on the other hand, takes the spatial dimensions of the regional economy as its starting point, and works towards the preparation of plans for the integrated development of selected areas of the region.

This concern with the spatial dimensions of the region's economy is founded on the premise that the spatial structure of the region - the relationship between urban and rural areas - is closely related to the pattern of development which occurs there. Empirical evidence in many parts of the world shows clearly that the network of settlements and the links to their hinterlands is a key factor in determining how the local economy functions and the manner in which developmental impulses are transmitted across geographical space.

The diffusion of innovations, such as new methods of production, new forms of communication or medical treatment, tend to be introduced in the principal city, and from there to be adopted gradually in secondary cities, intermediate centers and eventually smaller settlements. At the same time, the constant migration from rural areas to urban centers tends to concentrate in those places where there are new opportunities for employment and better services and infrastructure. Nevertheless, if there are gaps in the urban-rural system - large areas where there are no important settlements with adequate infrastructure - the diffusion of developmental impulses is impeded, those areas fall behind, and the population gradually abandons them.

In the same way, spatial linkages between producers and consumers, between inputs and outputs, influences the growth of economic activity. Farmers, for example, need access to agricultural supplies to improve their productivity, and to markets in order to sell their produce. The lack of access in more isolated areas inhibits the adoption of more appropriate methods of farming, and reduces the incentive to increase production. Similarly, the location of new shops and small factories is determined to a large extent by the size of the local market, costs of transport, and agglomeration economies which derive from the proximity of complementary services and activities. These factors are all related to the pattern of urban settlements, and the linkages between them and their rural hinterlands.

The third distinguishing characteristic of the UFRD approach is the emphasis placed upon devising practical methods for translating the concept of inte-

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grated development into an investment plan for specific projects. The original paper by Rondinelli and Ruddle included a vocabulary of techniques for spatial analysis which has evolved in light of subsequent experience into a ten step planning methodology based on five general principles.⁴

The first principle declares that any attempt at integrated planning should aim not so much at producing a particular plan, but rather at establishing an ongoing planning process, capable of generating the information that decision-makers need in order to make informed judgements about alternative investment opportunities. Second, the scope of the spatial analysis to be undertaken, and thus the range of data to be collected, should be determined with a clear objective in mind: namely, to facilitate the formulation of policy and the selection of projects. Third, the methods and techniques employed for planning purposes should be those that can be easily applied by local planners who may not necessarily have advanced technical training in regional science, and which can be clearly understood by those who have to make decisions about the choice and location of projects. Fourth, studies should ideally maximise the use of existing information, and embark on the collection of additional data only where this is essential for the purposes of analysis. Finally, given the inevitable constraints on the availability of data at the regional level in developing countries, planning staff should be encouraged to be innovative in adapting techniques for gathering and analyzing information to shed light on pertinent problems.

These principles guided the design of the ten step planning methodology, which has gradually evolved during the course of field experience. While particular details vary from case to case, the overall framework is now clearly established. In Potosi this took the following form:

- | | |
|-------------|---|
| Analysis | 1) Analysis of Basic Resources; |
| | 2) Analysis of the Settlement System; |
| | 3) Analysis of Linkages; |
| | 4) Study of Accessibility; |
| | 5) Analytical Mapping; |
| | 6) Interpreting the Existing Spatial Structure; |
| Plan-making | 7) Elaborating a Strategy of Integrated Regional Development; |
| | 8) Identifying Projects and Preparing an Investment Plan; |

- Implementation 9) Implementation, Monitoring and Evaluation;
10) Creating a Continuous Planning Process.

The first six steps are concerned with analysis, which is used in steps seven and eight for the preparation of plans and projects. Step 1 is intended to provide a quick preliminary overview of the region based on existing information. Steps 2, 3 and 4 examine the three main characteristics of the spatial system - its settlements, the linkages between them, and the population's accessibility to urban functions - and the fifth step is devoted to mapping the resulting data and information. The sixth step draws conclusions from the preceding analyses, and these form the basis in step 7 for tailoring the details of the UFRD strategy of integrated development to fit the specific characteristics of the region, and in step 8 for selecting projects and drawing up an investment plan. Steps 9 and 10, as their names imply, are concerned with institutionalizing the process of integrated regional planning.

Pilot Application in Potosi.

As an experiment to test the concepts and methods of planning integrated regional development embodied in the UFRD approach, AID's Office of Urban Development launched pilot projects in three countries. The first of these was started in 1977 in the Bicol River Basin of the Philippines, where the initial version of the methodology was formulated and tested, and a planning process was set up that could be emulated in other parts of the country. A second experiment was carried out in Africa in Upper Volta under substantially different conditions. Whereas the Philippines has a relatively extensive database for planning and analysis, and an incipient hierarchy of urban settlements, Upper Volta is a predominantly rural country with very few towns of any size and rudimentary statistics on the social, economic and physical characteristics of the population.

The third application of the UFRD approach has recently been completed in south-west Bolivia, in the Department of Potosi, as part of the USAID Mission's Rural Development Planning Program, which is being carried out nationwide in collaboration with the Bolivian Ministry of Planning and Coordination and the Regional Development Corporations. Bolivia was chosen partly because the government had already recognised the need for a better integrated spatial system to achieve a more widespread pattern of economic development, and partly because the UFRD approach was closely compatible with the USAID

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Mission's overall program for technical assistance. The Department of Potosi was preferred among potential sites since it contains a relatively large number of towns and villages, and since CORDEPO, the local development corporation, was willing to contribute staff and resources to undertake the project and to embrace the experiment in its planning process.

To carry out the project, a team was set up consisting of four people assigned full time from CORDEPO's planning department, and a fifth - the deputy planning director - working part-time, aided on a temporary basis by four assistants and a draughtsman. The team was led by a long term resident adviser, and supported by short term technical assistance for particular aspects, all funded by USAID. The main body of field work and analysis was completed in a period of eight months between August 1980 and March 1981. Since that time the team has played a key role in the inter-disciplinary deliberations with staff members from other departments of the Corporation in preparing a medium term regional development plan, which was released in the spring of 1982 and is currently being reviewed by the other institutions involved.

Contents of this Report.

This report is the first of two which provide an account of the accomplishments of the project to date. This volume summarises the results of the studies that were made, and describes the plans, policies and projects that have emerged or are in the process of emerging. It pays particular attention to the methodological framework behind the UFRD approach to integrated regional development, illustrating the evolution from analysis to spatial strategy and project identification. It also explains several of the methods of analysis that were employed during the course of the study, including an innovative model of accessibility. A companion volume offers a preliminary assessment of the UFRD methodology in terms of its impact on the regional planning process in the Department of Potosi.

The contents of this report follow broadly the framework of the UFRD methodology just presented. A preliminary chapter discusses the data required for an analysis of the spatial dimensions of a region's economy, and the main sources of existing information in Bolivia. It then describes three field surveys which were carried out to collect additional information. One covered

over a hundred towns and villages to compile an inventory of services, facilities and other functions to be found in each place. Another included the twenty principal periodic markets of the region to determine their area of influence. The third involved visits to some two hundred households to gather data on travel patterns to different urban functions for the study on accessibility.

Chapter II takes a look at the basic resources of the region in terms of its physical, demographic and economic characteristics. A comparison between Potosi and other Departments of Bolivia shows it to be not only the most backward, but also the one that is developing most slowly. A closer look at the incidence of development within the region also shows that it closely associated with the growth of urban population. The analysis is intended to provide a quick initial overview and a baseline profile against which to compare subsequent changes in the regional economy over the course of time.

The next three chapters examine the principal features of the urban-rural system: settlements, the linkages among them, and accessibility to urban-based functions. Chapter III reviews the growth and decline of urban centers in the region, and defines the hierarchy of central places according to their functional complexity. Chapter IV traces the physical, economic and service linkages between towns and their surrounding rural areas in order to find out the degree to which the region is spatially articulated. Chapter V describes an accessibility model which was used to delineate service areas of the main urban centers by measuring the level of access of the population in different zones of the region to a range of urban-based functions.

By synthesizing the conclusions of the previous analyses, chapter VI arrives at an interpretation of the existing spatial structure of the region, and pinpoints spatial constraints to development. Using concepts loosely borrowed from central place theory, the region is first defined in terms of functional economic areas, and this leads to the identification of peripheral areas that are weakly integrated into the main urban-rural system, and have poor access to urban service centers.

The main thrust behind the concept of integrated regional development as embodied in the UFRD approach has been outlined above. Chapter VII describes the details of the strategy as it has been modified and elaborated for the

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Department of Potosi in light of the preceding analyses. This consists of two key components: the articulation of the spatial system; and the integrated development of selected areas of the region based on their productive potential.

Chapter VIII discusses the methods evolved in Potosi for designing packages of projects for each area of the region, and the approach is illustrated with an example from the north of the Department. Based on the main economic activities of the area as a starting point, packages include a range of inputs to boost production and raise productivity, and these are complemented with other actions to improve the physical integration of the area, and to raise the level of access of the rural population to social services and other facilities.

The report concludes with a summary of what has been achieved so far, and what steps have been taken towards the next stage of implementing plans based on the UFRD concept of integrated regional development.

Footnotes to the Introduction.

1. For an account of growth pole strategies see Niles Hansen (ed) (1972) *Growth Centers in Regional Economic Development*. Free Press, New York.
2. See for example Michael E. Conroy (1973) "Rejection of Growth Center Strategy in Latin American Regional Development Planning", in *Land Economics*, XLIX.4.
3. Dennis A. Rondinelli and Kenneth Ruddle (1976) *Urban Functions in Rural Development*, Office of Urban Development, U.S. Agency for International Development, Washington. Subsequently published as *Urbanization and Rural Development: A Spatial Policy for Equitable Growth*, Praeger, New York, 1978.
4. Dennis A. Rondinelli (1980) "Spatial Analysis for Regional Resource Development: A Case Study of the Philippines", *Resource Systems Theory and Methodology Technical Papers*, No. 1, Natural Resources Programme, United Nations University, Tokyo.

A. DATA COLLECTION

CHAPTER I. DATA NEEDS AND FIELD SURVEYS

This chapter discusses the data required to analyse the spatial dimensions of the regional economy of the Department of Potosi, the sources from which this data was obtained, and the three field surveys that were carried out to collect information unavailable elsewhere. These surveys covered over a hundred towns and villages, twenty periodic markets, and some two hundred households.

The relationship between data collection, analysis, and policy making in the methodology evolved for the Urban Functions in Rural Development project differs from the conventional sequence of activities. Often, planning begins with the collection of data, followed by a period of analysis, which supposedly points to major problems, which in turn suggest an appropriate policy. In practice, much time is often wasted collecting unnecessary data, or making exhaustive analyses that fail to yield the insights needed to formulate policy. The UFRD methodology, on the other hand, starts from the concept of spatially integrated development, which is derived from empirical evidence and cumulative planning experience in many parts of the world. This provides the broad outlines of a development strategy, which defines the scope and content of the spatial analysis to be undertaken, and hence the kind of data and information that is needed.

As was indicated in the introduction, the studies that were undertaken in Potosi included analyses of the basic resources of the region, and of the spatial dimensions of the urban-rural system. The analysis of resources covered the physical, demographic and economic characteristics of the region, much of the data for which was culled from existing sources. Statistics on population, migration and employment, for example, were extracted from the two most recent population censuses of 1976 and 1950. General data on housing and infrastructure was available in the contemporaneous housing censuses, and aggregate data on production and investment was available from the Ministry of Planning and Coordination. Although a number of current studies will improve the situation, more detailed information on the agricultural sector proved harder to find, the most serious gaps being those related to soil types, land use and crop cultivation patterns.

The studies of the urban-rural system, however, required considerable informa-

tion that was not to be found in existing sources. The definition of the hierarchy of central places, for example, is based on measures of functional complexity, requiring information on an extensive range of infrastructure, services and other facilities to be found in each settlement of the region. Similarly, in order to determine the extent to which the existing urban-rural system is physically articulated, it is necessary to examine the interactions taking place between one town and another, and between each town and its hinterland. Likewise, the delineation of effective service areas based on access levels cannot be done without information on the travel patterns of local inhabitants.

After carefully preparing a schedule of all the data needed to carry out the various components of the spatial analysis, and comparing this with an inventory of material known to be available from existing sources, detailed questionnaires were prepared and surveys designed to yield the missing information. Due to the approaching onset of the rainy season, during which it is not feasible to travel extensively, all field work had to be completed in a relatively short space of time.

Given these constraints, it was decided to conduct three surveys simultaneously over a period of five weeks entailing visits to almost every corner of the Department. The first of these covered over a hundred urban centers to obtain information on the principal economic activities of the locality, the range of services and facilities located there, and the extent of the area served by those establishments. The second survey included the twenty largest markets in the region to determine their area of influence, the range of goods traded there, and the links between them. In the third survey over two hundred families in both urban and rural areas were interviewed to ascertain patterns of travel to a range of urban functions.

The Survey of Urban Centers.

The purpose of the survey of urban centers was to gather the information necessary to define the hierarchy of settlements, using the scalogram as the method of analysis¹, to trace the linkages between them and their surrounding rural areas,² and to delineate effective service areas of the larger towns based on levels of accessibility³. In addition, to help later on with the identification and design of packages of projects for areas of the region, the

1: Data Needs and Field Surveys

survey was used to provide general information on the principal economic activities of each community, the nature and condition of existing services and infrastructure, and the community's own priorities for future projects. The survey took the form of interviews with a small group of knowledgeable community leaders in each settlement - such as the mayor, if there was one, a school teacher, doctor, and a farmer - supplemented with a street count of shops, services and other urban functions.

Since most of the population of the Potosi region still lives in rural areas, and since the planning team was unfamiliar with many of the smaller villages in more distant corners of the Department, it was decided to include in the survey every settlement with more than two hundred inhabitants, and in less densely populated areas even smaller places if there was nothing larger in the vicinity. Although many of these places contained few or no functions of importance, they yielded information that helped to define the service areas of establishments located elsewhere. Furthermore, some of these settlements might subsequently prove to be potential sites for establishing new activities at a later date.

The definition of the urban hierarchy and the classification of settlements at each level was based on the range and type of functions to be found in each place. This assumes that certain kinds of functions are characteristic of different kinds of service centers. For example, while a junior school may be found in most villages serving just the local inhabitants, a university is probably only to be found in the principal city of the region, serving the entire population of that region. The survey of urban centers in Potosi initially included over one hundred and twenty functions, covering infrastructure, education, health, government agencies, community organizations, agriculture, mining, industry, transport, communications, commerce and other facilities. For the purposes of analysis, this list was later reduced to sixty functions that were thought to be good indicators of a settlement's functional complexity and area of influence.⁴

In order to determine the level of articulation of the urban-rural system, the degree of interaction between towns, and the size of their hinterlands, the survey sought information on the linkages between producers and consumers, buyers and sellers, doctors and patients, teachers and pupils, both at the point of origin and the destination. Thus, in those settlements with a given

facility, a health center for example, the question was asked:

- where do the people come from that use this health center (high school, warehouse, or whatever)?

And in those villages without the facility, the question was:

- where do people go to when they need a health center (high school, etc)?

In smaller towns and villages, the answers could usually be gotten from the community representatives. In the largest towns it was necessary to make more detailed inquiries at each major institution. The information compiled in this manner was not necessarily very precise, but it was certainly adequate for the purposes at hand.

To aid the process of identifying projects and designing project packages for particular areas later on, the survey questionnaire also sought information on the productive activities of each locality, the condition of infrastructure and social services, other projects either planned or being executed, and the community's own priorities for new services or amenities. Table 1.1 illustrates the kinds of questions that were included in the survey for each category of service or facility.

In order to calculate levels of accessibility, information was required on the number of establishments of different services and facilities in each settlement. Thus, the survey of urban centers was supplemented with a quick count, street by street, of shops, workshops, and other commercial premises, although in larger towns, where records existed, this information could sometimes be found in the mayor's office. To handle the wide variation in the size of some kinds of functions, especially shops, establishments were classified in four categories, and weighted accordingly. The total number of establishments of a particular function in a settlement was measured as the weighted sum, or a fraction of the same. (See table 1.2 as an example.)

The Survey of Markets.

In a predominantly rural region such as Potosi, where the majority of the population are engaged in agriculture, markets play a particularly crucial role, especially in smaller towns where there are few other commercial activities. Given their importance, it was decided to make a survey of the twenty periodic markets in the Department of Potosi that are held daily, or once or twice a week. The purpose of the survey was to establish the area of

**TABLE 1.1: TYPICAL QUESTIONS INCLUDED IN SURVEY OF URBAN CENTERS
FUNCTION: STORAGE FACILITY FOR FARM PRODUCE**

85 Is there a storage facility for farm produce in this community?
0 = no (go to Q92) 1 = yes

86 Who operates it?
1 = municipality 3 = private concern
2 = farmers' cooperative 4 = other (specify)

87 In what year was it built?

88 What does it consist of? 0 = no 1 = yes

(a) silo	<input type="checkbox"/>	(d) cold store	<input type="checkbox"/>
(b) warehouse	<input type="checkbox"/>	(e) liquid storage tanks	<input type="checkbox"/>
(c) barn	<input type="checkbox"/>	(f) other	<input type="checkbox"/>

89 From which communities do the users of this storage facility come?
Name of place Distance (kms) Direction

(a).....
(b).....

90 Does the storage facility meet local needs?
0 = no 1 = yes (go to 93)

91 Explain why it does not meet local needs. 0 = no 1 = yes

(a) inadequate capacity	<input type="checkbox"/>
(b) unsuitable for certain produce (specify)	<input type="checkbox"/>
(c) not available for public use	<input type="checkbox"/>
(d) user charges too high	<input type="checkbox"/>
(e) other (specify)	<input type="checkbox"/>

92 If there is no storage facility in this community, where do local farmers go when they need one?
Name of town/place distance (kms) direction

(a)
(b)

93 Are there any plans to construct or improve facilities for storing farm produce in this community?
0 = no (go to Q 95) 1 = yes

94 What is the name of the agency/organization responsible for these plans?
Name:.....

**TABLE 1.2: SURVEY OF URBAN CENTERS
EXAMPLE OF STREET COUNT OF SHOPS AND SERVICES**

Type of business	shoplet ¹ 1 unit	shop ² 4 units	store ³ 16 units	large ⁴ store 64 units	Total
10 Groceries					
11 Hardware					
12 Building materials					
13 Furniture/carpenter					
14 Household apparatus (cookers/frig/radio etc)					
15 Stationery					
16 Bank					
17 Savings and loan associations					
18 Pharmacy					
19 Cooking and heating fuels					

1. The smallest unit, typically run from the house as a sideline business.

2. Regular shop, usually with a couple of people in attendance.

3. A store with several assistants selling mainly one kind of merchandise.

4. An establishment selling many lines of merchandise.

Adapted from Ray Bromley (1980) "El Papel de Mercados Diarios y Semanales", an unpublished report for CORDEPO, 1980.

1: Data Needs and Field Surveys

influence of each market, its linkages with others, the type of goods traded there, and its role in the marketing system.

The first problem, which proved surprisingly difficult, was to locate these markets, not the large ones in the big cities, but the weekly or bi-weekly ones in smaller towns. The situation was aggravated by the fact that the survey had to be conducted in the month of October, before the onset of the rainy season, just when ploughing was in full swing and there was little activity in many of the smaller markets in rural areas. This made it all the more difficult to determine which ones were insignificant, and which ones were merely inactive at that time of year.

Next, it was necessary to devise a suitable survey format. Pilot studies were first carried out in two markets close to the city of Potosi. These provided detailed and relatively accurate information about the number of participants, their place of origin, and the type and quantity of goods and produce being traded there⁵. However, they required extensive preparation and the assistance of some thirty or forty interviewers over a twenty-four hour period.

Since time and manpower were limited, a simplified format was eventually adopted for the remaining markets. This could be completed by two people in three or four hours, and comprised a simple count of trading stalls, and interviews with a random sample of thirty buyers and sellers. The stall count provided a rough idea of the size of the market and the range of goods traded there. As with the street count of shops and commercial premises, stalls were classified by category and size. Each size was assigned a number of units, and the volume of trade was estimated in terms of the total number of units. Market participants were interviewed to find out where they came from, where they were going to, what they brought to market, and what they expected to take away. To determine the nature of trade, they were also asked questions to establish if they were producers, retailers or intermediaries.

The Survey of Households.

The household survey was undertaken to provide data for the accessibility model, which was designed to delineate effective service areas for the larger towns. The model, which is described in more detail in chapter V, measures accessibility in a given zone in terms of the convenience of travelling to a function, and the relative importance of that function. It is assumed that

1: Data Needs and Field Surveys

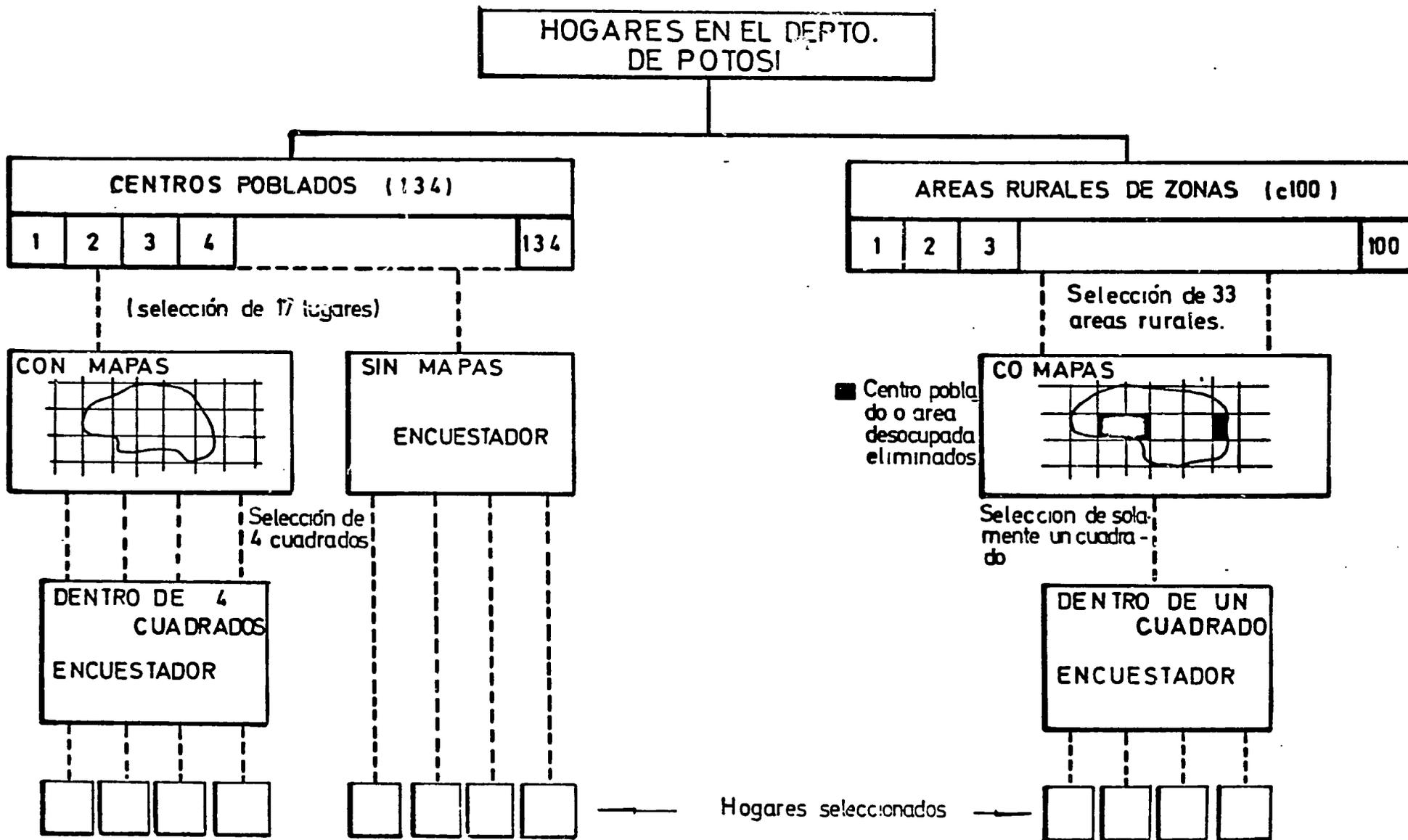
some functions, the market for example, are more important in the daily life of the local population than others, such as the office of the magistrate. The relative importance of a function was based on observed travel patterns: if people spend a lot of time visiting a certain facility, making many long trips, then it is reasonable to suppose that that facility is needed more than others which are visited only occasionally, especially if those are close by.

The survey thus sought to find out how often people visited different kinds of services and facilities, and how long they spent on the journey there. In addition, to explain anticipated variations in the observed patterns of travel, questions were included on the size and composition of the household unit, the level of education of each member, their occupation, and ownership of means of transport. After taking into account the statistical requirements for the kind of analytical relationships to be explored, it was decided to limit the survey to two hundred households. This was thought to be sufficient to allow analyses to be made between two or three variables, providing a minimum of thirty observations for each relationship.

The household sample was selected using a combination of list frame and area frame techniques. (See the diagramatic representation in figure 1.1.) Since the sample was to be drawn from throughout the Department of Potosi, it was first divided into two parts - 34% for urban areas and 66% for the rural areas - in proportion to the urban/rural distribution of the population. Next lists were prepared of all the urban centers in the region, and all the rural areas or cantonal districts, showing the population of each one rounded off to the nearest hundred. To ensure that the probability of selecting a town or canton was directly related to the number of households there, numbers were assigned to each place in proportion to its population, based on a cumulative total. For example:

Urban center	population (rounded)	cumulative total	assigned numbers
Potosi	77,300	77,300	1 - 773
Llallagua	23,400	100,700	774 - 1007
Siglo XX	10,800	111,500	1008 - 1115
Punütuma	500	238,300	2379 - 2383
Cahuana Chica	200	243,100	2430 - 2431

Fig. 1.1 HOUSEHOLD SURVEY SAMPLE SELECTION



NOTA: Una línea punteada representa una selección al azar.

1: Data Needs and Field Surveys

To reduce the time and cost of the survey, it was decided to interview four households in each urban center or canton, making fifty sites in all, seventeen in towns and thirty-three in rural areas. These sites were selected according to the randomly drawn assigned numbers.

The next step was to choose specific households at each of the selected sites. Urban centers were divided into two groups: those for which street maps were available, and those where they were not. For the mapped towns, area frame sampling techniques were used to select city blocks. Within the city block, and within other towns for which there were no maps, individual households were randomly selected by the interviewer. In the case of the rural cantons, similar area frame sampling techniques were used to locate particular households. In this case, however, urban settlements and uninhabited areas, such as mountains or salt flats, were first eliminated from consideration.

The questionnaire itself included a section on the social characteristics of the household members, and a second section concerning the pattern of visits to functions. The first section sought to establish the number of people in the household, the sex, age, level of education and occupation of each member. The second section covered some twenty five services and facilities, such as schools, health centers, government offices, farm supply stores, plants for processing minerals and agricultural produce. For each function, family members were asked how often they visited the facility, where this was located, and how long the journey took to get there, both in the dry season and the rainy season.

Implementation.

After preliminary field tests to check the questionnaires and train the interviewers, the three surveys of urban centers, markets, and households, were carried out simultaneously during a period of five weeks in the months of September and October of 1980. Members of the project staff were split into four teams each consisting of two interviewers with driver and jeep, and assigned to the north, center, south and west of the Department.

During the course of implementing these surveys, three general problems were encountered. First, the supervision of the field work was inadequate, due chiefly to the large geographic area being covered, and the dispersed location of towns and sites for the household interviews. The two supervisors were

1: Data Needs and Field Surveys

unable to cover all four teams at the same time, and in the worst instance, completed questionnaires were not reviewed until the end of a ten day trip. Had sufficient time been available, it would have been preferable to have the team travel together as a single unit, or at most two.

Second, due to the difficult terrain and the constraint on time, not to mention the logistical problem of finding gasoline in outlying places, it proved impossible to visit all the places intended. Visits to three small villages, and some of the household sites in more farflung corners of the Department, simply had to be abandoned. This inevitably distorted the randomness of the selection of households.

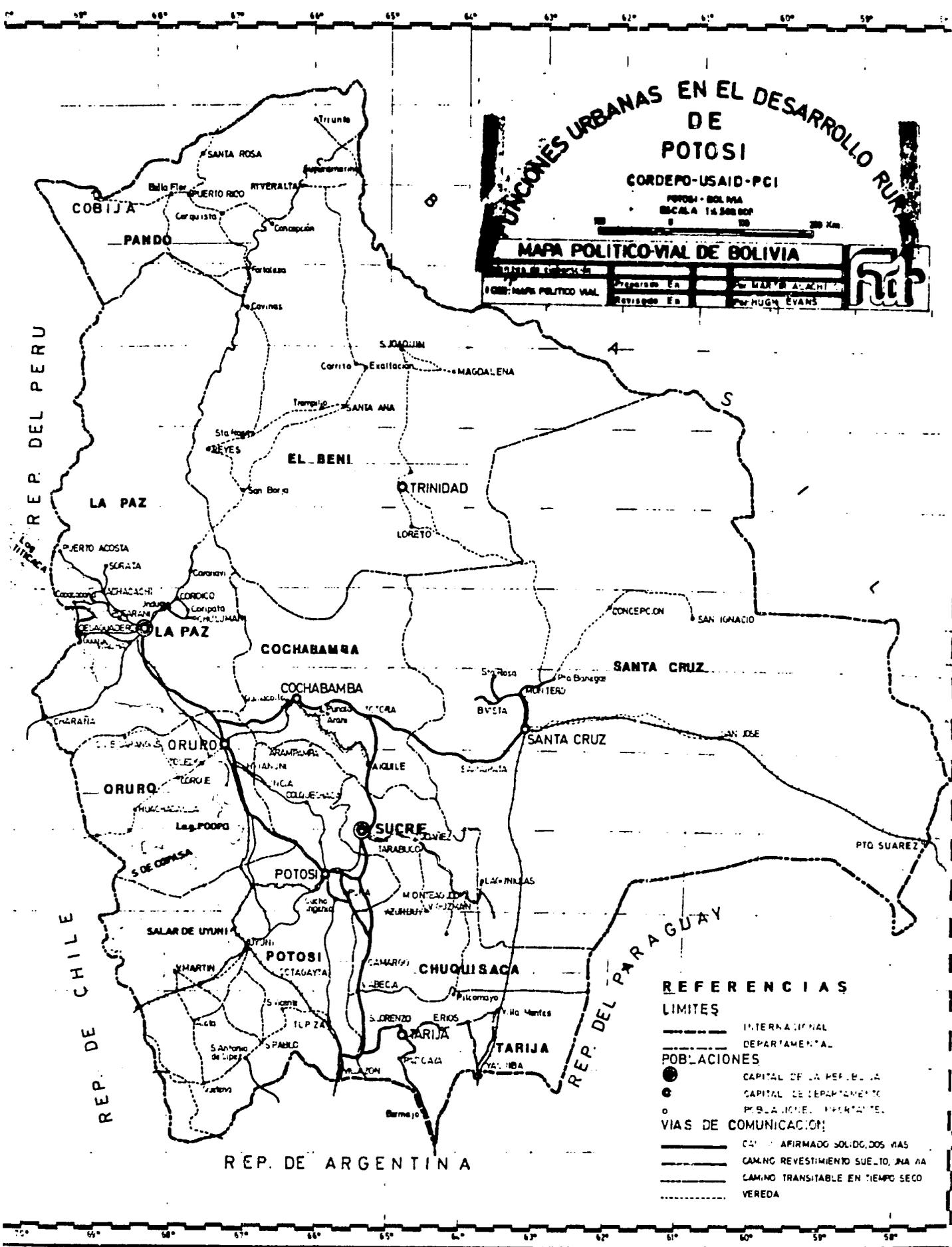
Third, as was mentioned before, October is not a good season for surveying markets, since farmers are busy at work in the fields, and there is little produce to sell. Thus, it is quite possible that the data collected underestimated the importance of the markets in the smaller towns and villages.

Nevertheless, despite these limitations and drawbacks, the surveys yielded adequate information for the spatial analysis, and its validity was acceptable for the purposes at hand. Some of the information was similar to what could have been found in other local agencies, although usually it was more complete, accurate and up to date, while much of it was completely original.

Footnotes to chapter I.

1. See chapter III.
2. See chapter IV.
3. See chapter V.
4. See figure 3.1 and table 3.3.
5. Ray Bromley, "El Papel de los Mercados Diarios y Semanales en las Relaciones Rural-Urbanas y el Proceso de Desarrollo Rural", unpublished report, CORDEPO, Potosi 1980.

B: SPATIAL ANALYSIS



Map 2.1 POLITICAL MAP OF BOLIVIA

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CHAPTER II. BASIC RESOURCE ANALYSIS

The first analytical element of the UFRD methodology is devoted to preparing a physical, demographic and socio-economic profile of the region. Initially, this is intended to provide a quick preliminary overview based on existing information, which can gradually be expanded as further data becomes available. Later, it serves as a baseline for monitoring and evaluating changes in the region's economy and spatial structure. In Bolivia, this profile consisted of two parts: an inter-regional analysis in which the main characteristics of Potosi were compared with the other eight Departments of the country (see map 2.1); and an intra-regional analysis, based on a comparison of the fifteen provinces of the Department to reveal variations within the region.

The inter-regional comparison looked at population trends, migration flows, and the composition of economic activity as measured by labor and capital inputs, the value of output, per capita income and location coefficients. Since economic data were not readily available at the sub-Departmental level, the intra-regional analysis focussed instead on population and employment characteristics, the geographical distribution of resources, and a set of development indicators estimated for each of the fifteen provinces.

The Inter-regional Analysis.

A comparison between Potosi and other Departments of Bolivia illustrates a familiar paradox: a region which for more than a hundred years provided the greater part of the wealth of the Spanish empire, and more recently much of Bolivia's own foreign earnings, is today the most backward area of the country, and falling still further behind.¹ In 1976, per capita income in Potosi, as measured by value of production, was the lowest in the country at US\$458, compared to highs of \$802 in Oruro, \$767 in Santa Cruz, and \$637 for the nation as a whole. (See table 2.1.) At the same time, in the period 1970-77 output was growing at a laggardly 2.3% per annum, compared to a national average of 6.3%, and over 10.0% in the new frontier regions of the Beni and Pando. As a result of this slow growth, Potosi's contribution to the gross national product fell from 13.5% in 1970 to 10.3% six years later, a sharp decline unparalleled by any other region.

The source of the wealth lies in the rich and abundant mineral deposits, originally silver and later tin and other metals, only a small part of which,

TABLE 2.1: SELECTED ECONOMIC INDICATORS OF THE DEPARTMENTS OF BOLIVIA

Department	Y/P 76	Y ₁ /Y 70	Y ₁ /Y 77	Change 1970-77	dY ₁ 1970-77
Potosi	458	13.5	10.3	-3.2	2.3
Chuquisaca	515	6.2	6.0	-0.2	5.8
La Paz	619	32.8	31.1	-1.7	5.6
Cochabamba	694	16.2	17.0	+0.8	7.1
Santa Cruz	767	16.7	18.6	+1.9	8.0
Oruro	802	8.8	8.6	-0.2	6.0
Tarija	681	3.0	4.2	+1.2	11.7
Beni	595	2.2	3.4	+1.2	13.0
Pando	698	0.6	0.8	+0.2	12.8
Bolivia	637	100.0	100.0	-	6.3

Y/P 76 = departmental product per capita in US\$ 1976
 Y₁/Y 70 = departmental product as % of gross national product 1970
 Y₁/Y 77 = departmental product as % of gross national product 1977
 Change = change in departmental contribution to national product
 dY₁ = % annual growth rate of departmental product 1970-77

Source: CORDEPO, *Funciones Urbanas en el Desarrollo Rural: Resultados del Estudio en Potosi*, Vol. 1, CORDEPO, Potosi, 1981.

2. Basic Resource Analysis

even today, has been surveyed, still less exploited. As may be seen from the location quotients in table 2.2, Potosi is the Department most highly specialised in mining, and this sector dominates the economy of the region, accounting for a third and often more of the local product. Nevertheless, in the period 1970-77 output barely increased, due partly to adverse conditions in the world market for metals, particularly tin, but also to poor management and underinvestment. This has plagued the sector since the largest mines were nationalized in 1952, to the point where the costs of production now exceed many other international competitors. Regardless of its current woes, however, the mining sector in Potosi, as in many other instances, is an enclave activity that has created great riches for some in distant places, but meager benefits for the local population.

Although mining dominates the local economy, it has generated few forward or backward linkages to related activities, with the result that the industrial sector is practically non-existent but for a few small food and drink establishments. Despite a relatively rapid rise in investment and output during the seven years ending 1977, manufacturing still only contributes some 4% of the local product, and employs only 6% of the workforce. Furthermore, much of what is defined in the census as "industry" turns out to be traditional rural handicraft activities.

Currently there is substantial investment from abroad, notably Europe and the Soviet Union, for the construction of large mineral processing plants using capital intensive technology. The sums of money involved are enormous, dwarfing the annual budget of the regional development agency. Apart from the initial impact on the construction sector, the plants should generate increased demand for lower grade ores, which will stimulate small scale mines in particular. However, most of the local multiplier effects are likely to be restricted to the city of Potosi and its immediate surroundings.

Despite the importance of the mining sector, it absorbs only a small part of the local workforce, about 12% in 1976, while more than half are still occupied in agriculture. Although Potosi is a mountainous region lying for the most part at well over 10,000 feet, and its land is by no means fertile, its agricultural potential is widely underestimated, and far from fully exploited. The cold temperatures, low rainfall and thin topsoil of the altiplano makes stock-raising difficult, while the cultivation of crops is mainly confined to

TABLE 2.2: ECONOMIC INDICATORS FOR THE DEPARTMENT OF POTOSI BY SECTORS

Sectors	Y_j 1977	Y_j/Y 1977	LQ_j 1977	dY_j 1970-77	dK_j 1970-75	N_j/N 1976	y_{ij}/y_j 1977
Agriculture	7,908	10.3	0.64	-1.6	-5.7	56.8	59.0
Mining	24,944	32.6	3.00	0.3	6.9	12.3	91.0
Industry	3,416	4.5	0.27	21.1	13.8	6.4	32.0
Construction	1,408	1.8	0.50	12.7	4.0	3.3	51.0
sub-total	37,676	49.2		1.2			
Energy	540	0.7	1.00	-5.1	9.8	0.1	50.0
Transport and Communicat'ns	6,424	8.4	0.88	1.3	11.2	2.5	110.0
sub-total	6,964	9.1		0.6			
Commerce and Finance	13,698	17.9	1.05	6.6	2.1	3.9	136.0
Government	5,996	7.8	0.88	4.5	6.2) 14.7	102.0
Housing	5,184	6.8	0.87	1.6	2.0		
Services	7,110	9.2	1.11	1.8	1.9		
sub-total	31,988	41.7		4.2			
Total	76,628	100.0	1.00	2.3	4.9	10.0	88.0

Y_j = value of product in sector j in thousands of US\$ in 1977
 Y_j/Y = value of product in sector j as % of total product in 1977
 LQ_j = Location quotient for sector j by value of product in 1977
 dY_j = % annual growth of product in sector j 1970-77
 dK_j = % annual growth of capital invested in sector j 1970-75
 N_j/N = employment in sector j as % of total departmental employment
 y_{ij}/y_j = labor productivity in sector j in the department as
 % of productivity in sector j nationally

2. Basic Resource Analysis

the more fertile plains and temperate valleys located to the east of the Department. Nevertheless, despite these natural constraints, the agricultural sector in Potosi has suffered most from negligence, disinvestment and lack of government support. According to available statistics, the productivity of farmers in Potosi is the lowest in the country, and during the period 1970 to 1977 output declined consistently, while invested capital shrank at the rate of nearly 6.0% each year.

With the productive sectors of its economy in such poor shape, it is no surprise to learn that people have been leaving Potosi faster than any other Department of the country, in search of jobs elsewhere, a net annual exodus of 6.4 people per thousand between 1971 and 1976. (See table 2.3.) While the biggest movement of migrants is between Potosi and the Departments of La Paz and neighboring Oruro, the largest net exodus is to Santa Cruz, Cochabamba and to a lesser extent Tarija. Movements to and from other countries, mainly Argentina and Chile, account for a small part of total migration. During the period in question, more people appear to have returned than left, though this may reflect an underestimate of emigrants rather than the true situation.

This heavy outmigration, coupled with high mortality rates, resulted in an annual population growth rate for Potosi of barely 1.00% during the twenty-six year period between censuses, which compares with 2.05% for the country, and is again the lowest of all Departments. As a proportion of the national total, the population of Potosi declined from nearly a fifth in 1950 to a seventh in 1976.

With only 15.3% of its 1976 population of 658,000 living in towns of more than 20,000 inhabitants, and a further 13.7% living in settlements with between two and twenty thousand people, Potosi emerges as one of the less urbanized regions of Bolivia. The remaining 71%, living in small villages and rural areas, compares with a national average of 58%, and 47% in the most urbanized Department of Santa Cruz. The low proportion of urban population in Potosi reflects once again the almost total lack of manufacturing industries, and the general scarcity of alternative job opportunities in the cities and towns throughout the region.

TABLE 2.3: PHYSICAL AND DEMOGRAPHIC CHARACTERISTICS OF DEPARTMENTS OF BOLIVIA

Department	P_i 76	P_i/P	%PR	%PU	dP_i	%M	km^2	P_i/km^2
Potosi	657.7	14.3	71.0	29.0	0.99	-0.64	118.2	5.56
Chuquisaca	358.5	7.8	78.4	21.6	1.23	-0.59	51.5	6.90
La Paz	1465.0	31.8	52.4	47.6	2.07	-0.11	134.0	10.93
Cochabamba	721.0	15.6	62.3	37.7	1.79	-0.12	55.6	12.96
Santa Cruz	710.7	15.4	47.3	52.7	4.09	+1.49	370.6	1.92
Oruro	310.4	6.7	48.9	51.1	1.84	-0.51	53.6	5.50
Tarija	187.2	4.1	61.1	38.9	2.28	+0.74	37.6	4.98
Beni	168.4	3.6	51.8	48.2	3.28	-0.61	213.6	0.79
Pando	34.5	0.7	89.4	10.6	2.88	+0.96	63.8	0.54
Nation	4613.5	100.0	58.3	41.7	2.05	-	1098.6	4.25

P_i	= Population of Department i in thousands in 1976	P_i/P	= population of Department i as % of national total in 1976
%PR _i	= rural population as % of total population in Department i	%PU _i	= urban population as % of total population in Department i
dP_i	= % annual growth of population in Department i	%M _i	= % annual net migration rate in Department i
km_i^2	= area of Department i in thousands of square kilometers	P/km_i^2	= population per square kilometer in Department i

The Intra-regional Analysis.

The intra-regional analysis aims to identify the distinguishing characteristics of the constituent areas of the region, and to compile information which would be useful later for identifying the productive potential of each area. Ideally the analysis ought to take into account the distribution of population, economic activities, and physical resources, paying particular attention to water resources, soil types, and patterns of land use and crop cultivation. In practice the scope of the analysis is bound to be determined by the availability of existing data and other information. In Potosi a number of studies are currently under way covering water resources and land-use patterns based on satellite photography. However, since these studies were either incomplete or unavailable at the time the spatial analysis was being prepared, these aspects received scant attention in the UFRD reports.

Hence the scope of the intra-regional analysis in the Department of Potosi was largely dictated by available information, supplemented with data from the field surveys. Since the province is the sub-departmental unit for which census data is most easily available, this was used as the unit of analysis. (See map 2.2.)

Briefly described, the Department of Potosi lies high in the Andes, for the most part a plateau between a parallel range of mountains, which gives way to a transitional zone of temperate valleys to the east, leading eventually down to the lowlands some distance beyond. As is suggested by the location quotients of table 2.4, the principal mining centers are to be found in the north in the province of Bustillos around Llallagua and Siglo XX; in the center around the city of Potosi and the famous Cerro Rico, site of the original discovery of silver in 1545; and further to the south in the provinces of Nor and Sud Chichas in the mountains around Atocha. On the altiplano itself, and the mountains either side, which together make up the greater part of the Potosi region, farming is restricted to the raising of sheep and llamas, and to a lesser extent to growing quinoa, an indigenous and highly nutritious cereal. The cultivation of other crops, is confined mainly to the temperate valleys of the eastern part of the Department: wheat in the province of Bilbao; potatoes and other vegetables in Charcas, Frias and Saavedra; corn and some fruits in Linares, Nor and Sud Chichas.

PROVINCIAS URBANAS EN EL DESARROLLO RURAL DE POTOSI

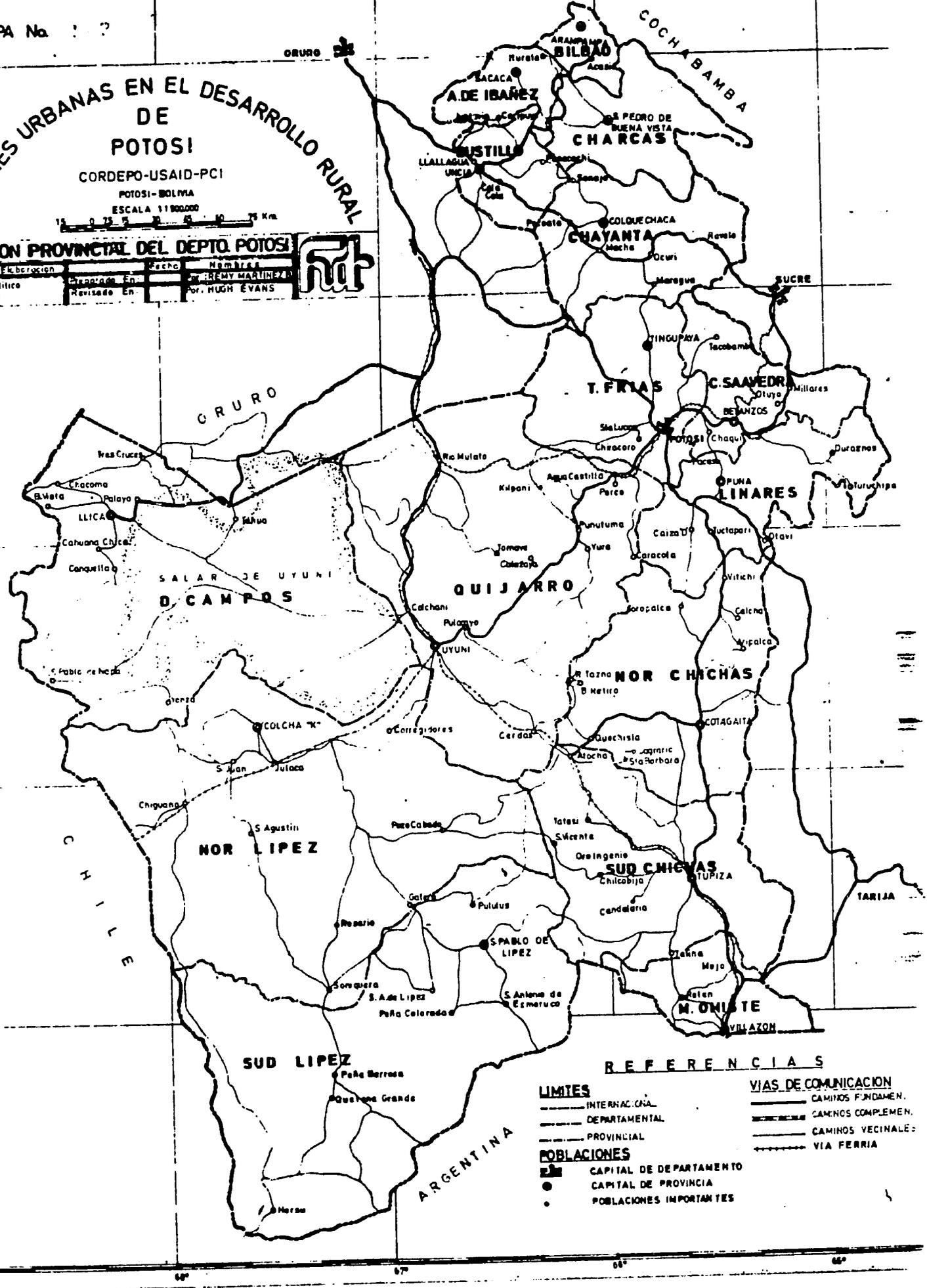
CORDEPO-USAID-PCI
POTOSI-BOLIVIA

ESCALA 1:100,000

0 5 10 15 20 25 Km

LEGENDA DE LA DIVISION PROVINCIAL DEL DEPTO. POTOSI

Elaboración	Fecha	Normas
Revisado En		Por: JHEMY MARINEZ
Revisado En		Por: MUGH EVANS



REFERENCIAS

LIMITES

- INTERNACIONAL
- DEPARTAMENTAL
- PROVINCIAL

POBLACIONES

- CAPITAL DE DEPARTAMENTO
- CAPITAL DE PROVINCIA
- POBLACIONES IMPORTANTES

VIAS DE COMUNICACION

- ===== CAMINOS FUNDAMENTALES
- ===== CAMINOS COMPLEMENTARIOS
- ===== CAMINOS VECINALES
- VIA FERREA

Map 2.2 PROVINCES OF POTOSI

70

TABLE 2.4: PHYSICAL AND DEMOGRAPHIC CHARACTERISTICS OF THE PROVINCES OF THE DEPARTMENT OF POTOSI

Provinces	P_i	P_i/P	km ²	P/km ²	Ag	Min	Ind
Bilbao	9,683	1.5	640	15.1	1.30	0.00	2.81
Ibanez	22,635	3.6	2,170	10.9	1.59	0.04	0.13
Charcas	32,302	4.9	2,964	10.9	1.49	0.01	1.20
Bustillos	91,418	13.9	2,235	40.9	0.73	2.03	0.82
Chayanta	88,960	13.5	7,026	12.7	1.44	0.19	1.31
Frias	122,810	18.8	3,420	35.9	0.53	1.54	1.16
Saavedra	54,113	8.2	2,375	22.8	1.31	0.41	1.21
Linares	53,481	8.1	5,136	10.4	1.40	0.24	0.89
Quijaro	38,723	5.9	14,890	2.7	0.81	1.19	0.61
Nor Chichas	47,965	7.3	8,979	5.3	1.06	1.47	0.48
Sud Chichas	51,115	8.4	8,516	6.5	0.46	1.97	0.66
Omiste	20,651	3.1	2,260	9.1	0.48	0.27	1.85
D. Campos	5,567	0.8	12,106	0.5	1.10	0.87	0.12
Nor Lipez	9,162	1.4	23,146	0.4	1.08	0.61	0.36
Sud Lipez	4,149	0.6	22,355	0.2	1.02	1.72	0.12
Department	657,743	100.0	118,218	5.6	1.00	1.00	1.00

P_i = population of province i in 1976
 P_i/P = population of province i as % of Department population
 km² = area of province in square kilometers
 P/km^2 = population per square kilometer
 Ag = location quotient for agriculture measured by employment
 Min = " " " mining " " "
 Ind = " " " industry (including handicrafts)

2. Basic Resource Analysis

The distribution of population largely follows the distribution of natural resources, mineral deposits, and the more fertile agricultural areas. Thus, the three western provinces are almost empty, accounting for almost half the land area but less than three per cent of the population, with as little as one person to five square kilometers in Sud Lipez. The population is most densely settled around the mining centers in the province of Bustillos (41 people per square kilometer), around the city of Potosi in the province of Tomas Frias (36p/km²), and to a lesser extent in the better farming land of Saavedra (23p/km²).

As part of the intra-regional analysis, a series of development indicators were calculated for each of the fifteen provinces, covering housing, education, health, employment, transport and communications. These were either derived from data in the population and housing censuses of 1976, or were based on information later collected in the survey of urban centers.

The results indeed portray a picture of a backward region. (See table 2.5.) Housing indicators show that very few homes in the Department are connected to modern infrastructure. More than three out of every four houses lack a direct connection to drinking water in seven of the fifteen provinces, to electricity in ten provinces, and to sewerage in all but one, Tomas Frias. In terms of education, more than half the population is illiterate in six of the provinces, more than half the school-age children have dropped out in nine of the provinces, and most serious of all, the vast majority of people have never reached high-school. Unemployment is estimated to be less than 10% in most cases, although this disguises the fact that many people are working only part-time or in certain seasons. Health indicators vary widely, showing one doctor for every 900 inhabitants in Sud Chichas, but no doctors at all in the provinces of Sud Lipez and Bilbao. Infant mortality rates in Bolivia are among the highest of any Latin American country, and reach their peak in the Department of Potosi: in all but three of the provinces more than one out of every ten children die before their first birthday, and in three provinces more than one out of six.

To arrive at a development index, the results were aggregated in the following manner. For each indicator the difference between the top and bottom score was divided into three equal parts, and provinces were classified accordingly as more developed, less developed and least developed. Since the number of

TABLE 2.5: DEVELOPMENT INDICATORS FOR THE PROVINCES OF THE DEPARTMENT OF POTOSI

Provinces	Housing				Education			Health				Labor
	A1	A2	A3	A4	B1	B2	B3	C1	C2	C3	C4	D1
Frias	59.2	29.5	48.9	67.4	65.9	55.7	20.5	13.15	0.8	2.4	8.0	93.7
Bustillos	53.1	8.2	42.6	63.0	60.6	54.5	15.0	6.71	0.7	4.0	11.0	91.0
Seavedra	9.6	1.0	5.4	36.1	34.0	35.1	1.9	6.31	0.1	0.5	10.9	96.0
Chayanta	7.2	0.4	3.5	12.0	25.0	28.0	1.5	0.85	0.1	0.8	4.5	96.0
Charcas	2.8	0.1	0.9	7.0	26.0	35.0	1.7	0.34	0.0	0.0	10.8	94.0
Nor Chichas	16.1	1.5	12.9	28.0	50.0	47.0	4.3	1.34	0.3	3.0	19.2	95.0
Ibanez	4.1	0.2	0.1	7.0	36.7	35.4	2.8	0.92	0.0	0.8	11.2	95.0
Sud Chichas	48.1	8.7	42.5	59.0	70.4	30.7	14.4	0.82	1.1	7.1	14.8	94.0
Nor Lipez	25.2	1.8	1.5	21.0	72.7	52.0	5.8	0.34	0.2	3.5	11.8	90.0
Sud Lipez	0.0	0.5	8.8	15.8	68.0	43.8	4.0	0.05	0.0	0.5	18.7	84.0
Linares	4.8	0.9	2.8	26.0	43.0	43.6	3.0	1.36	0.1	1.1	11.7	97.0
Quijarro	39.0	7.0	26.0	40.0	67.4	55.0	11.0	1.01	0.5	3.3	13.2	92.0
Bilbao	60.0	0.8	0.5	13.0	43.5	42.0	1.3	1.60	0.0	0.0	15.4	93.0
D.Campos	43.0	4.5	18.0	43.0	88.0	64.0	17.0	0.41	0.2	0.9	24.5	97.0
Omiste	42.0	22.0	34.0	52.0	69.0	54.0	14.0	3.10	0.1	1.5	9.7	94.0

A1 = % households with direct connection to water
 A2 = % households with direct connection to sewer
 A3 = % households with electricity
 A4 = % homes with at least 2 of 3 elements (wall, floor, roof) built from permanent materials
 B1 = % population that is literate
 B2 = % school age children attending school

B3 = % population with some high school education
 C1 = # of health facilities per 1000 square kms
 C2 = # of doctors per thousand inhabitants
 C3 = # of hospital beds per thousand inhabitants
 C4 = infant mortality, measured as % live births ending in death within first year
 D1 = % workforce employed full or part-time

Source: CORDEPO, *Funciones Urbanas en el Desarrollo Rural: Resultados del Estudio en Potosi*, Vol. 1, CORDEPO, Potosi. 1981.

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indicators for each aspect under consideration varied from one to four, depending on available data, they were assigned different weights to balance the importance attached to each aspect. Provinces were then ranked according to the weighted sum of their scores.

In addition, estimates were made of the per capita income levels in each of the provinces. These estimates were based on output per unit of labor in each sector at the departmental level, and sectoral employment in each province. This assumes that productivity levels are constant across all provinces, which is obviously not true, but in the absence of alternative data it provides at least a first approximation.²

When these per capita income estimates are compared with the development indicators, and the proportion of people in each province living in urban areas, a strong relationship is clearly evident. (See columns 1, 2 and 3 of table 2.6.) The five most urbanized provinces - Frias (with the city of Potosi), Omiste (with Villazon), Bustillos (with the mining towns around Llallagua/Uncia), Sud Chichas (with Tupiza), and Quijarro (with Uyuni) - have the highest income levels and, with one exception, the highest development indices. At the other end of the scale, the provinces with the lowest development indices and the lowest income levels all have less than 10% of their population living in urban areas, which in this case is defined as settlements having more than a thousand inhabitants.

This relationship is not hard to explain. It is easier and cheaper to provide infrastructure and services to people concentrated in towns than to those dispersed in the country. Furthermore, city dwellers have closer access to better health and education facilities, and tend to be employed in manufacturing, commerce and other service industries, which pay higher wages than agriculture. In Potosi, as often elsewhere, residents of more the urbanized provinces tend to be better paid, better housed, better educated, and in better health than those who live in rural areas.

A breakdown of migration patterns at the provincial level confirms a general drift from the poorer, more backward, rural provinces to the more urbanized areas. The figures in column five of table 2.6 reflect migration within Bolivia only, and do not take account of movements to and from abroad. However, in the period 1971-76, the five provinces with the highest proportion of

**TABLE 2.6: SELECTED CHARACTERISTICS OF THE PROVINCES
OF THE DEPARTMENT POTOSI**

Province	%PU _i	DI _i	Y/P _i	dP _i	%M _i
Frias	63.0	78.4	678	1.86	-0.28
Bustillos	61.3	66.6	609	1.61	-0.47
Omiste	60.7	72.6	861	0.70	+1.22
Sud Chichas	54.9	73.3	688	1.38	-0.76
Quijarro	31.6	58.2	580	0.26	-0.85
Daniel Campos	18.4	66.0	410	0.8	-0.85
Nor Chichas	16.2	50.8	389	0.02	-0.23
Ibanez	6.0	41.5	156	0.27	-0.30
Chayanta	4.3	36.9	231	1.10	-0.51
Linares	4.2	48.9	207	0.55	-1.10
Saavedra	4.1	48.6	270	0.64	-0.17
Sud Lipez	0.0	41.8	473	1.28	-0.33
Nor Lipez	0.0	46.8	384	0.95	-0.89
Bilbao	0.0	49.4	217	0.15	-0.51
Charcas	0.0	34.5	191	0.52	-0.54
Department	31.1		47	0.99	-0.64

%PU_i = urban population as a % of total population of province i 1976
 DI_i = Development Index in province i
 Y/P_i = Income per capita in province i in US\$ 1976
 dP_i = % annual population growth in province 1950-76
 %M_i = % annual net migration in province i 1971-76

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urban population were the only ones to register a net gain in the inter-provincial exchange of migrants, as farm-workers sought new jobs in the mining centers and larger towns. On the other hand, the only province to record a net influx of migrants from other Departments was Omiste on the frontier with Argentina, due to the role played by Villazon as a staging post and point of departure, a pattern also found among the towns of northern Mexico along the border with the United States, such as Tijuana, Mexicali and Ciudad Juarez.

In the inter-censal period from 1950 to 1976, the annual rate of population growth among the fifteen provinces varied only 1.0% either side of the mean for the Department of 0.99%. The province of Tomas Frias emerges as having the most rapid growth rate, a modest 1.86%, followed by Bustillos and Sud Chichas, again three of the four most urbanized areas. The only other provinces with growth rates above the average for the Department, the agricultural area of Chayanta and the sparsely populated Sud Lipez, also have important mining activities. After that, the pattern becomes blurred, with some strange surprises such as the virtual standstill in Nor Chichas, despite the birth of several mining towns. It should be born in mind, however, that the two censuses on which these figures are based were taken twenty-six years apart, and the overall trend may conceal sharp changes or even reversals in more recent years.

Footnotes to chapter 2.

1. During the mid-1600s Potosi was the largest city in the western hemisphere and one of the richest mining centers in South America. For a description of the city at the peak of its power and wealth, see Charles E. Chapman, *Colonial Hispanic America: A History*, (MacMillan, New York, 1933); and Lewis Hanke, *The Imperial City of Potosi: An Unwritten Chapter in the History of Spanish America*, (Martinus Nijhoff, The Hague, 1956).
2. Income per capita in province i , Y_i , is calculated as follows:

$$Y_i = \frac{1}{P_i} \sum_{j=1}^n N_{ij} \times y_j; \quad \text{with } y_j = Y_j/N_j$$

where P_i = population of the province i ;
 N_{ij} = labor in sector j in province i ;
 Y_j = output in sector j in the Department;
 N_j = labor in sector j in the Department.

CHAPTER III. ANALYSIS OF SETTLEMENTS

The second step of the UFRD methodology examines the first of three characteristics of the spatial structure of the region, the system of settlements. The purpose of the analysis is to define the hierarchy of central places in the region, and to determine the kind of urban functions to be found at each level of the hierarchy. Together with other studies, this information is used later to identify gaps in the urban system and in the distribution of services and facilities that may be impeding development.

In the Potosi study, the urban hierarchy was defined according to three criteria of functional complexity, using data from the survey of urban centers which indicated the presence or absence of specific functions in each settlement, and the scalogram as the method of analysis. This chapter reports the results of that analysis, and also includes a review of the recent growth and decline of towns and villages, and an overview of the provision of basic infrastructure in urban areas.

Growth and Decline of Settlements.

An analysis of the increase in the number of settlements, and the growth or decline of their populations, provides the broad dimensions of the process of urbanization in the region. Although the Department of Potosi is one of the least urbanized regions of Bolivia, it possesses a large number of settlements. In the period between the two censuses of 1950 and 1976, the number of towns with more than 500 inhabitants almost doubled from 32 to 60. (See table 3.1) In 1950 the city of Potosi was the only one in the region with more than 10,000 residents, but by 1976 there were six such cities, and twenty with more than 2,000 people, more than were to be found in the Departments of La Paz and Cochabamba, which have larger populations.

The pattern of growth and decline among these settlements during this period is remarkably consistent, the gainers are mining centers and the losers are farming towns. This clearly reflects the national policy of sustained public investment in the mining sector, while agriculture was allowed to languish in virtual neglect. Of the 32 towns in 1950 with more than 500 inhabitants, seventeen lost population over the next twenty-six years, all but two of which were farming communities. Meanwhile, of the 34 settlements which in the same period crossed the threshold of 500 inhabitants, all but four were mining

TABLE 3.1 SETTLEMENTS IN THE DEPARTMENT OF POTOSI BY POPULATION SIZE IN 1950 AND 1976

Size of population	1950		1976	
	Towns	Population	Towns	Population
More than 20,000	Potosi	43,306	Potosi Llallagua	77,334 23,361
Between 10,000 and 20,000			Villazon Siglo XX Tupiza	12,536 10,766 10,682
Between 5,000 and 10,000	Tupiza Pulacayo Uyuni Llallagua Villazon	8,235 7,735 6,671 6,626 6,175	Uyuni C.M.Catavi Uncia	8,639 7,593 7,396
Between 2,000 and 5,000	Uncia	4,454	Atocha R.Tazna Chayanta Animas Colquechaca S.Barbara Siete Suyos Pulacayo Tatasi Telamayu Betanzos B.Retiro	4,677 3,171 2,937 2,694 2,686 2,556 2,523 2,398 2,380 2,332 2,205 2,052
Between 1,000 and 2,000	10 towns		11 towns	
Between 500 and 1,000	15 villages		29 villages	

Source: CORDEPO, *Funciones Urbanas en el Desarrollo Rural: Resultados del Estudio en Potosi*, Vol. 1, CORDEPO, Potosi, 1981.

3. Analysis of Settlements

centers. As a result, a dramatic reversal took place: in 1950 farming towns predominated, and mining centers represented only one in every four settlements, but by 1976 this ratio had risen to three out five.

However, the few exceptions to this pervasive pattern illustrate two important points. First, the mining town of Pulacayo, which in 1950 was the third largest town in Potosi with a population of 7,700, lost over 70% of its residents during the period in question, as the more profitable mineral deposits were gradually exhausted: a sharp reminder that the life of these towns can also be insecure and often short. Second, the few farming towns that prospered during this period, notably Betanzos and Chayanta, are closely linked to large centers of consumption - the cities of Potosi and Llallagua respectively - underlining the importance of market outlets in stimulating rural production.

Definition of the Settlement System.

The system of settlements in a region may be interpreted as a hierarchy of urban centers with usually a single city at the top, containing a number of facilities which occur only there and nowhere else in the region, followed by a handful of places at the second level, with functions that are to be found only rarely, and successively more centers at lower levels with the kind of services that are encountered more frequently. In Potosi, the definition of the urban hierarchy was based on three criteria: the number of different functions to be found in a given place; the nature of those functions, which suggests the relative size of the town's area of influence; and an index of centrality, which provides a third measure of functional complexity in which functions are weighted in inverse proportion to the number of times they occur.

In each case the scalogram was used as the method of analysis. This is a two-dimensional matrix showing the functions to be found in each settlement, the data for which was collected through the survey of urban centers. As a preliminary step in constructing a scalogram, settlements are ranked by size of population on the left hand side of the matrix, while functions are grouped along the top according to sectors such as infrastructure, social services, and commercial activities. The presence (or absence) of a given function in each settlement is indicated in the matrix itself. The number of functions in each place is found by summing the rows, while the number of times each

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function occurs - its frequency of occurrence - is calculated by summing the columns. This done, a revised version of the matrix is prepared in which settlements are this time ranked according to the number of functions they possess, and functions are ordered from left to right according to their frequency.

For the purposes of defining the urban system it is important to take into account only those functions that are representative of a settlement's role as a service center. The first version of the scalogram prepared in Potosi included the complete inventory of information collected from the survey of urban centers, covering over 120 functions in 112 settlements. This was useful as a reference base, but in order to define the settlement system a second version of the scalogram was prepared, in which many less significant items, such as basketball courts, billiard saloons and cafes were eliminated, and the list was reduced to the 58 functions considered to be the best indicators of functional complexity. A reduced version of this scalogram, including the 58 functions but only the first half of the 112 settlements, is reproduced in figure 3.1.

The first of the three criteria to be taken into account was the number of different functions to be found in each place. At one end of the scale is the city of Potosi, which contains all but two of the 58 functions included in the scalogram, these two being the office of a Sub-prefect which occurs only in provincial capitals, and a medical post which is usually located in villages and small towns. At the other end of the scale are the smallest villages with very few amenities, perhaps a junior school, piped drinking water or a small grocery store.

Between these two extremes, there appear to be two clear intervals, both of them at the upper end. The first falls between the city of Potosi with 56 functions and the second-ranked Uyuni with 46 functions. The second interval lies between sixth-placed Uncia with 35 and seventh-placed Atocha with 29. Further down the list no such obvious breaks occur. But this suggests as a first approximation that there may be only one city in the first tier of the hierarchy, the city of Potosi, followed by a group of five at the second level - Uyuni, Tupiza, Villazon, Llallagua, and Uncia. The latter two are within five kilometers of each other, and were therefore treated as a single urban

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area. Together they score 45 functions, which emphasizes the gap between the second and third group beginning with Atocha.

The second criteria used for defining the urban hierarchy was the centrality index of a settlement. This index measures functional complexity in terms not only of the number of functions in a place, but also their frequency of occurrence. Functions are assigned a weight in inverse proportion to the frequency with which they occur. Thus a hospital or daily market, which is to be found in only a few places, is weighted more heavily than a doctor's clinic or grocery store which are more widespread. The centrality index for a given place is the sum of the weights of the functions which are found there: the higher the index, the greater its functional complexity.

The number of functions and the centrality index for a given settlement are not necessarily directly related. (See table 3.2.) True, Potosi and other large towns with the most functions also have the highest indices, but further down the line the relationship is less straightforward. Puna and Llica, for instance, both have twenty-two functions, but whereas the index for Llica is only 87, that for Puna is 123.6, almost half as high again. Conversely, the index for Llica's small neighbor, Huanaque, which has only fourteen functions, is just as big. The kind of functions, more than the number of functions, determines the centrality index of a settlement.

The third criterion taken into account looked explicitly at the type of functions to be found at each level of the urban hierarchy. Higher level centers obviously contain certain facilities that are not to be found in lower level settlements, such as banks, for example, technical institutes, or long distance telephone service. Based on the evidence in the scalogram, groups of functions were selected as being representative of different levels of the hierarchy. (See again table 3.2.) A town at one level would normally be expected to contain most if not all of the amenities of towns at lower levels. Thus, for a settlement to be classified at a given level of the hierarchy, it had to possess a minimum number of functions corresponding to that level or higher levels.

An examination of the evidence in light of these three criteria suggested that the urban hierarchy in the Department of Potosi consists of five tiers. (See tables 3.2 and 3.3.) At the top is the regional center, the city of Potosi

TABLE 3.2: ATTRIBUTES OF SETTLEMENTS AT EACH LEVEL OF THE URBAN HIERARCHY

Level and settlement type	# of Functions	Centrality Index	# of Functions of level 1 or higher
I Regional center			
City of Potosi	56	675	6
II Sub-regional center	(min 35)	(min 200.0)	(min 10 max 18)
Uyuni	46	372.7	17
Tupiza	46	299.4	15
Villazon	43	294.6	16
Llallagua	42	253.3	11
Uncia	35	209.3	10
III Rural center	(min 20)	(min 100.0)	(min 10 max 38)
Atocha	28	149.2	14
Betanzos	27	155.0	16
Siglo XX	27	153.3	15
Cotagaita	26	131.5	13
Colquechaca	24	121.7	11
Catavi	23	126.7	10
Quechisla	23	101.2	11
Rosario Tazna	23	104.7	11
Puna	22	123.6	10
Llica	22	37.0	10
Killpani	20	100.0	12
IV Local center	(min 13)	(min 50.0)	(min 7 max 43)
Pulacayo	23	92.2	12
San Pedro de Buena Vista	19	79.4	12
Chayanta	19	75.4	9
Sacaca	18	79.6	11
Telamayu	18	71.8	10
San Pedro de Quemez	17	61.0	8
Tatasi	17	72.5	9
Cancaniri	17	68.2	10
Punutuma	17	71.9	10
Rio Mulatos	17	64.5	9
Caiza "D"	16	60.3	8
Caracota	16	95.3	9
Otavi	15	81.0	9
Colcha "K"	15	53.5	7
Vitichi	15	70.7	7
Ocuri	15	59.9	8
Chilcobija	15	65.6	7
Colavi Mina	15	52.2	7
Macha	15	52.8	9
Entre Rios	14	72.8	8
Pocoata	14	47.2	8
Animas	14	57.5	8
Santa Barbara	14	46.7	7
Huanaque	14	87.7	7
San Pablo de Lipez	13	45.6	9
Santa Ana	13	48.8	9

TABLE 3.3: CHARACTERISTICS OF SETTLEMENTS AT EACH LEVEL OF THE URBAN HIERARCHY

Level	Function range	Index range	Typical Functions	P_i	P_i/P	
I	Regional center	56	675	Prefecture university air service television station newspaper office	77,334	11.7
II	Sub-regional center	35-46	209-381	rail service long distance telephone daily market hospital manufacturing industry banks farm suply stores	12,52	9.5
III	Rural center	20-28	87-156	inter-urban bus service newspaper delivery radio communication weekly market health center pharmacy vehicle repair workshop gas station	3,238	5.4
IV	Local	13-23	46-92	post and telegraph office doctor's clinic high school clothes store	1,371	5.2
V	Villages (non-central places)	0-12	0-8'	junior school grocery store drinking water	457	4.8

P_i = mean population of settlements at level i

P_i/P = % departmental population living in settlements at level i

3. Analysis of Settlements

with a population in 1976 of 77,000. This has a centrality index of 675, by far the highest, and possesses almost the full range of the 58 functions listed, including several which occur only once in the region, such as a university, the Prefecture, editorial offices of a newspaper, a television station and regular air service.¹

At the second level are five towns with an average population of 12,500, which effectively make up four central places: the urban area of Llalagua/Uncia to the north, Uyuni to the west, Tupiza to the south, and Villazon on the border with Argentina. Centrality indices range from 373 for Uyuni to 209 for Uncia. Treating Llalagua/Uncia as a single entity, this group of towns possesses a similar range of between 43 and 46 functions, typical of which are hospitals, daily markets, manufacturing industry, commercial banks, rail service, long distance telephone service, and depositories of the central Mining Bank, where independent mining concerns can sell their output to the government.

In terms of functional complexity, there is a wide gap between the second and third tiers of the hierarchy, the so-called rural service centers, which include only eleven settlements with a mean population of 3,200. These centers have centrality indices ranging from 149 down to 87, and between 20 and 28 functions, characteristic of which are weekly markets, health centers, vehicle repair shops, some kind of training facility, and daily bus service to other towns. At the fourth level, some twenty-six places meet at least two of the criteria for a local service center, having centrality indices from 95 to 45, and containing anywhere from 13 to 23 functions, most typically a post office, high school, doctor's clinic and clothing store. The remaining seventy settlements fall into the fifth category of villages or non-central places, having twelve functions or less, most of which serve only the residents of the immediate vicinity, such as drinking water, electricity, or a food store.

A closer examination of the scalogram reveals a weak relationship between the size of the settlement, measured by population, and its functional complexity. Uyuni, for example, with barely a quarter of the 30,000 population of the Llalagua/Uncia urban area, has the same number of functions, while Llica and Cotagaita with around 1,000 inhabitants each, have more functions than Catavi, which has seven times the number of residents. A look at map 3.1 provides part of the answer: the distance from a given center to its nearest larger-sized neighbor. Thus, Uyuni has no competition for miles around, while Catavi

CONDICIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI

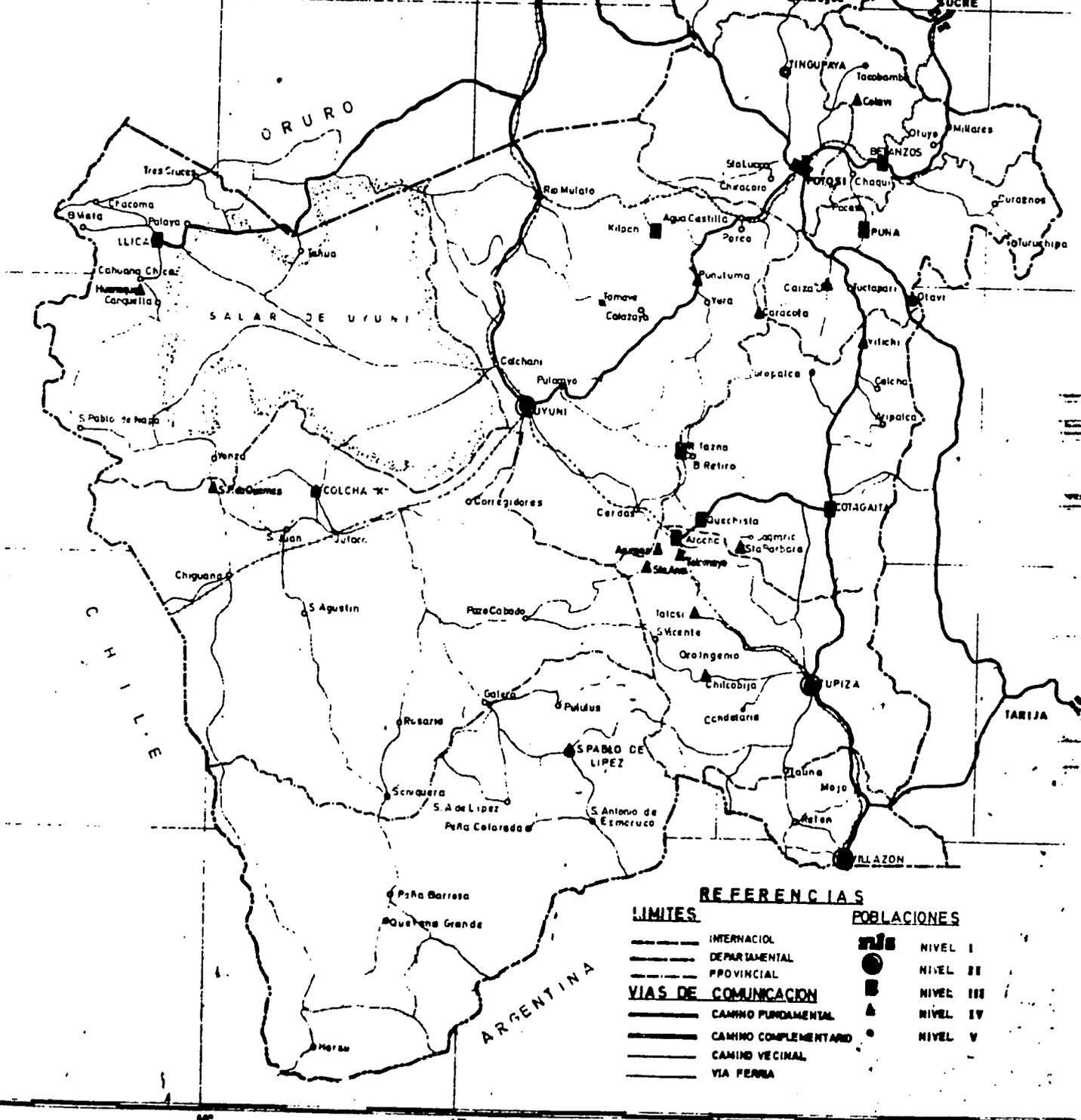
POTOSI-BOLIVIA

ESCALA 1:150,000

0 5 10 15 20 25 Km

LEGENDA DE CENTROS URBANOS / NIVELES

Elaboración	Revisado En	Fecha	Nombre
Mapa Político	Revisado En		Por: HENRY MARTINEZ
Cartas	Revisado En		Por: HUGH EVANS



REFERENCIAS

LIMITES	POBLACIONES
----- INTERNACIONAL	● NIVEL I
----- DEPARTAMENTAL	● NIVEL II
----- PROVINCIAL	● NIVEL III
VIAS DE COMUNICACION	● NIVEL IV
===== CAMINO FUNDAMENTAL	● NIVEL V
===== CAMINO COMPLEMENTARIO	
===== CAMINO VECINAL	
===== VIA FERREA	

Map 3.1 SETTLEMENT SYSTEM

is a mere five-minute bus ride from Llallagua. Another explanation stems from the favoured treatment of the mining centers, which are often equipped with basic infrastructure, health and education services, subsidized provision stores and other facilities, usually financed by the semi-autonomous state mining corporation, COMIBOL, or occasionally by large private mining companies. A further factor is the low level of urbanization of the region. With the majority of Potosinos scattered in small villages and rural areas, the population of a settlement is a poor guide to the number of people from roundabout who use its services and facilities.

Threshold Levels.

Scalograms have also been used to provide rough estimates of so-called "threshold" levels, that is the minimum population needed for a given service or commercial activity to be economically viable. Marshall has suggested a method using a version of the scalogram in which settlements are ranked according to the size of their population.² Since this method is based on the population of urban centers, it obviously ignores those living in rural areas. While this may yield satisfactory results in more heavily urbanized countries, it was quite evident from the Potosi study that it is not an appropriate method for regions with a predominantly rural population. As was just mentioned, the population of an urban center is often a poor guide to the size of its local market or catchment area. Thus, in the case of Potosi, threshold estimates tended to be far too low, and more or less useless for planning purposes. Although it was not attempted, a more promising method of estimating such threshold levels could be derived from the accessibility model described in chapter V.

Provision of Basic Infrastructure in Urban Centers.

Since a large part of CORDEPO's resources had traditionally been invested in basic physical infrastructure, it was thought appropriate to devise a simple index to measure the standard of provision in each settlement. The information also proved useful later on for designing project packages for specific areas. Published statistics from the housing census on connections to drinking water, sewerage and electricity are not disaggregated down to the level of individual towns and villages, and although this data is available on request, it was decided instead to use information collected in the survey of urban centers. This was only a rough estimate, but it was more up to date than the

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census data, and included in addition data on the provision of paved streets, street lighting and garbage collection.

For each of the six aspects of physical infrastructure that were taken into account, communities were graded on a scale of 0 to 4, representing none to all, for example, of houses that are directly connected to drinking water, or of streets that are paved. (See table 3.4.) Scores for the six categories were added together to arrive at a total for the community, and an average. Figures were summed for each of the four zones of the Department by simply calculating the average for all the communities in that zone. The city of Potosi was omitted from the calculation of the indices for the central area, since standards of provision there are so much higher than elsewhere and would distort the picture for the rest of the zone.

The conclusion to be drawn from this analysis is that the standard of provision of basic infrastructure is extremely low. The overall index for the entire Department (the city of Potosi excluded) is 1.15 on the scale of 0 to 4. Of the six elements considered, the provision of drinking water is furthest advanced, scoring 2.06 overall, although this still represents only a small part of the total population. Next comes electricity at 1.85, paved roads (1.11), street lighting (1.06) and garbage collection (0.51). Sewerage, at the bottom with 0.29, is evidently rarely to be found outside the largest towns. In terms of regional variations, the south emerges as best off with an overall index of 1.65, probably due to the numerous mining centers in the area equipped by the state corporation COMIBOL, but still a low score. Otherwise there is little to choose between the northern, central, and western parts of the region, all of which stand at around 1.00.

Footnotes for chapter III.

1. For the past two years, the city of Potosi has in fact had no air service of any kind, due to protracted repairs to the airport runway. However, prior to closing the airport in January 1980, it had "regular air service", and this is scheduled to resume once the runway is again operational.
2. See John V. Marshall, *The Location of Service Towns*, University of Toronto Press, Toronto, 1969.

TABLE 3.4: SUMMARY OF INFRASTRUCTURE INDICES FOR THE DEPARTMENT OF POTOSI

	Population of survey settlements	water	sewer	garbage	elect'y	street light	paved streets	total	average
North	72,071	2.33	0.33	0.30	1.48	0.63	1.00	6.07	1.01
Center*	26,812	1.61	0.07	0.10	1.85	1.22	1.07	5.93	0.99
South	51,482	1.93	0.73	1.32	2.86	1.73	1.32	9.89	1.65
West	18,157	2.38	0.05	0.48	1.19	0.67	1.05	5.81	0.97
Total	168,522	8.25	1.18	2.20	7.38	4.25	4.44	27.00	4.62
Average		2.06	0.29	0.51	1.85	1.06	1.11	6.92	1.15

* The central zone does not include the City of Potosi.

CHAPTER IV. ANALYSIS OF LINKAGES

Empirical evidence in many parts of the world shows clearly that the diffusion of social and economic development is closely related not only to the form of the urban hierarchy but also to the network of linkages which tie settlements together and connect them to their hinterlands.¹ After defining the urban hierarchy, the next step of the UFRD methodology examines a second characteristic of the spatial system looking at a range of physical, economic and service linkages. The purpose of this analysis is to establish the level of interaction between the larger towns, and to sketch out the extent of their hinterlands. Later, this information is combined with other studies to determine which components of the spatial system are better articulated, and which others are poorly integrated or largely isolated.

Chief among the linkages that were examined in the Potosi study were road and rail networks; production and marketing linkages; those related to the delivery of health and education services; technological linkages associated with energy and communications; and public administration linkages related to local government offices. Descriptions of physical linkages, such as roads, long distance telephone lines and electric power grids, were based on information obtained from the respective public agencies. However, to describe most other kinds of linkages - those for production, marketing or services, for example - it was necessary to find out where sellers are located and where their buyers come from; likewise for producers and consumers, teachers and students, doctors and patients.

Collecting such information, for example through surveys of farmers, miners, factories, schools or hospitals, can become extremely time-consuming and costly. In Potosi it was decided instead to adopt a simpler and more straightforward method, taking advantage of the survey of urban centers, and supplementing this with a survey of the principal markets². In the first case, knowledgeable representatives of each community were asked where people came from that used the amenities of that community, and conversely where local residents went when they needed services not available there. Since this survey covered only towns and villages, no data were collected on the use of facilities located in rural areas, such as primary schools, or health posts, but usually these serve only the people from the immediate vicinity. The market survey, as was mentioned before, took place during the ploughing

season, when there was little activity in some country marketplaces; thus, their size and area of influence may have been underestimated. The data gathered from these surveys was not necessarily very precise or detailed, but it sufficed to sketch out the links between one community and another.

Road, Rail, and Transport Links.

Bolivia is a poor nation, and building highways for small populations scattered across a large mountainous country is an expensive proposition. It is not surprising, then, to find that there are few good roads. In relation to its land area, the Department of Potosi has a more extensive network than other regions, although not one kilometer is paved. Given the precipitous terrain, travelling becomes difficult and slow, especially in the rainy season.

SENAC, the national highway service, classifies roads into three categories: the basic network, a system of supposedly all-weather highways that connect the capital cities of the nine Departments one with another; the complementary network, also intended to be passable throughout the year, which links the capital cities with the larger secondary towns; and the local network which includes everything else. (See map 2.2.)

Elements of the basic network connect the city of Potosi with the Departmental capitals of Sucre in Chuquisaca to the east, with Tarija to the south-east, and Oruro to the north-west and La Paz beyond. They also pass through the north of the Department linking Oruro with Sucre, via Llallagua/Uncia. Several roads in Potosi are classified as part of the complementary network, although only the link between Potosi and Tupiza and Villazon to the south approaches all-weather status. Work is in progress to upgrade other links between Potosi and Uyuni, and between Llallagua and Cochabamba to the north, but is proceeding slowly. Local feeder roads reach most but not all settlements with more than a couple of hundred inhabitants, but outside the flatter western half of the Department, they are extremely tortuous and rarely permit vehicles to travel more than 15 kilometers in an hour.

Due to the poor condition of most roads, private transportation companies offer bus service only to cities and towns connected by the better all-weather highways. In Potosi, this means regular daily services only on the links mentioned above, less than daily service between Potosi and the second largest

4. Analysis of Linkages

city of the region, Llallagua/Uncia, and no regular service to the fourth largest city of Uyuni. In the absence of an adequate bus service, the main means of transport, particularly to any town or village off the main highway, are trucks where there are roads, and mules and llamas where there are not.

The rail system was built primarily for the purpose of exporting minerals to seaports in Chile and Peru, and south to Argentina. Passenger service, however, is inferior to road transport, offering connections only once or twice a week between the city of Potosi and Sucre, Oruro, La Paz beyond, Uyuni, and points south.

Until recently, there was a regular air service two or three times a week from Potosi to La Paz and Cochabamba, but it has been suspended since January 1980, in order to rebuild the airport runway. Air travellers now use the airport at Sucre instead, which is four hours distant by road.

Production Linkages.

The analysis of production linkages attempted to trace the connections between the sources of inputs, the places of production, and the destination of outputs, in mining, industry, and most importantly in agriculture, since this is the sector that provides a livelihood for the majority of the population. Thus, the survey of urban centers sought to determine not only the location of depositories of the Mining Bank, processing plants for minerals and for agricultural products, and farm supply stores providing seeds, fertilizers, equipment and machinery, but also the area served by these establishments.

In the case of agriculture, it is clear that few facilities exist to support production. These few are located chiefly in the main cities of Potosi, Llallagua, Tupiza and Uyuni, or in a handful of smaller places with active farmers' cooperatives, such as Betanzos in the more fertile province of Saavedra, and Colcha K in Nor Lipez. Seeds, fertilizers and other agro-chemicals are sold in only half a dozen towns in the entire Department, tools and equipment in ten places - though some of these deal more with mining than agricultural implements - and farming machinery is available for hire or purchase in just four locations.

Traditional methods are still used almost everywhere for storing agricultural produce, and almost all the grinding of wheat and corn is done in small water-mills scattered everywhere. A storage silo was recently completed in Betan-

zos, and the only two modern mills in the region are to be found in the city of Potosi, the second one having opened in 1981. Given the size of the Department, it is not surprising to find that users of the few facilities that do exist come from far and wide. (See map 4.1.)

The mining sector is better provided for. Since mines tend to be concentrated in clusters, preliminary processing plants are usually to be found close by. Depositories of the national Mining Bank are located in the main towns, and some mining centers such as Atocha, Chayanta and Agua de Castilla. Secondary processing plants, though, are practically non-existent; thus most ores are shipped out of the country untransformed, especially to Chile. However, a large new plant recently opened in Oruro, two others are under construction in the city of Potosi and nearby at La Palca, and more are planned.

Marketing and Commercial Linkages.

In a region such as Potosi where more than half the population is occupied in agriculture, markets play an important role not only as outlets for the sale of farm produce, but also for the distribution and sale of merchandise to the inhabitants of rural areas. *A priori*, one might expect markets to occur either at the point of demand, that is in the larger towns or centers of consumption, or at the point of supply, where production is concentrated.

In the Department of Potosi, markets are certainly found among the main centers of consumption, but the incidence of markets in the areas of production is uneven. (See map 4.2.) The largest urban center in the region, the city of Potosi, has five markets, which collectively exert the strongest influence in terms of interactions with the surrounding area. The size of demand in the city, added to that in nearby Sucre, coupled with a relatively good network of local roads, has stimulated vigorous market activity in several small towns close to the main areas of production, notably in Betanzos, Puna, Otavi, and even a new market right on the main highway in the village of Ckullco, occupied only on market days, which is obviously aimed at supplying wholesalers.

To the south, several markets are to be found in centers of consumption: daily ones in Tupiza, Villazon, and Atocha; and weekly ones in smaller mining centers such as Quechisla and Rosario Tazna. However, even though there is considerable agricultural activity in the valleys to the east, only the markets in Cotagaita and Vitichi are close to areas of production.

MAPA No.

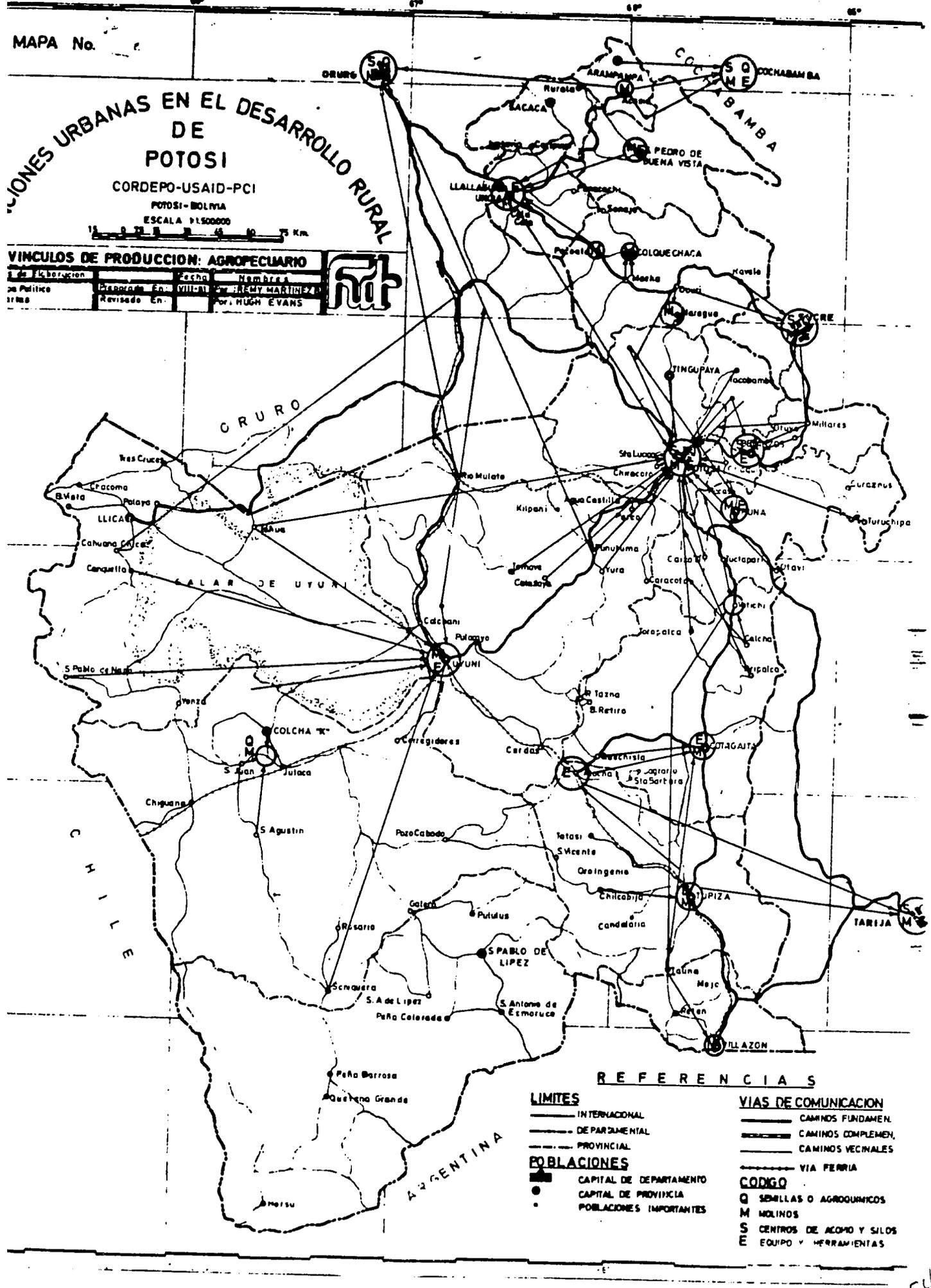
CONEXIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI
POTOSI-BOLIVIA
ESCALA 1:1500000

0 5 10 15 20 25 30 Km

VINCULOS DE PRODUCCION: AGROPECUARIO

Fecha de Elaboración	Fecha	Nombre
de Política	Elaborado En	Por: HENRY MARTINEZ
Forma	Revisado En	Por: HUGH EVANS



REFERENCIAS

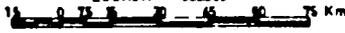
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| — PROVINCIAL | — CAMINOS VECINALES |
| POBLACIONES | — VIA FERREA |
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| ● CAPITAL DE PROVINCIA | Q SEMILLAS O AGROQUIMICOS |
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| | S CENTROS DE ACOMO Y SILOS |
| | E EQUIPO Y HERRAMIENTAS |

Map 4.1 AGRICULTURAL PRODUCTION LINKAGES

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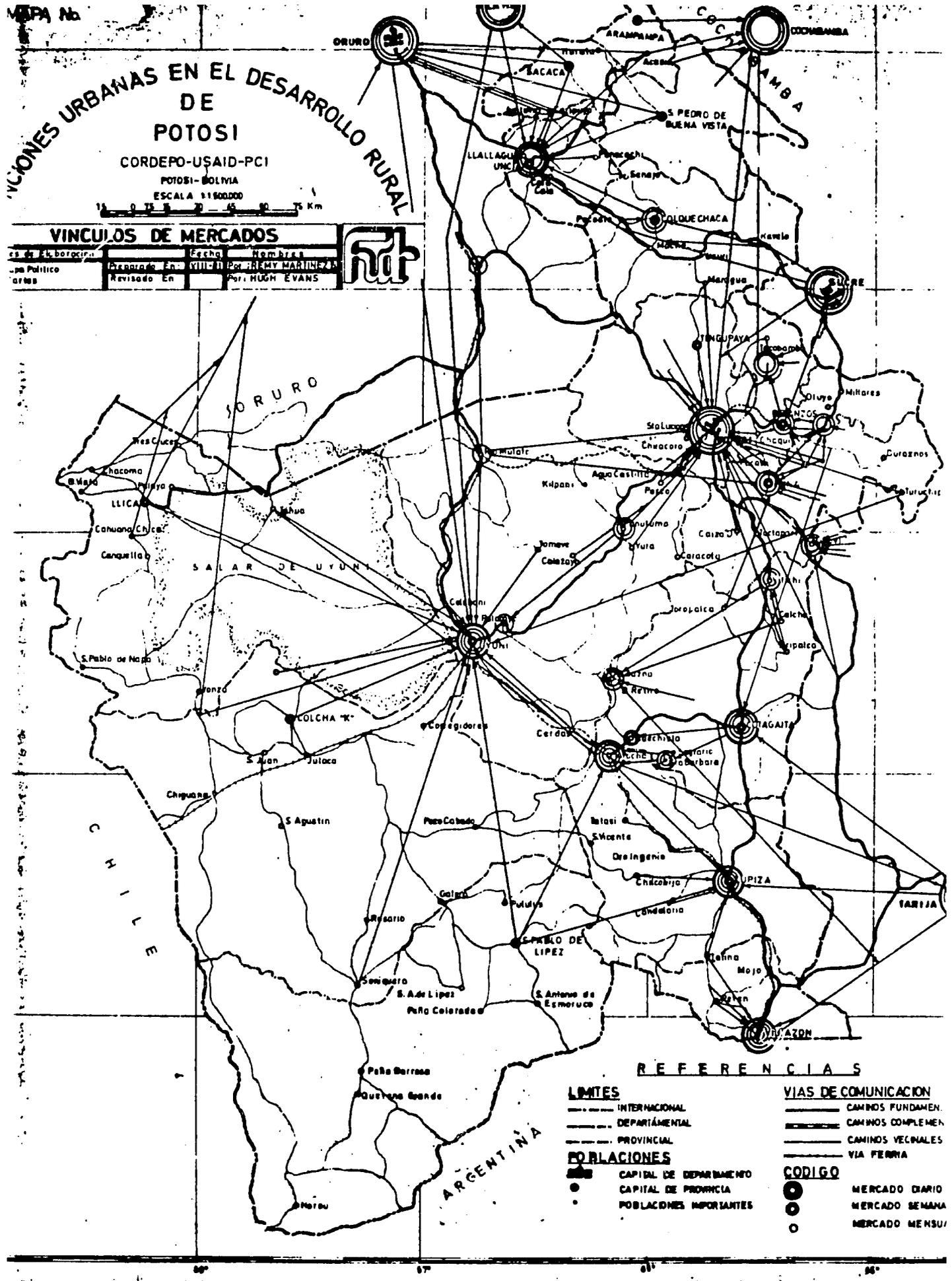
VICIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI
POTOSI-BOLIVIA
ESCALA 1:150,000



VINCULOS DE MERCADOS

Elaborado En: VIII/71	Por: JEMY MARTINEZ
Revisado En:	Por: HUGH EVANS



REFERENCIAS

LIMTES

- INTERNACIONAL
- DEPARTAMENTAL
- PROVINCIAL

POBLACIONES

- CAPITAL DE DEPARTAMENTO
- CAPITAL DE PROVINCIA
- POBLACIONES IMPORTANTES

VIAS DE COMUNICACION

- CAMINOS FUNDAMEN.
- CAMINOS COMPLEMEN.
- CAMINOS VECNALES
- VIA FERREA

CODIGO

- MERCADO DIARIO
- MERCADO SEMANA
- MERCADO MENSU

Map 4.2 MARKET LINKAGES

4. Analysis of Linkages

The two markets in Uyuni are the only ones throughout the whole of the western half of the Department. This is partly because few people live there, and partly because farming is restricted to stock-raising, which depends less on daily or weekly markets. Their area of influence is thus far larger than others, extending up to the frontier with Chile. Residents of Daniel Campos, however, also tend to use Oruro, especially during the rainy season when the Uyuni salt flats become impassable.

In the north, the various markets in the populous mining area of Llallagua/Uncia/Siglo XX exert their influence throughout the province of Bustillos, and most of Ibanez and Chayanta. There is also a weekly market in Colquechaca, another mining town, which serves at the same time as a wholesale outlet for producers in the province of Chayanta. However, in the provinces of Bilbao and Charcas in the far north, there is no marketplace at all, despite the fact that it is an area of considerable agricultural potential. This, coupled with the lack of roads in the area, creates a serious disincentive for local farmers. Information from the survey of households in this part of the region showed that visits to market occurred much less frequently than elsewhere. However, as in other northern provinces, when people do go to market, they tend to use those outside the Department of Potosi, such as Challapata and Oruro to the west, and Tarata, Capinota, Cliza and Cochabamba to the north.

An analysis of the linkages associated with other business and commercial activities reveals an interesting pattern. (See map 4.3.) Even though smaller towns may possess a few of these functions - such as banks, savings and loan associations, hotels, pharmacies, and stores for domestic appliances, furniture and hardware - it is only the larger towns that possess several of them. And it is only the larger towns that are visited by rural inhabitants even though they could find some of these amenities closer at hand. Evidently, once they decide to make a trip for shopping purposes, rural residents prefer to travel further if necessary, so that they can accomplish all their errands in one visit. Thus, the urban area of Llallagua/Uncia/Siglo XX, together with the city of Potosi, and especially Uyuni, have large service areas for these functions, while Tupiza and Villazon share the south with Atocha, which provides for the surrounding mining communities.

This suggests that a certain threshold or minimum range of such functions is necessary before a town becomes fully operational as a service center for

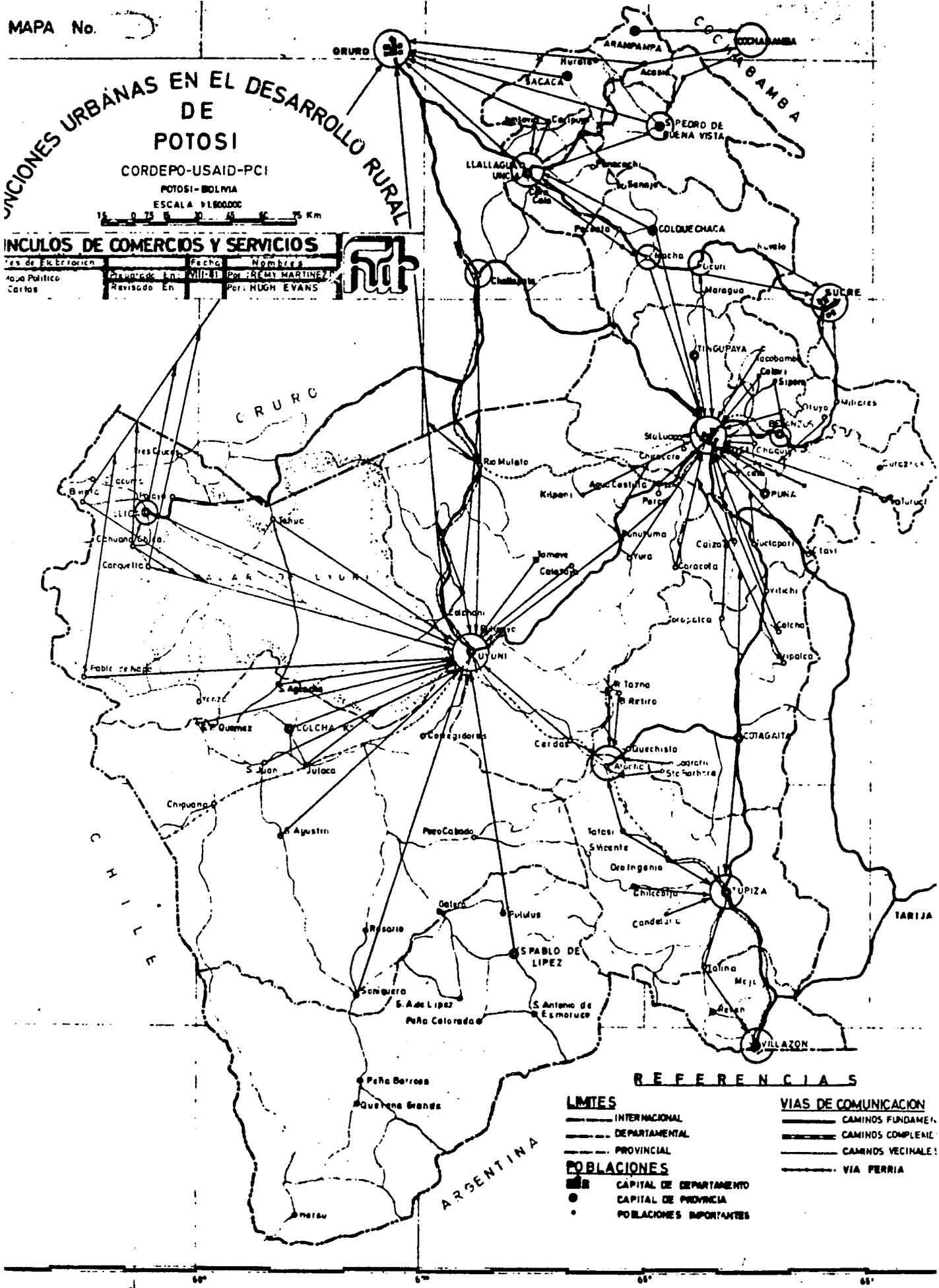
CONEXIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI
POTOSI-BOLIVIA
ESCALA 1:180,000

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INCULCOS DE COMERCIOS Y SERVICIOS

Proyecto de Ejecución	Fecha	Por
Elaborado En	Revisado En	Por
Mapa Político	Mapa Político	REMY MARTINEZ
Cartas	Cartas	HUGH EVANS



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| — PROVINCIAL | — CAMINOS VICINALES |
| POBLACIONES | — VIA FERREA |
| ● CAPITAL DE DEPARTAMENTO | |
| ● CAPITAL DE PROVINCIA | |
| ● POBLACIONES IMPORTANTES | |

Map 4.3 COMMERCIAL LINKAGES

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4. Analysis of Linkages

business and commerce. The linkage analysis indicates that Atocha and perhaps Betanzos have reached this point, and both these towns are at the top of the third tier of the urban hierarchy. Smaller towns possessing just a few of these functions do not appear to attract significant trade. At the same time the absence of many of these functions in intermediate level towns reflects insufficient demand, due partly to the low income level of most of the population, but also to the poor connections between these settlements and their hinterlands. Significantly, both Atocha and Betanzos are among the few that are better connected to surrounding communities.

Service Linkages.

Service linkages include those related to health and education facilities. In the case of education, it was decided to look only at high schools, training centers and technical institutes. Junior and junior-high schools were omitted because many of them are situated in rural areas, and information about them was not collected in the survey of urban centers. Although these schools are distributed all over the Department, it is still not uncommon to find children having to make long journeys of two hours or more each way. However, the main problem is not physical access - buildings abound - but the provision of adequately trained teachers, and appropriate materials and equipment.

This problem is no less severe at the high school level. (See map 4.4.) Although they are to be found in all the larger towns and several smaller places, the latter rarely offer a complete curriculum, more usually just the first few years. A complete high school education is usually offered only in the bigger cities, which means that children from rural areas have to move away from home. In such cases, a child may go to the nearest town with a full curriculum high school, or equally likely to a town where the school is known to be good, or where the family has relatives who can provide accommodation. Hence those cities with better schools, such as Potosi, Llallagua, Uyuni and Tupiza, attract children from a large surrounding area, and sometimes beyond.

In Bolivia, the training of teachers for country schools is conducted separately from those who plan to teach in city schools. In Potosi, training institutes for country school teachers are located in four places; Llica, which is a third tier settlement; and Caiza D, Chayanta and Sacaca, all fourth tier places. Students attending those institutes come mainly from surrounding villages, but as might be expected, given the nature of the establishment,

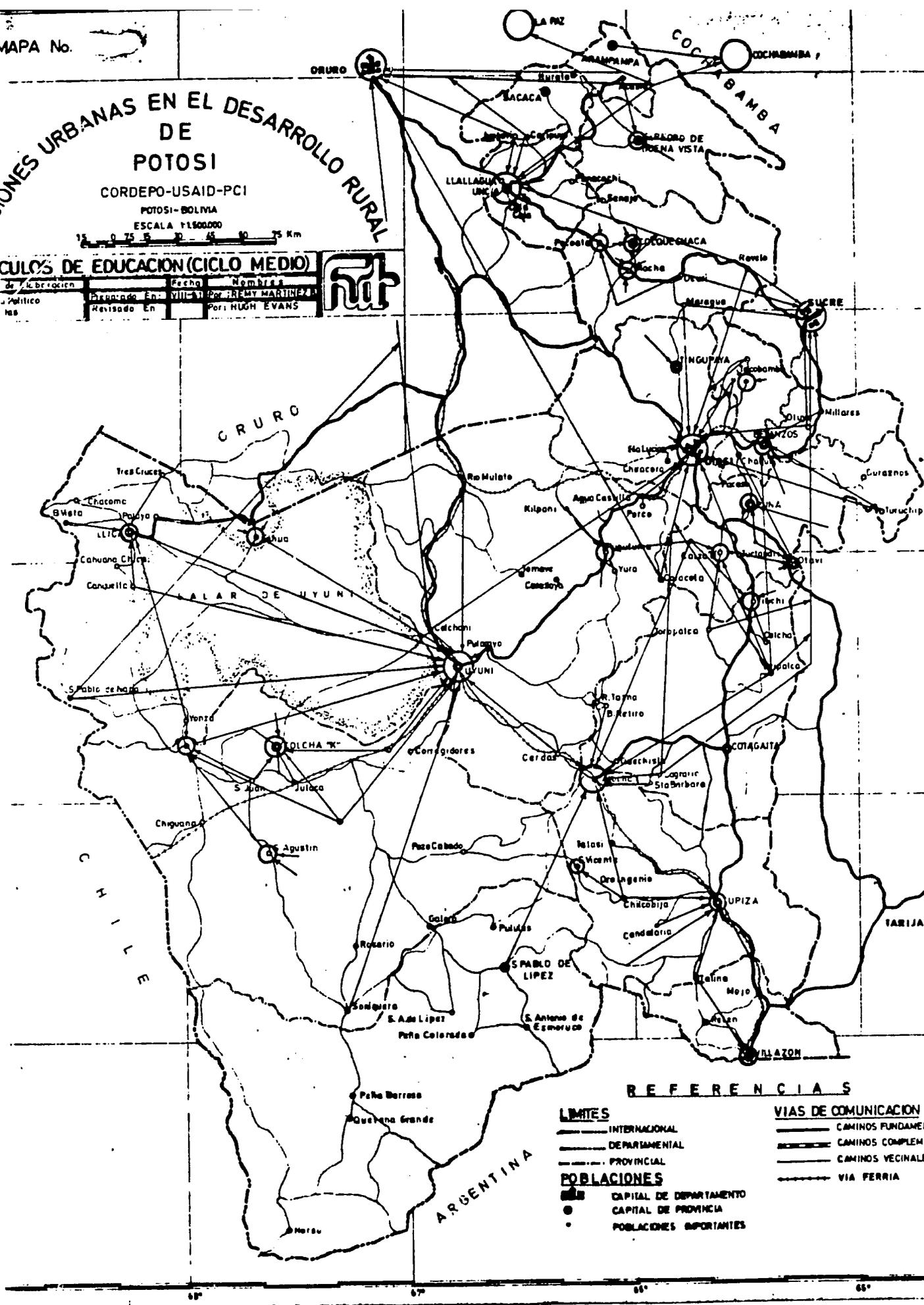
UNIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI
POTOSI-BOLIVIA
ESCALA 1:150,000

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CULOS DE EDUCACION (CICLO MEDIO)

de Aprobacion	Elaborado En	Fecha	Nombres
Político	Revisado En	VIII-51	Por: JEREMY MARTINEZ
			Por: HUGH EVANS



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| — DEPARTAMENTAL | — CAMINOS COMPLETOS |
| — PROVINCIAL | — CAMINOS VECINALES |
| POBLACIONES | — VIA FERRIA |
| ● CAPITAL DE DEPARTAMENTO | |
| ● CAPITAL DE PROVINCIA | |
| ● POBLACIONES IMPORTANTES | |

4. Analysis of Linkages

they also come from all over the Department and even further afield. There are few centers for training skilled laborers, and only two for farmers - one in Puna, the other in Ocuri - serving mainly those from within the province. Other centers which aim to train mothers in health and nutrition care are to be found in many places, catering chiefly to the local community.

In the case of both education and health facilities, it can be observed that the more specialised the establishment, the more dispersed and farflung are the linkages. Thus, the university of Tomas Frias in the city of Potosi serves students from throughout the country. Conversely, patients in need of specialised medical treatment must go to La Paz, Cochabamba, Sucre or Santa Cruz. General hospitals on the other hand are located in all the large towns, serving an extensive surrounding area, while health centers, consisting of a group of three or more doctors, are found in all large and intermediate towns, and some of the lower level settlements including most sizable mining communities. Where these are not restricted to company employees, their service area extends roughly to the size of the province. Doctors' and nurses' clinics are scattered liberally all over the Department, intended to serve the local community, although as was mentioned before, few of them are functioning effectively for lack of staff, equipment or supplies.

Energy and Communication Linkages.

The national grid for electricity extends into the Department of Potosi, and includes all the large towns, most of the intermediate level settlements, and many of the sizable mining centers. However, the majority of smaller settlements still depend on diesel plants to generate electrical energy, at least where there is road access for delivering fuel; otherwise they do without.

A micro-wave long distance telephone network connects the city of Potosi, Uyuni, Tupiza, and Villazon, with major cities in the rest of the country, and these towns together with Llallagua and several other mining centers also have local telephone service, although in some cases this is restricted to company use. A branch of the national post office offers radio-communication between many of the large and middle-sized towns. Otherwise most communities, especially the smaller ones, have to rely on an antiquated telegraph system. Postal service reaches many settlements, but by no means all.

Governmental Linkages.

The functions of government, are distributed more or less according to the political divisions of the Department. The Prefect resides in the capital of the Department, Sub-prefects are to be found in the capitals of each province, and magistrates and registrars - often the same person - in the main town or village of each canton. Most towns of any importance have a mayor and a branch of the police force. The linkages in this case are quite straightforward, since residents of any particular community refer first to the local office, before dealing if necessary with higher level functionaries in the provincial or ultimately the Departmental capital.

Conclusions.

The main picture to emerge from this analysis is that the Department is composed of four distinct sub-systems, centred on Llallagua/Uncia in the north, the city of Potosi in the middle, Uyuni in the west, and Tupiza in the south. This is consistent with the findings of the scalogram analysis, with the exception of the fifth second-tier town, Villazon, which is here shown to be less important as a service center for the surrounding population due to the proximity of the more conveniently located town of Tupiza.

As may be expected, given the severe physical terrain of the region, the one factor that influences more than any other the intensity and direction of linkages between places is the road system. The interactions between towns lying along the main highways are clearly more intense, while those areas of the Department with poor road connections to the city of Potosi, or other second tier settlements, are likely to rely more on regional centers outside the Department: the northwest on Oruro, the northeast on Cochabamba and Sucre.

Another feature which emerges from this analysis is that despite poor roads, limited public transport and widespread reliance on llamas and mules for transporting goods, people travel enormous distances. This is due to some extent to the absence of facilities in nearby towns, especially agricultural supply stores for example, but also to the inadequate or unreliable provision of services in many instances, especially among schools and health facilities. People evidently prefer to travel further if they can be more certain of better service.

4. Analysis of Linkages

Footnotes for chapter IV.

1. See Walter B. Stohr, "Some Hypotheses on the Role of Secondary Growth Centers as Agents of Change for the Spatial Transmission of Development in Newly Developing Countries - The Case of Latin America", in F. Helleiner and W. Stohr, (eds) *Proceedings of the Commission on Regional Aspects of Development of the International Geographical Union*, Vol. II (IGU, Ontario, 1974), pp 75-111; R.P.Misra and K.V.Sundaram, "Growth Foci as Instruments of Modernization in India", in A. Kuklinski (ed) *Regional Policies in Nigeria, India and Brazil*, (Mouton, The Hague, 1978), p 97-204; and Dennis A. Rondinelli, "Regional Disparities and Investment Allocation Policies in the Philippines: Spatial Dimensions of Poverty in a Developing Country", *Canadian Journal of Development Studies*, Vol. I, No. 2 (Fall 1980), pp 262-287.
2. See chapter I.

CHAPTER V. THE ACCESSIBILITY MODEL

The linkage analysis, described in the previous chapter, provides a first approximation of the level of interaction between the larger towns and their hinterlands, and sketches out the area of influence of each settlement. However, many of the links revealed in the analysis represent long journeys in terms of time or distance, which imply inadequate service for residents of more remote locations. A visit to the doctor requiring several hours means sick people will not receive proper medical attention; distant markets reduce incentives for farmers; and faraway stores for agricultural supplies impede the application of improved inputs and new production techniques.

In an attempt to define with greater precision the effective service area of a town, a new step in the UFRD methodology was introduced in the Potosi study. This took the form of an accessibility model, designed to measure the level of access of the population in different zones of the region to specific urban functions. The model can also be used to evaluate alternative solutions for improving physical access, for example by building facilities in new locations versus upgrading roads to existing ones, thus reducing the time involved in travelling there.

In this chapter we will first explain the model briefly, and the data required to construct it; then we will discuss the travel patterns that were discerned from the survey of households, described in chapter I; and finally we will present the results of the accessibility study.

The Model¹.

The accessibility model is constructed in three stages. First, a factor is estimated to represent the level of access for an individual resident of each zone to a range of functions. This makes it possible to delimit the effective service area of each function located in a particular town. Second, total individual access is computed as the weighted sum of access to each function. This information can be used together with the results of other studies to approximate the effective area of influence of the larger settlements, and hence to delineate the existing functional economic areas of the region. Third, total accessibility in a zone is calculated by taking into account the population of that zone, and the change in total accessibility may be used as a criterion for evaluating alternative proposals for improving access.

5. The Accessibility Model

Conceptually, the first factor representing the level of individual access is measured in terms of the convenience of travelling to a given function, or type of facility, such as a grocery store, market, or hospital. This is high in a zone where there are many establishments of that function within easy reach, and declines as the number of establishments falls, and the journey time increases. Expressed mathematically, individual access in zone i to the function j , is:

$$A_{ij} = \sum_{k=1}^n (N_{kj}/T_{ik}) \quad (\text{Eq. 1})$$

where N_{kj} = the number of establishments of function j in zone k ;

and T_{ik} = the travel time from zone i to zone k .

In calculating total individual access it is assumed that some functions, for example markets, are more important in the daily life of local residents than others, say a magistrate's office. To represent its relative importance, each function is assigned a weight based on observed travel patterns, reflecting the average number of visits, the average travel time, and the proportion of the population that normally uses that function. Thus, total individual access in zone i for all m functions being taken into account is:

$$A_i = \sum_{j=1}^m (A_{ij} \times W_j) \quad (\text{Eq. 2})$$

where W_j = the weight assigned to function j ;

$$= \bar{N}_j \times T_j \times P_j \quad (\text{Eq. 3})$$

and \bar{N}_j = average number of visits by a household in time t , to the function j ;

T_j = average travel time to function j ;

P_j = proportion of the population that uses function j ;

Finally, to arrive at the total accessibility in the zone, $A(P)_i$, the total individual level of access is multiplied by the population of the zone. Thus:

$$A(P)_i = A_i \times P_i \quad \therefore \sum_{j=1}^m A_{ij} \times W_j \times P_i \quad (\text{Eq. 4})$$

The construction of the model requires a fair amount of data. This includes, for each zone, the population of the rural area and each settlement; an estimate of the average speed and distance of road links; and the number of establishments of some twenty-five functions. In addition, information is needed on travel patterns in order to estimate the weights for each function.

In Potosi, much of this data was culled from existing sources, some came from the survey of urban centers, and the statistics on the frequency of visits and journey times were derived from the household survey described in chapter I.

Travel Patterns.

In the course of collecting data on travel patterns, a number of problems were encountered that affected the quality of the data. First, the confusing format of the questionnaire coupled with the lack of close supervision in the field, led to errors in recording the frequency of visits. Second, it was found that estimates of the distance and time of journeys, particularly longer ones, varied widely, and people's recall of the number of trips made was often unreliable, unless the interviewer remembered to phrase the question specifically in terms of the number of trips made during the last week, month or year. Third, the random selection of households included several located in remote places, where it was found that families visited few or no functions at all. In order to ensure sufficient observations for analysis, it was decided to replace these households with others less distant, where people were more likely to travel. However, this obviously distorted the randomness of the original selection.

Nevertheless, data were collected for twenty-four functions including health and education facilities, several kinds of shops and stores, government offices, and services for mining and agriculture. To calculate the average number of visits to each function, data were handled in three ways, depending on the kind of function. In the case of schools and health facilities, where the visit is clearly for the exclusive purpose of one individual, averages were based on observations for individual members of the household. For other kinds of functions, such as farm supply stores, processing plants, pharmacies, fuel stores, the post office or government offices, where the visit is for the benefit of the family as a whole, or the household as a production unit, averages were based on the total number of visits made by the household as a whole. In some cases, however, such as markets, clothing and grocery stores, where this procedure tends to exaggerate or double count the number of trips, averages were based on the total number of visits made by the household divided by the number of people who made them.

Not surprisingly, it emerges from this survey that schools are the function

5. The Accessibility Model

visited most often - informants almost invariably claimed that their children never missed a day during school term - at an average journey time of around fifteen minutes for junior schools and high schools, a little more for junior-high schools. (See table 5.1.) Nevertheless, what seems like a short average journey disguises many instances of children in rural areas spending up to an hour and a half or two hours on the journeys to school and home again.

Next most frequent are visits to the grocery store - in most cases little more than a small family shop selling the bare necessities - once or twice a week with an average travel time of half an hour; to markets, nearly three times a month with a mean journey time of two hours; and to stores selling cooking and heating fuel, twice a month at about an hour and twenty-five minutes. People seldom visit the doctor or hospital, only two or three times a year, no doubt in part because they cannot afford it, but also because of the scarcity of proper service. Pharmacies are also few and far between, but used a little more often. Farm-related services and amenities are among the least frequently visited functions, only once or twice a year, but have the longest mean travel times - between four and five hours - again reflecting the fact that they are to be found in only a handful of places in the entire Department.

Using this data on observed travel patterns, weights were calculated for each of the twenty-four functions, to represent their relative utility in the daily life of the residents of Potosi. As was explained before, these weights are the product of the average number of visits per year, the average journey time, and the proportion of the population using a given facility. Based on the method adopted here, it emerges that the most important function is the market, followed by the grocery store, the fuel store, the pharmacy, junior and junior-high schools, and post offices. By this reckoning, health facilities and agricultural supply stores appear among the least important functions, due mainly to the small number of visits. However, it should be borne in mind that this reflects current usage patterns due to the existing scarcity of such establishments, and is probably an inaccurate estimate of their inherent utility.

The same data were used to examine the distance-decay relationship for each function, reflecting the drop-off in the number of visits as the length of journey increases. A slow decline in this relationship means of course that

TABLE 5.1: FUNCTION WEIGHTS FOR THE ACCESSIBILITY MODEL

Function	Number of observations	N_j	T_j	P_j	Weight
Market	179	32	2.15	1.00	68.8
Grocery store	100	73	0.54	1.00	39.4
Cooking and heating fuel store	151	24	1.39	1.00	33.4
Radiocommunication and t'phones	17	15	1.33	1.00	(20.0)
Pharmacy	141	5	2.03	1.00	10.1
Junior school	159	200	0.27	0.16	8.6
Banks	11	12	1.34	0.49	(7.9)
Junior-high school	82	196	0.29	0.13	7.4
Post and telegraph office	94	10	0.73	1.00	7.3
Mineral processing plant	6	44	1.22	0.13	(7.0)
Shoe and clothing store	180	2	3.04	1.00	6.1
Silo or farm produce storage	3	2	4.40	0.60	(5.3)
Mining Bank depository	8	12	3.24	0.13	(5.1)
High school	43	200	0.25	0.10	5.0
Training center	6	200	0.30	0.08	(4.8)
Hospital or health center	224	3	1.56	1.00	4.7
Domestic appliance store	103	1	3.80	1.00	3.8
Farm produce processing plant	48	3	1.95	0.60	3.5
Hardware store	65	1	3.32	1.00	3.3
Farm tools and equipment store	60	1	4.85	0.60	2.9
Seeds and fertilizer store	51	1	4.61	0.60	2.8
Prefect/mayor/civil registrar	133	2	1.03	1.00	2.1
Doctor's clinic or nurse's post	146	2	0.92	1.00	1.8
Police station or magistrate	84	4	0.35	1.00	1.4

N_j = average number of visits per year to function j

T_j = average time in hours of journeys to function j

P_j = proportion of the population that normally uses the function j

Weighting factor $W_j = N_j \times T_j \times P_j$

Figures in (parentheses) should be interpreted cautiously due to the limited number of observations.

Source: CORDEPO, *Funciones Urbanas en el Desarrollo Rural: Resultados del Estudio en Potosi*, Vol. 2, CORDEPO, Potosi, 1981.

5. The Accessibility Model

the length of the journey deters people less from visiting that function. Observations were plotted on a graph with number of visits and length of journey as the two axes. This information is summarised in table 5.2 which shows the cumulative percentage of visits over time for ten widely used functions.

As may be seen, the distance-decay relationship declines most rapidly in the case of grocery stores, where 83% of visits are within 15 minutes, followed by high schools where 70% of trips are within the same interval. Next come post offices and doctor's clinics for which over 70% of trips are less than half-an-hour. The fall-off is slower in the case of fuel stores, pharmacies, hospitals and markets, which reach the seventieth percentile after two hours, and slowest of all for farm supplies, which reach that level only after five hours.

This confirms the impression gained from the linkage analysis that, instead of visiting a doctor's clinic nearby, people tend to travel to a hospital further away, presumably in the hope of receiving better treatment. The persistence of farmers in visiting the few agricultural supply stores, even though they are so far away, also suggests there may be a large pent-up demand for such facilities.

Accessibility in the Region.

For the purposes of modelling the Potosi region, the Department was divided into ninety-six zones, each composed of one or more cantons, while Chile, Argentina, and the four Departments of Tarija, Chuquisaca, Cochabamba and Oruro, which together surround Potosi, were treated as six external zones. Internal zones were drawn roughly the same size, and defined in terms of adjacent communities sharing the same roads, though given the vagaries of cantonal limits, particularly in the sparsely populated western provinces, this was not always possible. (See map 5.1.)

All zones, both internal and external, were assigned a centroid. This was usually the largest population center in the zone, or in rural areas without an obvious center, some centrally located road junction. The centroids of the external zones were Calama in Chile, Jujuy in Argentina, and the Departmental capitals. To simplify matters, several assumptions were made: all establishments in a zone are located in its centroid; all journeys thus terminate in a

TABLE 5.2: CUMULATIVE PERCENTAGES OF VISITS TO SELECTED FUNCTIONS BY TRAVEL TIME

Travel time		U	R	B	A	N	F	U	N	C	T	I	O	N	S	hospital	farm equip't
H M		high school	post office	doctor's clinic	farm supplies	grocery store	pharmacy	cooking fuel	market	hospital	farm equip't	market	hospital	farm equip't	market	hospital	farm equip't
0	15	70.0	52.5	62.7		83.0	35.0	48.0	35.3	56.0	5.0						
0	30	97.5	72.5	71.1	25.0	84.4	43.0	59.3	46.3	63.8	10.0						
0	45		75.5						47.8								
1	00		78.5	73.1	30.5	88.4	55.0	63.3	55.7	65.8	13.0						
1	30	100.0	82.8	76.5	35.5	92.4	65.0	70.1	64.5	69.8	20.0						
2	00		92.8	81.5	43.5	94.0	74.0	83.1	74.2	74.8	41.0						
3	00		98.1	94.9	58.5	96.8	85.0	90.1	83.8	86.4	60.0						
4	00		98.3	98.9	65.5	98.0	89.3	95.1	89.7	89.4	66.0						
5	00		98.7		67.0	98.6	91.6	95.4	90.4	93.4	69.0						
6	00										75.0						
7	00				80.5		94.3		94.6	97.8	83.0						
8	00		100.0		85.0		96.3	97.3	96.6		88.0						
9	00			100.0	90.0												
10	00																
12	00						97.5	99.1									
16	00				100.0												
20	00					100.0	100.0	100.0									
24	00								100.0	100.0							
48	00													100.0	100.0		100.0

Source: CORDEPO, *Funciones Urbanas en el Desarrollo Rural: Resultados del Estudio en Potosi*, Vol. 1, CORDEPO, Potosi, 1981.

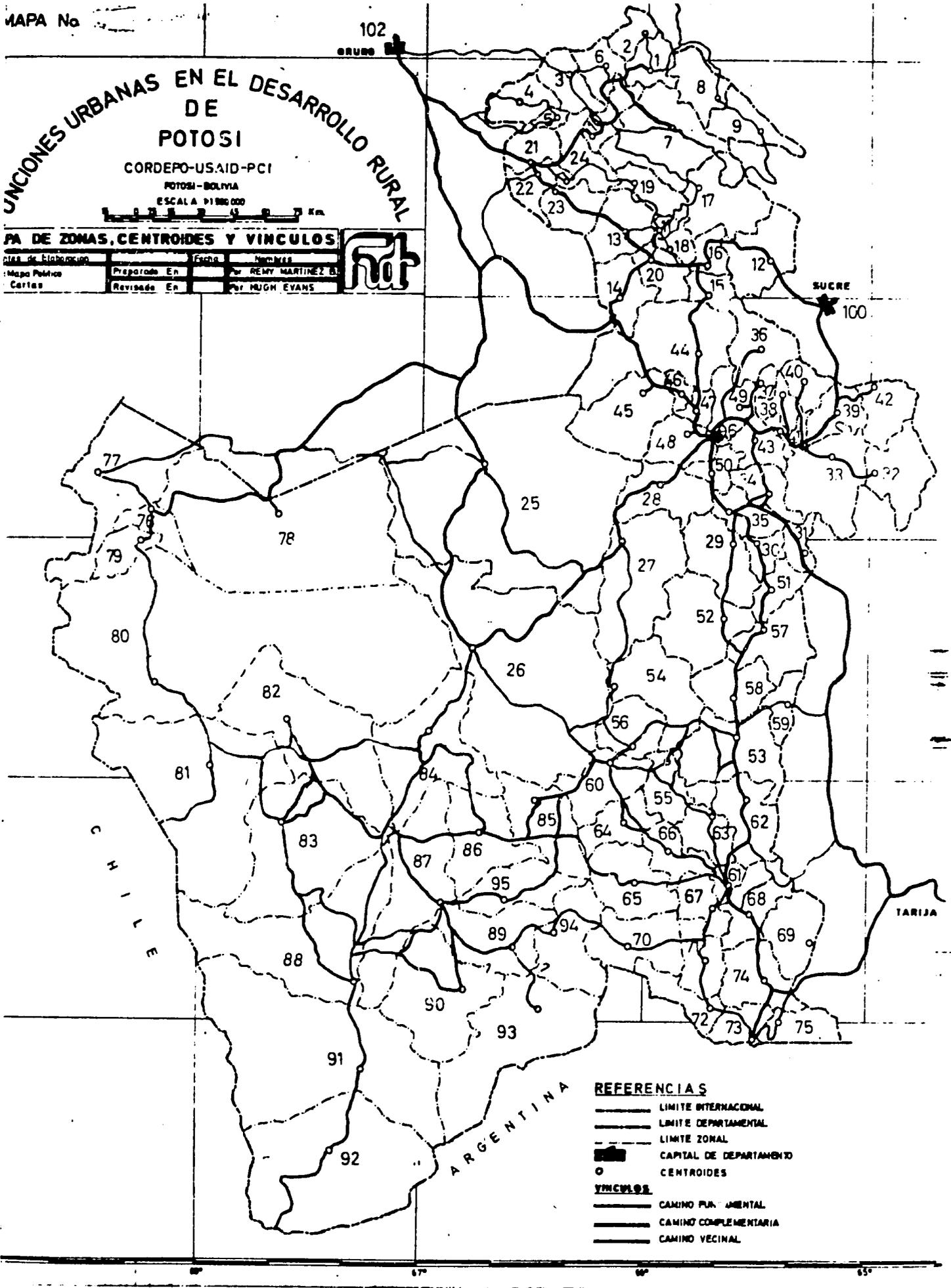
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5. The Accessibility Model

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MAPA DE ZONAS, CENTROIDES Y VINCULOS

Clase de Elaboracion	Fecha	Nombre
Mapa Político	Preparado En	Por REMY MARTINEZ B.
Cartas	Revisado En	Por MUGH EVANS



REFERENCIAS

- LIMITE INTERNACIONAL
 - LIMITE DEPARTAMENTAL
 - LIMITE ZONAL
 - CAPITAL DE DEPARTAMENTO
 - CENTROIDES
- VINCULOS**
- CAMINO PRINCIPAL
 - CAMINO COMPLEMENTARIA
 - CAMINO VECINAL

Map 5.1 ZONES, CENTROIDS, AND ROAD LINKS

centroid; and any journey that does not begin in a centroid passes through it before leaving the zone of origin. Information on the number of establishments of each function in each internal zone was derived from the survey of urban centers; for the centroids of external zones, the numbers were extrapolated in proportion to their populations based on the figures for the larger towns in the Department of Potosi.

A network of road and footpath links was then identified which connected these centroids. The distance of each link was calculated, and depending on its condition it was assigned a travelling speed of 4, 15, 25, 40, or exceptionally 70 kph to represent a journey on foot, by bus, or by truck. To reduce the number of computations, the region was divided into four sub-regions, and a matrix was then prepared indicating the links from one zone to all others in the same sub-region and to the most relevant ones outside. Using the data on distance and speeds, a second matrix was computed indicating the minimum journey times from zone to zone. This information was used to calculate the first stage of the model, levels of individual access to particular functions.

The results for six functions - markets, farm supply stores, food stores, high schools, hospitals and smaller health facilities - are discussed here. Since levels of access vary widely, usually with a few places having good access and most having poor access, zones have been classified in five categories on a geometric scale to differentiate more clearly among the zones at the lower end of the scale. Leaving aside the city of Potosi, which invariably registers the highest levels of access for all functions, this scale ranges from 0% to 100% of the observed maximum with intervals occurring at 8%, 20%, and 50%.

Occasionally a zone is shown to have a level of access of zero. This signifies that there are no establishments of that particular function within the maximum travel time observed in the household survey. To illustrate this with an example, it was found that people did not spend more than three hours and forty minutes travelling to a doctor's clinic. Thus any zone beyond this distance from a clinic was regarded as having zero access to that function.

It was mentioned before that there are in the region very few stores supplying inputs for farmers, for example seeds, fertilizers, tools and equipment. This shows up clearly in map 5.2, from which it can be seen that only a few areas have relatively good access, those being the ones within easy reach of Villa-

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DE
POTOSI

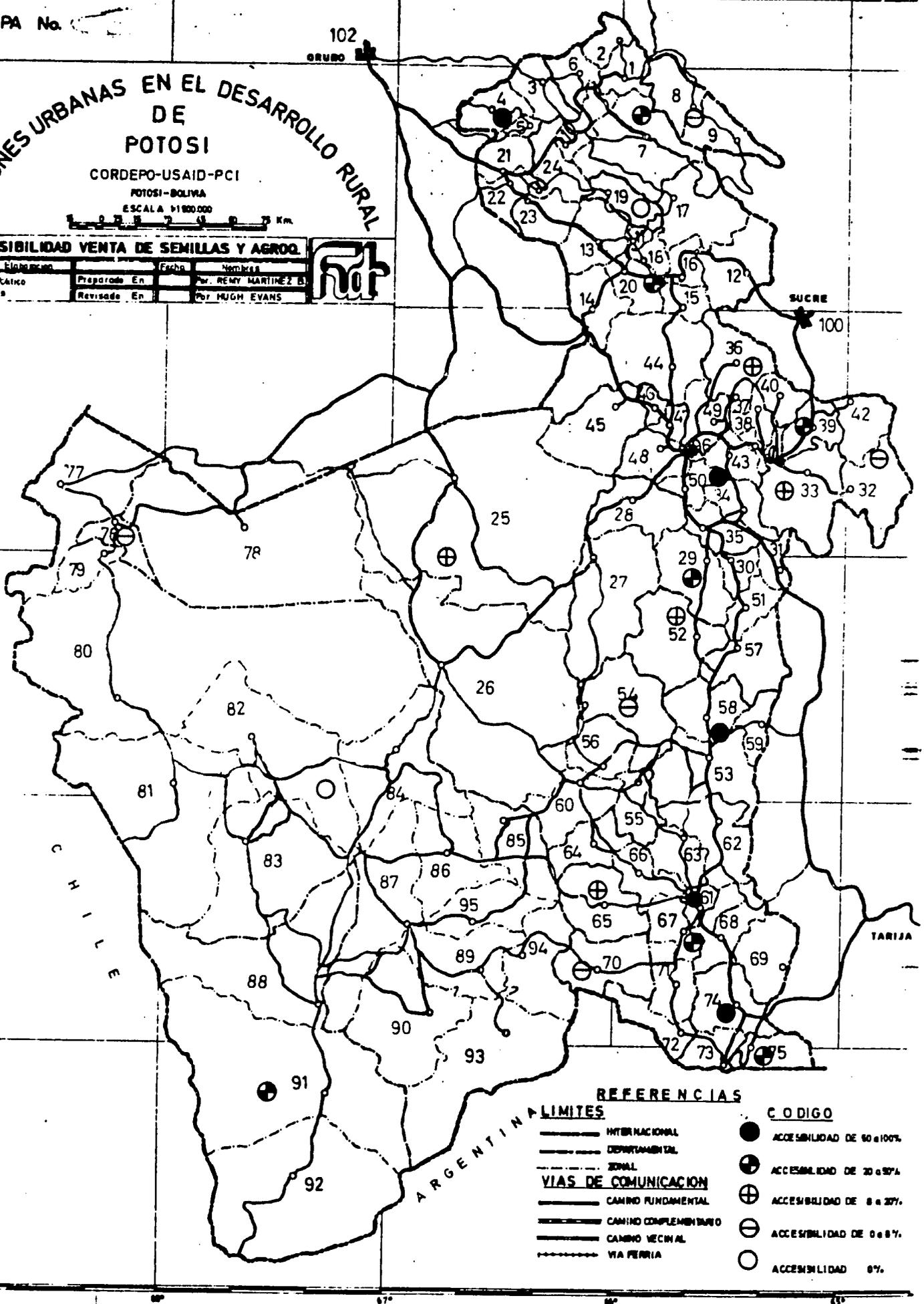
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POTOSI-BOLIVIA

ESCALA 1:100,000

0 1 2 3 4 5 Km

ACCESIBILIDAD VENTA DE SEMILLAS Y AGROQ.

Mapa de Clasificación	Preparado En	Fecha	Nombre
Mapa Plástico			Dr. Remy Martínez B.
Cartas	Revisado En		Por: HUGH EVANS



REFERENCIAS

LIMITES

———— INTERNACIONAL

———— DEPARTAMENTAL

———— ZONAL

VIAS DE COMUNICACION

———— CAMINO FUNDAMENTAL

———— CAMINO COMPLEMENTARIO

———— CAMINO VECINAL

———— VIA FERREA

CODIGO

● ACCESIBILIDAD DE 50 a 100%

⊕ ACCESIBILIDAD DE 20 a 50%

⊗ ACCESIBILIDAD DE 8 a 20%

⊖ ACCESIBILIDAD DE 0 a 8%

○ ACCESIBILIDAD 0%

Map 5.2 ACCESSIBILITY TO FARM SUPPLIES

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zon, Tupiza, the city of Potosi, and Llailagua, or in the extreme north-west close to Oruro. Otherwise, access is poor throughout most of the Department, and paradoxically even worse in some of the better agricultural areas in the provinces of Linares, Saavedra, Chayanta and Charcas. The apparent anomaly of slightly better access in the far south-west is due to the proximity of the city of Calama in Chile.

Compared to many other functions, access to markets is relatively good, due to the fact that they are more widely dispersed throughout the region, particularly around the middle and south-east. Thus, most zones adjacent to the main highways leading to these market towns have good or moderately good access. Nevertheless, levels of access in all three western provinces are poor or very poor, and there are many pockets - some quite extensive - among the more fertile agricultural areas in the east where access is also bad, reaching zero in the extreme north-east. The generally low level of access here is due partly to the absence of markets, and partly to the widespread lack of feeder roads to the hinterland. This constitutes one of the most critical bottlenecks impeding increased production in this area.

The picture for food and grocery stores provides a very clear example of the importance of good roads in raising levels of accessibility. This is of course highest as usual in the larger urban centers, but is also consistently good in the zones adjacent to the main all weather highways, with the exception of a few at the southern end of the Potosi-Villazon link. Access in these zones is relatively good, not only because the better roads speed journeys to the adjacent larger towns, but more critically because distributors of manufactured foods and other common household items, can easily reach smaller towns and villages along the route. Nevertheless, outside these narrow corridors - which means by far the largest part of the region - access ranges from poor, through very poor in the western provinces, to zero in some pockets in the central area and in the province of Charcas, invariably due to the absence of towns of any size with such stores.

One of the functions with the worst levels of access is the high school. As was mentioned before, they are to be found in many towns, but quite often only part of the full five year curriculum is offered. Thus, it is really only those zones which possess full curriculum high schools that have adequate access, and these are confined to just the handful of larger urban centers.

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Otherwise, levels of access in the region are almost universally poor. Since children normally walk to school, service areas are small, which means access in a great many zones is zero, especially in the west, the south-east, and much of the provinces of Linares, Saavedra, Chayanta and further north.

The Bolivian public health system distinguishes between four kinds of facilities: hospitals, health centers, doctor's clinics and nurse's stations. In the Potosi study, the first two items were considered separately from the latter two. As the household survey showed, people are prepared to travel further to a hospital or health center, than to a doctor's clinic or nurse's station. The average travel time for the former is a little over an hour and a half compared to under an hour for the latter, with maximum observed travel times of twelve hours on foot versus only two and a half hours. It follows, therefore, that the computation of access levels takes account of hospitals and health centers located some considerable distance from the zone in question, but includes only those smaller health facilities that are nearby. Thus, while accessibility to the first function is by no means high, it is moderately good in several zones where it was not expected to be, such as in the south-west, where residents are within reach of facilities in Calama over the frontier in Chile, and in several parts of Nor Chichas and Quijaro in the vicinity of the mining centers, again reflecting the superior provision of services by COMIBOL, the national mining corporation, and other private concerns.

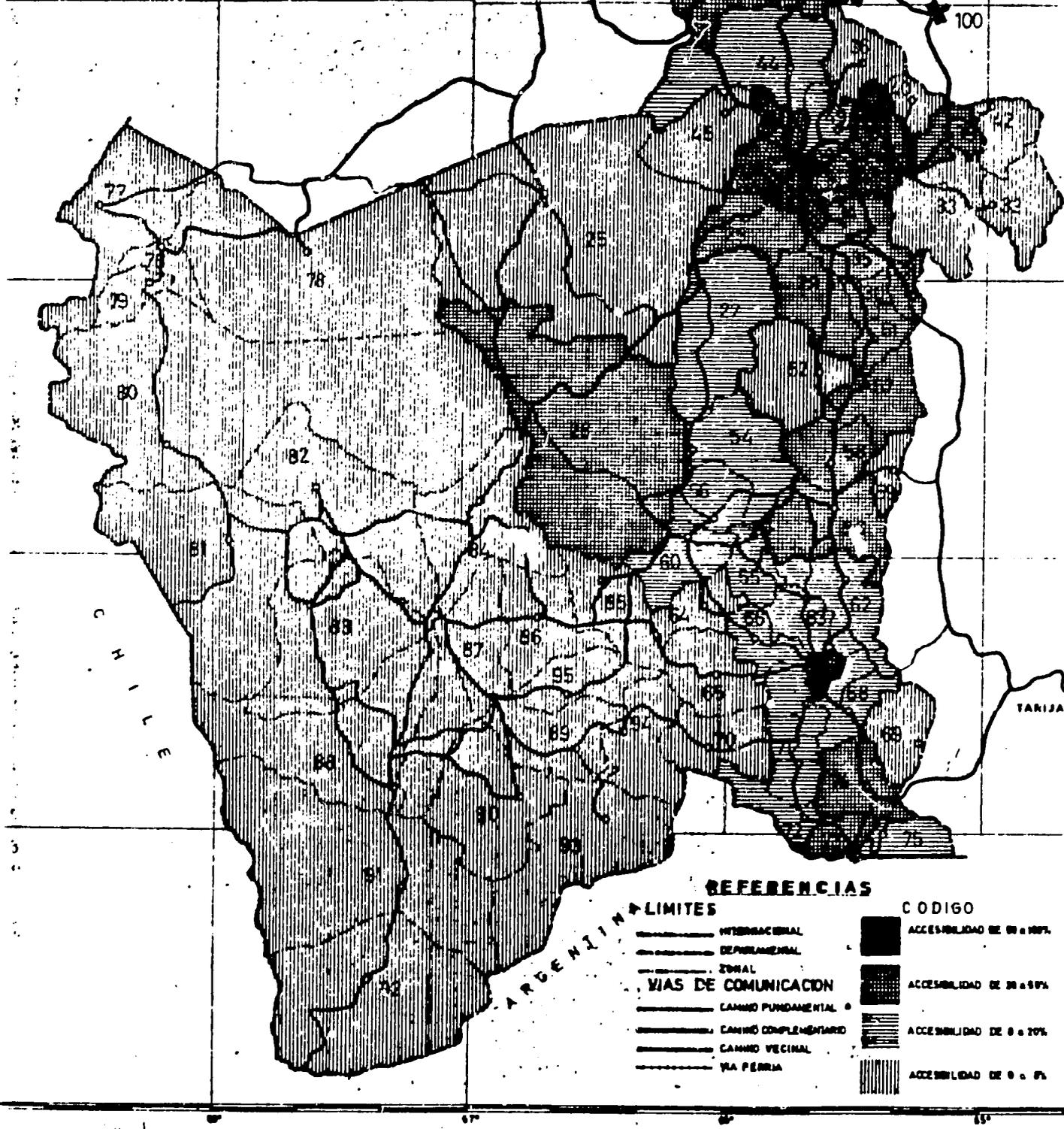
For the second stage of the model, individual access levels to separate functions were aggregated using the weights derived from table 5.1. Map 5.3 illustrates clearly the variation in access levels in different zones of the region, and helps to identify those which are particularly isolated or badly attended.

Two conclusions can be drawn. First, overall accessibility throughout the Potosi region is extremely low: if "effective" service is defined as 50% or more of the levels observed in the main urban areas, then less than 20% of the population is adequately served. Second, the better attended areas with higher levels of access are clearly those lying adjacent to the main roads, not only because they are within close reach of the larger urban centers where many amenities are located, but also because smaller towns lying on the main

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ACCESIBILIDAD TOTAL PER CAPITA

Localidad	Preparado En	Fecha	Revisado En	Por	Nombre
San Pedro de Buena Vista		VI-81			MARTINA ACHIC
Ciudad	Revisado En				MUGH EVANS



REFERENCIAS

LIMITES		CODIGO	
—	INTERNACIONAL	■	ACCESIBILIDAD DE 90 a 100%
—	DEPARTAMENTAL	▣	ACCESIBILIDAD DE 80 a 90%
—	ZONAL	▤	ACCESIBILIDAD DE 70 a 80%
VIAS DE COMUNICACION			
—	CAMINO FUNDAMENTAL	▥	ACCESIBILIDAD DE 60 a 70%
—	CAMINO COMPLEMENTARIO	▧	ACCESIBILIDAD DE 50 a 60%
—	CAMINO VICINAL		
—	VIA PIEDRA		

Map 5.3 TOTAL PER CAPITA ACCESSIBILITY

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routes are likely to be more viable locations for new commercial activities. As roads deteriorate and travel times increase, levels of access fall off sharply, to the point where many areas are virtually beyond the reach of many urban functions, some of them critical to the well-being of the community such as markets, hospitals and high schools. This is especially true in the north-east and much of the west of the Department.

Footnotes to chapter 5.

1. The accessibility model is explained in more detail in John Dickey and Hugh Evans, "Estudio de Accesibilidad: Metodos de Analisis", *Documento de Trabajo*, No. M4, CORDEPO, Potosí, 1981. See also an unpublished paper by John Dickey, "Manual for an Accessibility Model for the Potosí Region Of Bolivia"; 1982.

CHAPTER VI. THE EXISTING SPATIAL STRUCTURE

Earlier steps of the UFRD methodology examined the three main spatial characteristics of the region - the urban hierarchy, the linkages between settlements and the hinterlands, and levels of accessibility. The next step synthesizes the results of the previous analyses in order to draw conclusions about the existing spatial structure of the region and what this implies for planning future development.

As was explained before, the UFRD strategy of integrated regional development is derived from empirical observations that the spatial structure of the region is a major determinant in the diffusion of social and economic development. It is argued that a well articulated spatial system - in which cities, towns, and villages are closely linked and integrated with their surrounding rural areas - facilitates the flow and exchange of people, goods, and services; promotes economic growth; and improves access to education, health care, and other basic necessities of life. Thus, planners need to know which elements of the spatial structure are more or less in place and functioning articulately, and which others are weak or missing.

For this purpose it is helpful to borrow loosely some ideas from central place theory, particularly the notion of a hierarchy of cities, towns and villages, each with its attendant hinterland, or surrounding rural area. (See figure 6.1.) In a region such as Potosi, where many assumptions behind the theory are obviously violated, such as a flat plain and uniform distribution of population and natural resources, the real world situation is unlikely to bear much resemblance to the neat regularity predicted by it. Nevertheless, the concept of a hierarchy of central places and graduated market areas, or functional economic areas, matched against empirical findings, helps to identify spatial and functional "gaps" in the system: areas which lack urban service centers where the model suggests they might be expected; and functions which are absent in settlements where the scalogram analysis suggests they might be found.

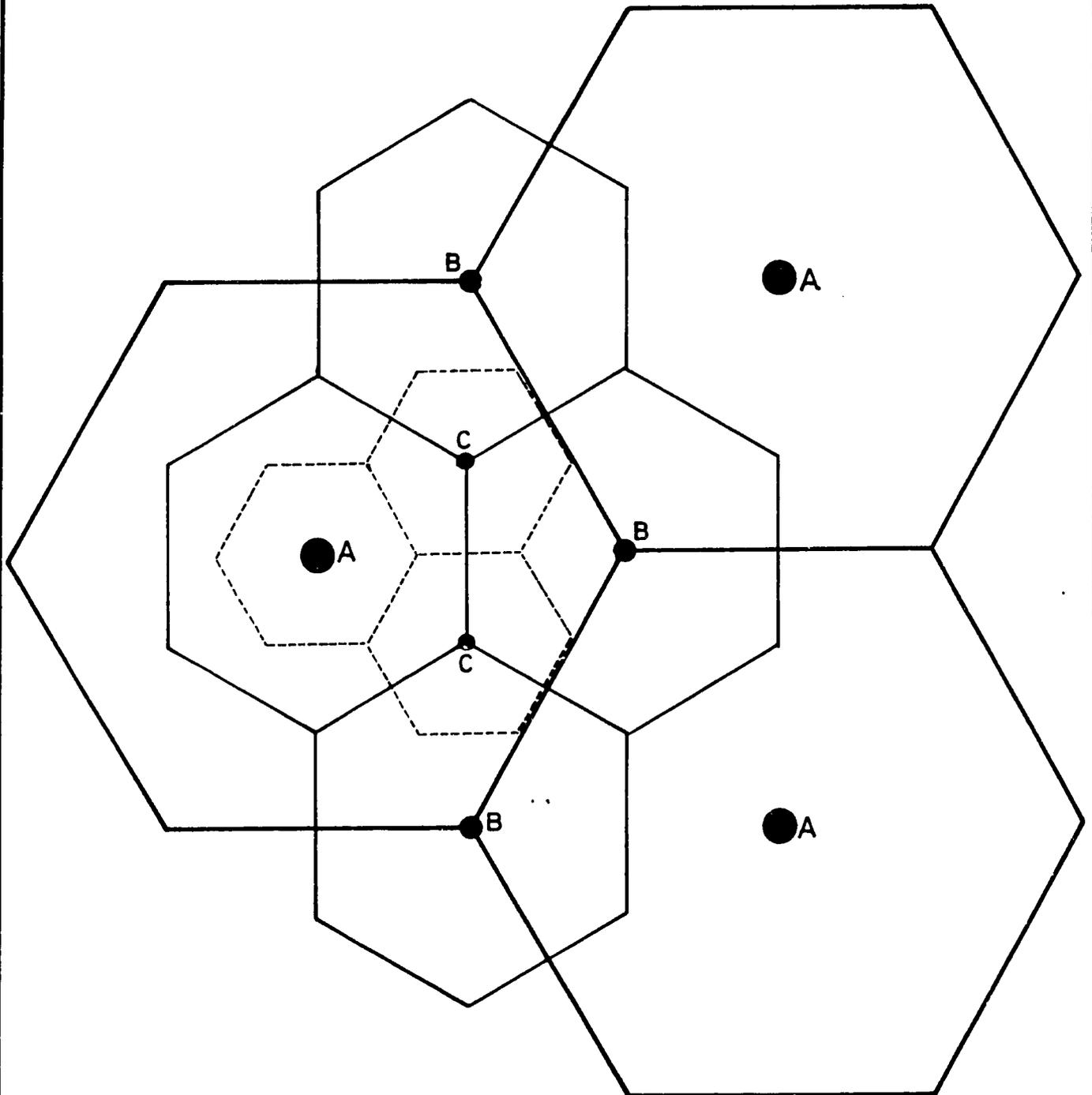
Delineating the Aereal Components of the Region.

The scalogram analysis in step two defined the hierarchy of settlements, and the linkage analysis provided a first approximation of the area of influence of the larger towns. This information, together with the accessibility model,

Fig. 6.1 SCHEMATIC REPRESENTATION OF HIERARCHY OF CENTRAL PLACES

REFERENCIAS

- A=** Centros a nivel I
- B=** Centros a nivel II
- C=** Centros a nivel III
- Límite del área de influencia de centro tipo A
- Límite del área de influencia de centro tipo B
- - - Límite del área de influencia de centro tipo C



6. The Existing Spatial structure

makes it possible to delineate effective market areas, and hence the graduated functional economic areas, associated with settlements at each level of the hierarchy.

The scalogram analysis suggested that the urban hierarchy in the Department of Potosi consists of five tiers of settlements. For the purposes of describing the spatial structure of the region, these were called respectively the regional center, (the city of Potosi), the sub-regional centers, rural centers, local centers, and villages or non-central places. However, before attempting to trace out the areas of influence associated with each kind of center, it was necessary to revise the classification of some of them.

As will be recalled, settlements were classified among other criteria according to groups of functions that were identified as typifying urban centers at each level of the hierarchy. However, as was pointed out before, the use of certain amenities, such as schools, health facilities and stores, is restricted in many mining towns to company employees and their families. For the purposes of delineating the aerial components of the region, these establishments were discounted from consideration, since they could not be regarded as providing service to the surrounding rural population. The settlements concerned were thus re-classified as if they did not possess such facilities. In this fashion, three towns were eliminated from the category of rural centers and treated instead as local centers: Kilpani in the province of Quijarro, Quechisla and Rosario Tazna in Nor Chichas.

Another special case is the town of Villazon on the frontier with Argentina. It clearly possesses the functions characteristic of a second-tier town in the urban hierarchy, and this suggests that it ought to be regarded as a sub-regional center. However, as was indicated by the linkage analysis, Villazon in reality has a limited area of influence as a service center for the surrounding area, and instead plays the role of a frontier trading post and point of departure for prospective emigrants. Most of the population in the southern provinces appear to use the facilities of Tupiza instead, no doubt because it is more conveniently located. Thus, it was decided to treat Tupiza as the principal center of the southern sub-region, and Villazon as a subordinate center.

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Hypothetically, the accessibility model could have been used to determine the market areas corresponding to each level of settlement in the hierarchy. In practice, however, it was used in this way only to delineate the rural areas, since it was decided that these should form the basic aerial planning units for regional development. The delineation of these rural areas was accomplished in the first place by preparing maps showing the effective service areas of rural centers for each of the functions representing third-tier settlements, such as weekly markets, health centers, fuel stores and pharmacies. Next, these maps were superimposed on each other to compare the service areas of different functions located in the same town. While they rarely coincided, the effective market area of the rural center - its functional economic area - was delineated in terms of those zones with effective service to the majority of functions. In ambiguous cases, where residents of a zone have access to establishments in more than one center, the zone was assigned to the market area of that town which provided the larger part of its accessibility.

What constitutes an "effective" service area is of course debatable. In the Potosi study, it was defined as that area which includes only those zones where the level of access is at least 50% of the maximum observed in urban areas outside the city of Potosi. However, there are other definitions that could have been used, based for example on observed use. The information on travel patterns gathered from the survey of households showed not only that the number of visits to a function tends to fall off as the journey time increases, but also that the proportion of families making journeys also declines. It might be, for example, that in the case of pharmacies, 90% of families use such a facility when the travel time is less than half an hour, 75% when the journey is less than one hour, and 50% when it is less than three hours. If "effective" service is defined in terms of observed use, say where at least 50% of families made use of the facility, then the effective area would include only those zones where the journey time is less than three hours.

Clearly, the more numerous the zones in which the region is divided for the accessibility model, the more precisely can such market areas be defined. However, there are limiting factors. Firstly, more zones means more numerous computations, a critical consideration in Potosi, since these were initially

6. The Existing Spatial structure

done manually. Furthermore, given the availability of census data, zones were defined in terms of cantons. Some of these are very large, which tends to mask wide variations in levels of access within a given zone. In a few cases, where topographical features suggested an obvious natural division, only part of the zone was regarded as effectively served, and thus included in a given market area.

Interpreting the Results.

The scalogram suggested that there were five tiers in the urban hierarchy, and it was assumed that with the exception of the bottom tier, each one was matched by a corresponding service area. These were referred to respectively as the region, the sub-regions, the rural areas and the local areas.

(1) **The Region.** For planning purposes the region of Potosi was regarded as synonymous with the political unit of the Department, although as an economic unit many peripheral areas are more closely tied to adjacent regional centers. This is in keeping with the expectations of central place theory, which suggests that lower level market areas in the hierarchy are likely to include segments from two or three adjacent higher level areas. (See figure 6.1.) Thus, the north-west of the Department tends to rely more on Oruro, the north on Cochabamba, and the north-east on Sucre. For some purposes, mainly processing of minerals, mining companies in the south and south-west depend on Calama in Chile, although more general transactions across the frontier are of course curtailed by the need for passports and exit visas.

The Department functions most strongly as a region in three respects: higher education, notably the university and other technical training institutes; the communications media, especially newspapers and television; and of course as a unit of government administration, though even here there are deviations. While offices within the Prefect's responsibility are organised according to the political divisions of Department, province and canton, many agencies follow other demarcation lines, such as health, education, and transport, where the provinces in the north of Potosi come under the jurisdiction of regional offices in Oruro, Cochabamba, and Chuquisaca.

(2) **The Sub-regions.** Within the Department, as was noted earlier, four sub-regions are clearly discernible, centered on the urban area of Llallagua/Uncia/Siglo XX in the north, the city of Potosi in the middle, Uyuni in the

6. The Existing Spatial structure

west, and Tupiza in the south. (See map 6.1.) This is shown most clearly in the case of business services, such as banks, savings and loan associations, legal services, wholesaling and import-export agents, and retail outlets for less frequently purchased items like furniture and domestic appliances. It is also holds true for several government agencies which have branch offices in these towns responsible for an area more or less similar in extent to the sub-region, such as the Bolivian Institute for Agricultural Technology (IBTA), the National Highway Service (SENAC) and the National Social Security Service (CNSS). Although the pattern is blurred somewhat by the amenities to be found in some mining towns, these four settlements also function as centers for their respective sub-regions in the provision of hospitals, daily markets, radio stations, and farm supply stores.

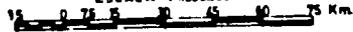
The sub-regions were delineated using information from the analysis of linkages. Again, this could have been done with the accessibility model, but without a computer the calculations would have been time-consuming. As was the case in defining the region, the political boundary of the Department was accepted as the external limit of the sub-regions, although as before these do not necessarily coincide with their limits as functional economic units.

In the case of the northern sub-region, its southern boundary is clearly defined, falling along the line between the provinces of Chayanta and Frias. The influence of the Llallagua/Uncia urban area extends further in the southern part of Chayanta than the city of Potosi, since the road connections with the north-west are much better than with the south. Nevertheless, beyond Ocuri, the population starts to rely more on Sucre for their needs. Due to the appalling roads in the northern part of the sub-region, the influence of Llallagua/Uncia peters out soon after Colluma towards the north-east, and residents of much of Ibanez tend to depend more on Oruro which is easier to reach, while people living in the province of Bilbao and the north of Charcas look to Cochabamba, especially for marketing agricultural produce.

The influence of the city of Potosi as a sub-regional center, as distinct from its role as the regional capital, extends a good way towards Uyuni in the west, more or less to the northern half of Nor Chichas in the south, and probably well beyond the Departmental limit in the south-east towards Tarija. However, those living beyond the edge of the altiplano on the eastern periphery of the province of Saavedra are more likely to use Sucre for business

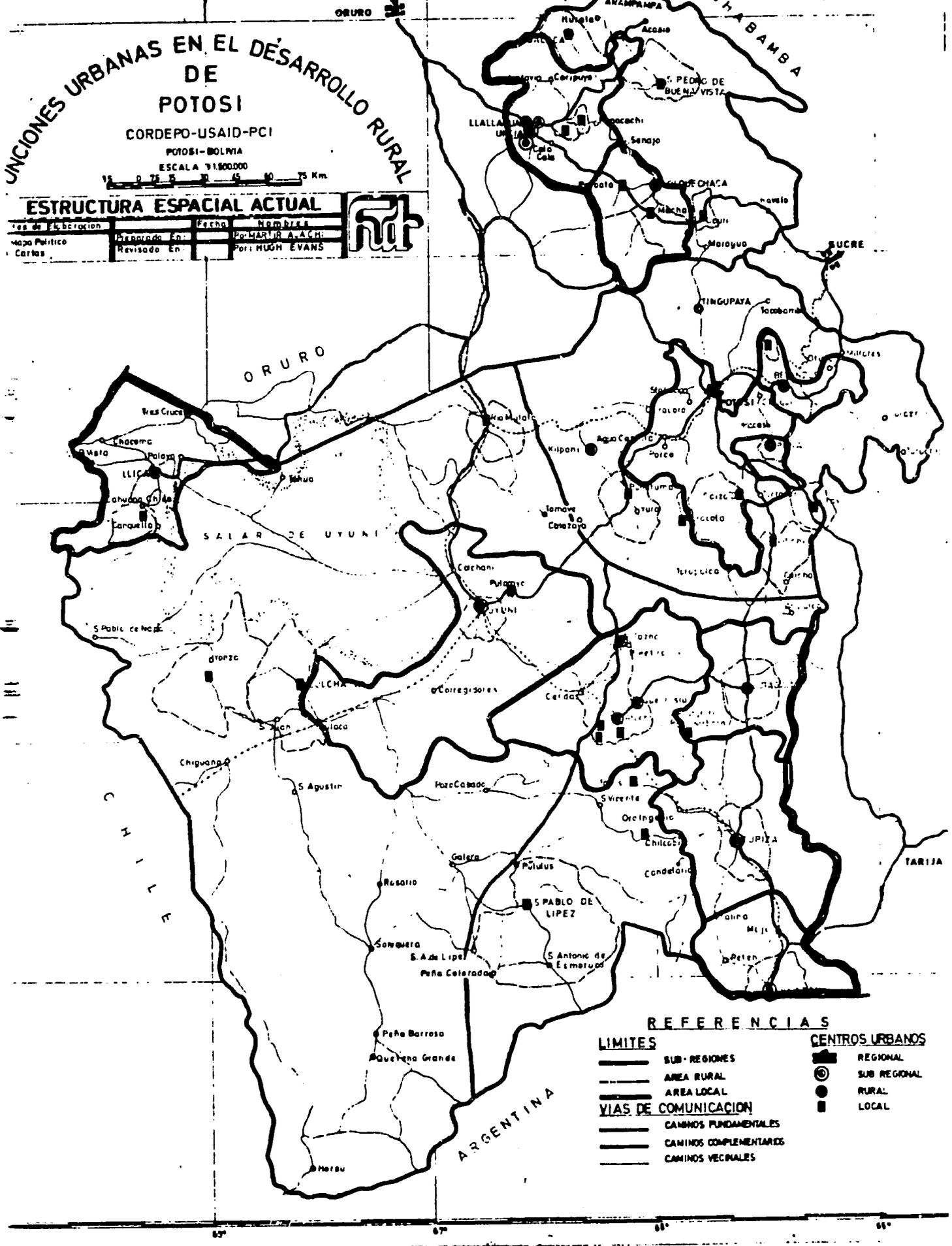
UNIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI
POTOSI-BOLIVIA
ESCALA 1:100,000



ESTRUCTURA ESPACIAL ACTUAL

Tipo de Elaboración	Fecha	Nombre
Mapa Político	Elaborado En:	Por: MARJOR A. A. C. H.
Cartas	Revisado En:	Por: HUGH EVANS



REFERENCIAS	
LIMITES	CENTROS URBANOS
— SUB-REGIONES	■ REGIONAL
— AREA RURAL	⊙ SUB REGIONAL
— AREA LOCAL	● RURAL
VIAS DE COMUNICACION	■ LOCAL
— CAMINOS FUNDAMENTALES	
— CAMINOS COMPLEMENTARIOS	
— CAMINOS VECINALES	

Map 6.1 EXISTING SPATIAL STRUCTURE

6. The Existing Spatial structure

and commercial needs, providing they can cross the river Pilcomayo, which forms the Departmental limit with Chuquisaca.

The southern sub-region embraces most of the mining towns located high in the mountains to the west of Nor and Sud Chichas, and extends into Sur Lipez as far as San Pablo de Lipez, a small town with a population of just under five hundred. Finally, due mainly to the absence of any other city or town of any significant size, the western sub-region with its center in Uyuni includes most of the province of Quijarro, and virtually the whole of the three western provinces, covering an area almost as large as the other three sub-regions combined. Nevertheless, since the distances involved are so large, the influence of Uyuni as a sub-regional center weakens to the south towards the Chilean border, and on the far side of the salt flats in the province of Daniel Campos.

Despite their wide variation in size, the maximum travel time from any zone on the periphery of a sub-region to the main center of that sub-region does not vary greatly. According to estimates from the accessibility model, the maximum travel time in the northern, central, and southern sub-regions is almost exactly the same at about ten hours, and in the much larger western sub-region it is only four hours more, since the roads there are much flatter and in better condition.

(3) Rural and Local Areas. The breakdown of rural areas and local areas within each of the sub-regions is summarised in table 6.1 and illustrated in map 6.1. As was mentioned before, a number of third-tier centers identified in the scalogram analysis were eliminated as effective service centers since many of their amenities are restricted to company employees and their families.

The northern sub-region contains two rural areas, one centred on the Llalagua/Uncia, the other on Colquechaca. The first includes nearby Catavi and Siglo XX, which both qualify as rural centers independently of their larger neighbors, and together they offer all the facilities to be expected in such a center. The second embraces an area either side of the main highway to Sucre, but stops abruptly to the north-east of Colquechaca, due to the absence of roads in that direction. As a rural center, Colquechaca possesses neither a farm supply store, a gas station, nor a vocational training facility, and despite the presence of several mines in the vicinity, it lacks any kind of

TABLE 6.1: SUMMARY OF THE AERIAL COMPONENTS OF THE POTOSI REGION

Sub-region	Rural area	T_{max} (hrs)	km ²	Local area
NORTH				
Center: Llallagua/	Llallagua/Uncia	5.54	3,300	Llallagua/Uncia Chayanta Entre Rios
	Colquechaca	2.28	2,700	Colquechaca Macha Pocoata
	None corresponding			Ocuri Sacaca S.P.de Buena Vista
CENTRAL				
Center: City of	City of Potosi	3.11	3,200	City of Potosi Caiza "D"
	Betanzos	1.99	1,600	Betanzos Colavi
	Puna	0.72	600	Puna
	None corresponding			Punutuma Otavi Vitichi
SOUTH				
Center: Tupiza	Tupiza	3.58	4,300	Tupiza
	Villazon	4.06	2,500	Villazon
	Atocha (part of)	5.27	5,300	Atocha Rosario Tazna
	Cotagaita	1.41	2,400	Cotagaita
	None corresponding			S.P.de Lipez
WEST				
Center: Uyuni	Uyuni	3.24	8,000	Uyuni Pulacayo
	Llica	2.50	4,100	Llica Huanaque
	Atocha (part of)	5.27	5,300	Atocha
	None corresponding			Colcha "K" S.P.de Quemez Rio Mulatos

T_{max} = estimated maximum travel time from any zone in the rural area to the rural center.

6. The Existing Spatial structure

artesan workshop or light manufacturing. Thus, outside the corridor either side of the main roads leading to Llallagua/Uncia, the greater part of the northern sub-region has poor access to the services and amenities expected of a rural center. This is especially true in the provinces of Bilbao and Charcas, which are practically devoid of passable roads, and as a result very poorly served.

Local service areas were not defined with any great precision. Based on the information from the survey of travel patterns, it was simply assumed that a local center served more or less the population of its own canton. In the north, eight of the twenty-five settlements in the sub-region were classified as local centers, a relatively high proportion. All but one are located on or close to main routes. The exception, San Pedro de Buena Vista, lies at the end of an appalling road, and probably acquired many of its amenities due to its position as the capital of the province of Charcas, or inherited them from the days when it was an important farming town. During the past three decades, however, the town has steadily lost population and today appears decidedly derelict.

In the central sub-region, three settlements fulfill the role of rural service centers: the city of Potosi, of course; Betanzos on the road to Sucre; and Puna, which evidently has good political connections with the Departmental capital. The area served effectively by the city of Potosi as a rural center, extends quite far to the south either side of the routes to Uyuni and Tupiza, but not so far to the north, due again to the lack of roads. Betanzos, one of the few vigorous farming towns in the region, serves the relatively fertile and productive agricultural area around the plains of Lequezana in the province of Saavedra, but its effective service area is once again curtailed by inadequate feeder roads particularly to the south-east. The third rural center, Puna, has a small attendant hinterland, since it is not an obvious focal point for the surrounding area. Outside these three rural areas, extensive parts of the sub-region are poorly integrated into the urban-rural system, notably the north of the province of Frias and to the north and west in the less densely populated province of Quijarro.

Local service centers in the central sub-region are almost as numerous as in the north. Three of them are mining towns: Kilpani and Caracota offer restricted amenities to the surrounding population, but Colavi has a sizable

6. The Existing Spatial structure

"civilian" population. Three others, Vitichi, Otavi and Punutuma, lie on main roads, while Caiza D is one of the few farming communities not to have lost population in recent years, and has most recently attracted the benefice of local public agencies through some aggressive political lobbying.

Of all the sub-regions, the south emerges as the best articulated, with less obviously unintegrated areas. Apart from Tupiza, there are three other rural centers: Villazon, which as was mentioned before, possesses all the attributes of a sub-regional center but with a restricted area of influence due to its role as a frontier post and the competition from Tupiza; Cotagaita, a farming town lying on the main highway from Potosi to Tupiza; and Atocha, located on the Uyuni/Tupiza road, serving a substantial population in a cluster of surrounding mining communities. Only the sparsely populated mountains to the west of Tupiza and the adjacent part of Sud Lipez fall outside the areas effectively serviced by these rural centers.

Within this subregion there are seven local centers, all but one of which, San Pablo de Lipez, are mining centers. As is the case elsewhere, the use of their facilities is restricted, but in this part of the region the rural population is sparse. More serious is the lack of local centers in the farming areas to the east of the sub-region in the more temperate valleys, which would bring high schools, doctor's clinics, post offices and a few more basic shopping facilities closer to the rural population.

In the western sub-region, the provision of infrastructure and the diffusion of urban amenities in smaller towns is hampered by the sparsity of population dispersed over such a large area. Outside Uyuni, there is only one other settlement which fulfills the role of a rural service center, Llica in the far west, serving the communities wedged in between the salt flats and the Chilean frontier. In addition there are five local service centers: to the north at Rio Mulatos; close by Uyuni in the once busy mining center of Pulacayo; and three others around the salt lake, including Colcha K, a small town with a promising potential for mineral processing industries related to sodium and phosphate products. Otherwise, the rest of the sub-region is an empty wilderness, occupied by a handful of small scattered communities.

To conclude, it may be said that just as the process of urbanization in the Department of Potosi is still in its early stages, so too the articulation of

6. The Existing Spatial structure

the spatial system has only just begun. While a few elements are already in place, many are missing. The regional capital, the sub-regional centers and a number of lower level service centers, have established themselves, though some of these, particularly the smaller settlements serving the farming communities are weak and in some cases show signs of decline. Many parts of the region, however, particularly the provinces of the far north, lack towns with the infrastructure and facilities necessary to function properly as service centers for their surrounding rural populations.

Furthermore, the links between these urban centers are strong only along the main highways, from Potosi to Sucre and to Villazon, and between Oruro, Lla-llagua/Uncia, and Sucre. Those between the sub-regional centers, such as Uyuni and Potosi, Uyuni and Atocha, and Potosi and Lla-llagua are weak, while the links between service centers and their hinterlands are really only beginning to function in a few areas adjacent to the main highways, for example in parts of the province of Chayanta, around Betanzos in Saavedra, and in Nor and Sud Chichas. The roads in these areas are hardly good, but in many other areas they do not exist, especially in the north again, the south-east of Linares and parts of Saavedra and Frias. In sum, it is fair to say that by far the greater part of the region remains poorly integrated into the main urban-rural system, particularly the provinces of Ibanez, Bilbao and Charcas in the north, the periphery of Linares and Saavedra, even many communities in Frias and Quijarro in the middle, and almost the whole of the western part of the region.

C. PLANS, POLICIES, AND PROJECTS

CHAPTER VII: REGIONAL DEVELOPMENT STRATEGY

Before the UFRD project started in Potosi, the regional development corporation, CORDEPO, had already initiated studies for the preparation of a medium term development plan. These studies included a global component dealing with the macro-economic dimensions of the regional economy, and sectoral components for agriculture, mining, industry, transportation, tourism, basic infrastructure and so on. However, as is often the case, no studies had been contemplated to cover the settlement system of the region.

The UFRD studies focussing on the spatial characteristics of the regional economy were thus introduced as a complementary component of the planning process, the horizontal dimension of a matrix in which sectoral planning represented the vertical dimension. As will be seen in the next chapter, this required a complex procedure for rationalizing and coordinating the projects proposed by each of the teams involved in global, sectoral, and spatial planning. Prior to that, however, it was necessary to ensure that objectives and strategies, particularly those related to the global and spatial components of the plan, were consistent with one another.

The relationship between strategy and analysis in the UFRD methodology differs from common planning practice. Often the preparation of a plan begins with a general analysis, which ostensibly leads to the identification of key problems and the design of an appropriate development strategy, which in turn provides the guidelines for the selection of specific projects. With the UFRD approach, this procedure is partially reversed. Instead, the strategy of spatially integrated regional development is derived from the cumulative experience of previous planning efforts in many countries around the world. In this case, the overall shape of the strategy is laid down at the outset, and this determines the focus of the subsequent analyses, the purpose of which is to test initial assumptions and to clarify strategy details in light of the specific characteristics of the region and prevailing conditions there. Thus, the seventh step of the UFRD methodology, as it was applied in Potosi, was devoted not only to elaborating the details of development policy, and to making sure that the spatial and global components of that policy were compatible, but also to verifying that the initial approach to integrated development posited by UFRD was indeed valid in the Potosi region.

Policy Implications of the Foregoing Analyses.

The macro-economic and spatial analyses pointed to a number of conclusions with implications for development policy. First of all, it was quite clear that despite the presence of considerable mining activity, which generates a major contribution to the country's foreign exchange earnings, the Department of Potosi is the most backward region of the country, and falling further behind. It has the lowest per-capita income, the highest level of infant mortality, and the slowest growing population. As is so often the case, the mining sector proves to be an enclave that generates few benefits for the local inhabitants. On the other hand the agricultural sector, which still absorbs the majority of the working population, has suffered from underinvestment and widespread neglect, which in recent years has led to an absolute decline in the value of production. It was clear, therefore, to the planners of CORDEPO that, in order to achieve a more widespread and equitable pattern of development within the region, support of the rural sector had to be the cornerstone of development policy.

Second, the analysis of health, education, and other welfare indicators for the provinces of the Department showed there to be a close relationship between the level of development and the proportion of the population in urban areas. Incomes are higher in urban occupations like manufacturing and commerce than in agriculture, and town-dwellers have better access to better amenities, such as schools, health care and basic infrastructure. Moreover, the provision of such services to a population concentrated in towns is obviously easier and less costly than to households scattered in rural areas. This implied that a second component of development strategy should be to encourage the concentration of the rural population in small and medium-sized settlements.

Third, an analysis of the growth and decline of settlements revealed that with few exceptions it is the mining towns that have gained and the farming towns that have lost, a pattern that closely reflects the relative priority accorded at the national level to mining and agriculture. At the same time the scalogram analysis showed that seven of the eleven third-tier settlements of the urban hierarchy, so called rural centers, and almost half the the fourth tier, or local centers, are mining towns, even though proportionally they represent a much smaller fraction of the total number of towns and villages. Much of the

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infrastructure and social services that are to be found in these mining towns has been provided by COMIBOL or other large mining corporations, while the provision of such amenities to farming communities has been largely ignored. It was clear, therefore, that there was an urgent need to redress this imbalance by increasing investment in social infrastructure in selected towns and villages serving the farming population.

Furthermore, it was evident from an examination of the distribution of other urban functions, that there is a widespread lack of the infrastructure and services required for agricultural production, such as irrigation, storage facilities, farm supply stores for seeds, fertilizers, tools, and equipment, as well as mills and other plants for processing farm produce. This once again reflects the low priority previously given to agriculture in the region, and also the weak demand for such facilities due to the low level of income of most farmers. It was concluded, therefore, that future development policy should pay particular attention to the provision of such infrastructure.

Finally, the studies of linkages and accessibility emphasized once again the paramount importance of feeder roads in connecting rural communities to their nearby urban service centers, not only as a means of increasing access for the rural population to the services and amenities to be found there, but also as a way of enlarging the potential market areas of smaller towns, thus inducing the location of prospective manufacturing and commercial activities there. This in turn serves to generate new employment opportunities, providing an incentive for the rural population to concentrate in these settlements. Hence, it was decided that high priority should be given in future plans to improving the integration of outlying and poorly served rural communities.

To all intents and purposes, therefore, the initial framework posited in the UFRD approach of spatially integrated development was found to be valid in the Potosi region, and to be closely compatible with the viewpoint of local planners. The following pages describe how this framework was translated into global and spatial strategies for the regional development plan for the Department of Potosi.

Global Strategy.

According to this plan, global or macro-level policy embraces two sets of objectives, one at the national level, the other at the regional level. The

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set of national objectives derives from an argument that Potosi's plight of poverty and backwardness is due to two factors, both of which can be attributed to national policies. The first of these arises from the country's long established policy of development based on the export of raw materials, at first silver, and now tin and other minerals. The second factor is the continued domination or subjugation of the region in face of other national priorities, which has resulted in the exploitation of the region's riches for the benefit of other parts of the country, notably the so-called "central axis", comprising the cities of La Paz, Cochabamba, and Santa Cruz.

Faced with this predicament, the Plan lays down three objectives to be attained at the national level. First, national development plans should no longer disregard regional priorities, but should address them directly. Second, the present *de facto* policy of preferential treatment for a few selected regions should be replaced by a national policy of regional development that strives for the complementary development of all regions in harmony. Third, the central government should support such a policy by providing permanent financial and technical assistance to the responsible agencies to allow them to carry out mutually agreed priorities for the social and economic development of each region.

At the regional level, two objectives are specified, both of which are clearly concerned with equity: to maximise the growth of the local economy in order to reduce the gap in income levels between the nation and the region; and to reduce the even wider gap within the region between the welfare and living standards of urban and rural inhabitants.

To accomplish regional objectives, the plan proposes a four-point macro-level strategy of supporting agriculture as the cornerstone of regional development, coupled with efforts to promote industries related to agriculture, to provide the infrastructure and services necessary to facilitate the production and marketing of agricultural goods, and to encourage the concentration of the rural population in selected towns and villages.

The arguments behind the choice of agriculture as the cornerstone of development policy have been alluded to before, but bear further elaboration. It is not an obvious choice in a region where the principal economic activity has always been mining, and the agricultural potential of the region is not rich

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by comparison to other parts of the country. The reasons, however, are both political and economic. In the first place, public intervention in the mining sector is virtually the exclusive preserve of the national mining corporation, COMIBOL, which acts to all intents and purposes as an autonomous fiefdom, largely impervious to outside control. Thus, even had it wanted to intervene, the regional development corporation's scope for action in a sector which is regarded as being of national concern, would have been severely circumscribed.

But the economic reasons are more compelling. The agricultural potential of the region may not be as great as other parts of the country, but it is often under-estimated, and has only partially been exploited. Due to the widespread lack of roads in many areas, much of the farming is at subsistence level, yet there are considerable possibilities for producing surpluses to be marketed in nearby towns and cities. Moreover, as was pointed out before, despite the predominance of mining, the principal means of livelihood for the majority of the workforce is still agriculture. Thus, if the objective is to improve the welfare of the rural poor, it becomes imperative to focus development efforts on the farming sector.

This may appear to be an equity argument, but there are other considerations relevant to longer term national objectives for economic development. Bolivia is a poor country with a small population and an incipient industrial sector. Efforts to encourage domestic manufacturing founder because of the lack of a local market sufficiently large to permit significant economies of scale. Before Bolivian industry can grow, or create new employment opportunities to absorb surplus labor from agriculture, it is essential to raise income levels of the majority of the population in order to expand effective domestic demand. Since most of the people are still living in rural areas, this can only be accomplished by a broad-based policy of rural development, which is thus not merely desirable for equity reasons but an essential precondition for the longer term economic prosperity of the country.

If agriculture is to be the cornerstone of development policy, the promotion of related industries is crucial to stimulate and diversify demand for local farm produce. With potatoes, corn, and wheat as the main crops, followed by other cereals, vegetables, some fruits, and animal products, there are ample opportunities for storage and packaging facilities, mills, slaughterhouses, and other small scale labor-intensive food processing operations.

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Agricultural production is unlikely to increase without overcoming the extensive deficiency of farm-oriented infrastructure and services, and complementing this with other basic necessities for rural inhabitants. The provision of infrastructure is to include, where appropriate, irrigation works, technical assistance, credit, production and marketing cooperatives, and above all rural feeder roads. To improve the rural population's access to social services, it is intended to rationalize and upgrade the present distribution of schools, health facilities, and other basic amenities.

The promotion of new industries related to agriculture in small and middle-sized settlements also serves other goals of the plan. The prospect of better jobs, coupled with the policy of upgrading the provision of infrastructure and services in selected towns and villages, is designed to provide the incentives necessary to encourage the rural population to re-settle in urban centers. The increased urbanization of the population is expected in turn to facilitate the diffusion of developmental impulses and to act as a catalyst in exposing farmers to more modern methods of production.

The Spatial Strategy.

Thinking through the implications of the spatial analyses in line with the UFRD approach to integrated development led to the identification of two key elements in the spatial strategy: the articulation of the urban-rural system; and the integrated development of component areas of the region - the functional economic areas identified in chapter VI - based on their productive potential.

(1) **The Articulation of the Urban-Rural System.** The first element of the spatial strategy, the articulation of the spatial structure, is designed to strengthen the hierarchy of central places, particularly the small and intermediate-sized settlements; to improve the linkages between them and their surrounding communities, in order to integrate isolated or peripheral areas; and to provide the necessary facilities in each center to support agricultural production and to meet the basic needs of the predominantly rural inhabitants.

Strengthening the urban hierarchy means selecting towns and villages which have the potential to act as rural and local service centers in those areas which at present lack such places. In Potosi, the selection of these centers

7. Regional Development Strategy

is based on three factors: most importantly, the economic potential of the locality and its longer term prospects for continued growth and prosperity; second, its links both outside the area to other towns and inside to the surrounding communities it is intended to serve; and third, though less critically, the existing range of functions to be found in the settlement. Particular attention is being paid to reinvigorating some of the traditional farming towns which in recent years have suffered decline.

Improving linkages means constructing or upgrading main roads between the larger towns in the region, and also building feeder roads to connect service centers to their surrounding rural communities. This is intended not only to raise levels of access for the rural population to amenities located in urban service centers, but also to expand the potential market size for manufacturing and commercial establishments located there. It will also become much easier for farmers to transport their goods to market, and this is expected to provide a major incentive to increase production.

Strengthening the urban hierarchy also means installing new urban functions in service centers where they are missing, and rationalizing the distribution of existing facilities, which in some cases could mean that certain establishments may be eliminated.

(2) The Integrated Development of Component Areas. While sectoral strategies focus on the vertical coordination between projects in the same sector, the second element of the spatial strategy, the integrated development of component areas of the region is oriented towards the horizontal coordination of projects in the same area. These component areas are defined along the lines of the functional economic areas identified in the foregoing spatial analysis. The purpose is to promote the social and economic development of a given area as a whole, which implies a package of related actions to increase production, raise productivity, facilitate marketing, and improve the health and welfare of the inhabitants.

However, the starting point for this element of the strategy is the exploitation of the productive potential of each area, which is taken as the *sine qua non* of development, the economic base on which the long term prosperity of the inhabitants depends. The design of the project package thus begins by identifying the main economic activities of the area, and figuring out the infra-

7. Regional Development Strategy

structure and services needed to support these activities, such as irrigation, credit, technical assistance, storage and market facilities. Alongside the actions in support of production, the package also includes other projects designed to take care of community needs for education, health care and other basic amenities.

In Potosi, the concept of designing packages of projects for specific areas, as opposed to the more conventional approach of individual projects in each sector, introduced a new perspective on the allocation of investments. Whereas before, the discussion had always been in terms of sectoral needs and priorities, now for the first time the distribution of resources in different parts of the Department was taken into account explicitly: planners and decision-makers were able to consider instead the options of giving priority to specific provinces or areas of the region.

CHAPTER VIII: PROJECT PACKAGES AND INVESTMENT PLAN

New data, illuminating analyses, and cogent strategies, desirable though they may be, are only steps along the way to a key goal of the UFRD methodology, which is to yield a regional development plan - more specifically a medium term investment plan - based on a coherent set of projects that will contribute to the social and economic development of the region, and will benefit the rural poor in particular. "Medium term" in this context means a period of time sufficient to implement a typical project package, which is to say four, five, or six years. This plan is not intended to be a rigid document, but one which is revised periodically, perhaps every one or two years, in light of changing circumstances, new opportunities, and earlier experience. Such a medium term investment plan can then be used as a framework from which to derive annual operating plans.

To translate the strategies outlined in the previous chapter into an investment plan, it is necessary to identify projects or in certain cases to design packages of projects, to rank these in order of priority, and to select from among them according to the financial resources available. This chapter describes the procedures adopted in Potosi in order to elaborate the details of a five year plan for the period 1983-87, and illustrates the notion of a project package with an example from the north of Potosi.

Definition of the Spatial Components.

As was just explained, the spatial strategy comprises two key elements: the articulation of the urban-rural system; and the integrated development of constituent areas of the region. As a preliminary step, therefore, it was necessary to define the components of the spatial structure that are to be adopted as the basis of the spatial strategy. These include the areas of the region that are to serve as the basic planning units for integrated development, and the hierarchy of settlements that are to fulfill the role of service centers in the region and each of its constituent areas.

In the first place, given the findings of the spatial analysis as summarised in chapter VI, it was decided to adopt the third tier of the spatial hierarchy, the rural areas, as the basic unit for planning integrated development. While the sub-regional centers are already clearly established, the third level central places are still at the formative stage and in many cases are

8. Project Packages and Investment Plan

fragile and in danger of losing population. Moreover, rural areas were thought to be the appropriate scale of operation for planning integrated development, since they are large enough to support a number of more specialised activities serving several communities, yet small enough to form financially viable development packages.

Based on the interpretation of the existing spatial structure, the Department was divided into seventeen planning areas, some of which are already more or less functioning as an economic unit, while others are thought to have the potential to do so. (Compare map 8.1 with map 6.1 and see table 8.1.) A number of these approximate existing rural areas, such as Cotagaita and Atocha (nos. 9 and 10) in the southeast; others are expanded to include communities that at present are peripheral, for example Chayanta, Betanzos and Tupiza (nos. 3, 6 and 11); and a few constitute what at the moment are largely isolated parts of the region, such as the north of Potosi, the east of Quijarro and Nor Lipez (nos. 1, 7 and 16). In one instance, two rural areas were combined: the one centred on Puna, which otherwise would have been an anomaly because of its small size, was absorbed into the adjacent one based on the city of Potosi.

For reasons connected with setting up an ongoing planning process, which will be explained later, the development plan proposes to divide the Department into four sub-regions, each comprising groups of rural areas. The northern sub-region, centred on the Llallagua/Uncia urban area, encompasses the three rural areas of Bustillos, Chayanta, and the north of Potosi. The middle sub-region, with the city of Potosi at its center, includes the four rural areas of Frias, Betanzos, Vitichi and east Quijarro, while in the south, the sub-region based on Tupiza incorporates the four rural areas of Cotagaita, Tupiza, Villazon and Atocha. Despite its large size, the western half of the Department contains only one sub-regional center, Uyuni, which serves the rural areas of Uyuni, Rio Mulatos, Nor Lipez and Daniel Campos, and the two sparsely populated areas in the south-west of San Pablo de Lipez and Sud Lipez.

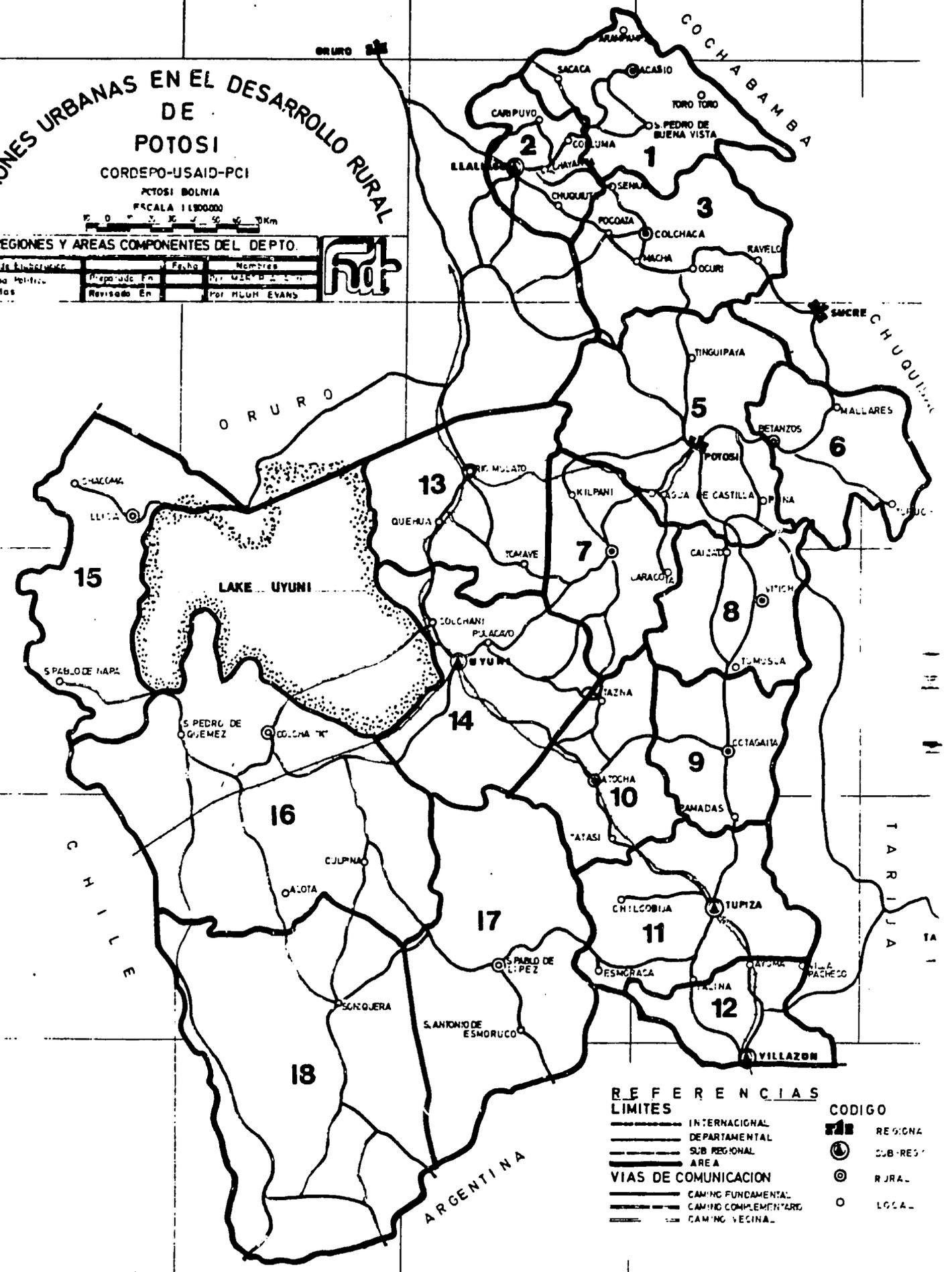
In the second place, it was necessary to select the hierarchy of settlements that are to fulfill the role of service centers. Once these are determined, it becomes easier to identify the links in the urban-rural system that need to be strengthened, and to determine the location of new services and facilities.

UNIONES URBANAS EN EL DESARROLLO RURAL DE POTOSI

CORDEPO-USAID-PCI
 POTOSI BOLIVIA
 ESCALA 1:150,000
 E 0 10 20 30 40 50 60 Km

B-REGIONES Y AREAS COMPONENTES DEL DEPTO.

Fecha	Nombre
Elaborado En	Por M. S. B. L. S.
Revisado En	Por H. L. H. E. V. A. N. S.



REFERENCIAS

LIMITES

- INTERNACIONAL
- DEPARTAMENTAL
- SUB REGIONAL
- AREA

VIAS DE COMUNICACION

- CAMINO FUNDAMENTAL
- CAMINO COMPLEMENTARIO
- CAMINO VECINAL

CODIGO

- REGIONAL
- SUB-REGIONAL
- RURAL
- LOCAL

Map 8.1 AERIAL PLANNING UNITS

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**TABLE 8.1: SUB-REGIONS, RURAL AREAS, AND THEIR CORRESPONDING CENTERS
AS PROPOSED IN THE REGIONAL DEVELOPMENT PLAN**

Sub-region	Sub-regional center	Rural area	Rural center
North	Llallagua/Uncia	1. North of Potosi	Acasio
		2. Bustillos	Llallagua/Uncia
		3. Chayanta	Colquechaca
Central	City of Potosi	5.* Potosi	City of Potosi
		6. Betanzos	Betanzos
		7. Quijarro East	Punutuma
		8. Vitich	Vitichi
South	Tupiza	9. Cotagaita	Cotagaita
		10. Atocha	Atocha
		11. Tupiza	Tupiza
		12. Villazon	Villazon
North-west	Uyuni	13. Rio Mulatos	Rio Mulatos
		14. Uyuni	Uyuni
		15. D. Campos	Llica
		16. Nor Lipez	Colcha "K"
South-west	none	17. S.P. de Lipez	S.P. de Lipez
		18. Sud Lipez	(to be determined)

*Rural area #4 was subsequently absorbed into rural area #5, Potosi.

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The regional center and the four sub-regional centers are already well established and not in dispute. However, at the third and fourth tiers of the hierarchy, the situation is less clear. In those areas of the region without a functioning rural center, it was necessary to select a settlement with a good potential for fulfilling such a role. First among the selection criteria to be considered was the productive potential of the settlement and its locality: it was argued that, in order to function satisfactorily as a stable service center for the surrounding area, the town must have a sound economic base. Second, in order for a settlement to be accessible to the population it is intended to serve, it should be more or less centrally located in relation to its hinterland, and even more importantly, as was clear from the spatial analysis, it should be well connected to higher level towns in adjacent areas. This favored settlements located on the principal highways, rather than those off the track which might not be so easy to integrate. The third criteria concerned the range of functions which the settlement possesses. While this is an indication of its present role, it is not a critical consideration, since those that are lacking can be installed, and over the long term a flourishing town will attract an increasing range of new activities.

At the fourth tier of the urban hierarchy, there is at present a widespread shortage of central places. The development plan includes a preliminary selection of settlements that might serve as local centers in those areas of the region where they are lacking, but in many cases there are no villages of any significant size, and it was clear that a more fine-grained analysis would have to be made before an informed decision could be reached.

Identification and Design of Project Packages.

In line with the first element of the spatial strategy, concerned with the articulation of the urban-rural system, the five year plan proposes substantial investments for improving a number of links in the main highway network between the principal urban centers of the region. Although the city of Potosi is relatively well linked to Oruro, Sucre, and Tupiza in the south, connections to the northern and western sub-regions are weak. Hence, the first of the links earmarked for improvement is between the city of Potosi and Uyuni - a route which at present has no regular bus service - to be extended to the west as far as Julaca in Nor Lipez, and from there to Llica on the far side of the salt flats. A second link is from Llallagua/Uncia through the

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northern provinces of Ibanez, Charcas and Bilbao, to the Departmental limit with Cochabamba at Anzaldo. This is urgently needed in order to connect the isolated communities in this part of the region, many of which have substantial agricultural potential, to markets in the mining centers and in Cochabamba. The third link to be upgraded is between the city of Potosi and Macha in the province of Chayanta, which would provide better access for the population of the north to the Departmental capital.

The second element of the spatial strategy, the integrated development of constituent areas of the region, was approached in Potosi by designing packages of projects for each area based in the first instance on its productive potential and existing economic activities. The design of these project packages, and the coordination of spatial and sectoral plans, was accomplished by a complex and sometimes lengthy process involving the participation of the entire planning staff working together in interdisciplinary teams. To expedite this process, use was made of a two-dimensional matrix in which the columns represent sectoral projects and the rows represent packages of projects in each area. (See for example table 8.2.)

The process began with the identification of the principal economic activities of each area, or potentially productive activities. This information came primarily from CORDEPO's own department of agriculture and the local office of the Ministry of Agriculture, and was occasionally supplemented by data from the UFRD surveys of urban centers and markets. Using this information, and their personal knowledge of each area, staff members proposed two or three key agricultural activities to be the focus of production efforts, and estimated current and potential output. From this starting point, preliminary proposals were put forward for related activities, such as plants for sorting and packing, mills, slaughterhouses, and other small scale labor-intensive food processing operations.

Staff members then made a preliminary estimate of the inputs required to support these productive activities, such as the extent of irrigation works, the capacity of storage facilities, the number of extension agents, the amount of credit, and the provision of agricultural supplies. Next, they identified the need for infrastructure indirectly related to agricultural production and small scale manufacturing, such as electrical energy, and most importantly markets and local feeder roads. Using the inventory of urban functions to be

TABLE 8.2: IDENTIFICATION OF PROJECTS BY SECTORS AND AREAS
(1) AGRICULTURE

Sub-region and Area	Location	P r o j e c t s												
		W h e a t	C o r n	P o t a t o e s	V e g e t a b l e s	T a r h u i	B a r l e y	F r u i t	Q u i n o a	S h e e p	P o u l t r y	D a i r y P r o d s	P i g s	
North Area	I	x	x	x										
	II									x				
	III			x		x	x	x		x				
East	IV					x								
	V		x	x				x				x		
South	VI		x						x				x	
	VII	x			x			x	x		x			
	VIII			x								x		
West	IX								x	x				
	X								x	x				

Note: The above is a schematic representation only.

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found in each settlement, and the study of accessibility, staff were also able to determine the need for other basic infrastructure and complementary services for the inhabitants of the area, such as drinking water, sewerage, schools, training centers, health care facilities, and various kinds of stores. To complete the project package, proposals were also included for farmers cooperatives, credit associations, and other supporting community organisations.

The location of these facilities was determined in light of the preceding spatial studies and the hierarchy of settlements in the area. Using the scalogram analysis as a guide, new urban functions identified as necessary ingredients in the project package, such as a market, farm supply store, high school or health facility, were located accordingly in the rural center or the local centers. Almost invariably a key ingredient was the provision of local feeder roads designed explicitly to reinforce the position of the rural center by linking it to local centers and other surrounding communities.

The next step involved the preparation of a timetable for each area of the region showing the sequence of activities year by year, starting points, and estimated implementation times for each element of the package. Some activities obviously continue indefinitely, such as crop cultivation, stock raising or manufacturing, but others like the building of roads or irrigation systems are expected to be completed within a specific period of time. Each timetable starts in year 1, rather than any specific date, such as 1983, since it was not known at the outset when a given project package would be implemented.

These timetables were then used as the basis for a rough estimate of the costs of project packages in each of the first five years. Estimates showed the expenditures to be incurred by each participating public agency, the contributions anticipated from outside sources under existing aid programs, and in the case of certain manufacturing activities, the investments that might be expected from the private sector. Other private sector investments, for example from farmers or campesino cooperatives, were usually ignored. Annual costs were then summed for each project and each area to show the distribution of investments, both by geographical area and by sectors such as agriculture, mining, industry and so on. These figures were later used in selecting particular projects and project packages.

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An example of a project package is given in table 8.3 which shows draft proposals for Area #1: the North of Potosi, an isolated area with poor linkages to market towns, but considerable potential for agricultural production. Given the almost total absence of roads in this part of the region, the main priority during the first couple of years is to improve the highway linking the area with markets in Llallagua, Uncia, Siglo XX, and the Department of Cochabamba, and to construct feeder roads to connect Acasio, the settlement recommended as the rural center, to surrounding communities, particularly the local centers in Arampampa, San Pedro de Buena Vista, and Toro Toro.

In the second year work is intended to begin on building irrigation systems, and in the third year, with some of the key roads in place, it becomes feasible to start providing farm supplies, technical assistance, credit and other inputs for raising productivity and increasing production of the principal crops in the area - wheat, corn, and potatoes. Parallel with the efforts to boost crop production, the construction of a potato packing station and a small flour mill is scheduled to start in the second year ready for operations in the third year, followed a little later by a plant for dehydrating oca, a local vegetable for which there is some demand.

Since Acasio is at present a small village with few amenities, the package calls for the installation of a range of urban functions appropriate to a rural service center. These include a post and telegraph office, a high school, a health center staffed by doctors equipped with jeeps to visit neighboring communities, a gas station and vehicle repair workshop, and most importantly a market, agricultural supply store and warehousing facilities. The four local centers - Arampampa, Toro Toro, San Pedro de Buena Vista and Sacaca - are scheduled to receive as a minimum a drinking water system, a high school, post office and a nurse's clinic properly equipped and staffed.

Project Selection and Investment Plan.

In the course of designing project packages for each area of the region, far more projects were identified than could be financed with the resources available. In order to complete the final step of drawing up an investment plan for the five year period 1983-87, there remained the complex task of selecting from the many alternatives, and of resolving the differences among global, sectoral and spatial priorities.

TABLE 8.3: SUMMARY OF PROJECT PACKAGE: AREA #1 NORTE DE POTOSI

Project	Location	Organization	Years				
			1	2	3	4	5
Agriculture							
Irrigation	various	CORDEPO	-----				
Extension service	"	IBTA			-----		
Credit	RC	BAB			-----		
Construction	various	CORDEPO	-----				
Farm supplies	RC	MACA/CORDEPO			-----		
Wheat	Arampampa	MACA/CORDEPO			-----		
Corn	Acasio/Aram	"			-----		
Potatoes	Acasio/Aram	"			-----		
Sheep raising	Sacaca	INFOL/MACA/CORD				-----	
Mining							
Machinery hire	various	CORDEPO/BAMIN			-----		
Industry							
Mill	RC	MinInd/CORDEPO	-----				
Animal feed plant	RC	"			-----		
Dried oca plant	RC	"			-----		
Tourism							
Resource survey	various	IBT/CORDEPO			-----		
Craft workshop	San Pedro BV	"			-----		
Transport & Comms							
Highways	Uncia-Anzaldo	SENAC/CORDEPO	-----				
Feeder roads	RC to LCs	ALDE/CORDEPO	-----				
Telephones	RC	ENTEL	-----				
Post Office	RC	MinTC			-----		
Energy							
Grid extension	various	ENDE	-----				
Local generators	RC & LCs	CORDEPO			-----		
Education							
High schools	RC & LCs	MinEd/CORD			-----		
Training center	RC	MinEd			-----		
Literacy program	various	MinEd			-----		
Health							
Health center	RC	UnSan/CORD			-----		
Clinics	LCs	UnSan/CORD				-----	
Infrastructure							
Drinking water	RC & LCs	CORDEPO	-----				
Sewerage	RC	CORDEPO			-----		
Market	RC	CORDEPO			-----		
Institutions							
Producers coop	various	IPTK/MACA			-----		
Marketing coop	RC	IPTY/MACA			-----		
Field office	RC	CORDEPO	-----				

RC = Rural center = Acasio;

LC = local centers = Arampampa, Sacaca, Toro Toro and S. P. de Buena Vista.

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In the first instance, the total estimated cost of the projects proposed amounted to three times an optimistic projection of anticipated resources. To evaluate and rank the seventeen project packages for the constituent areas, a set of criteria were drawn up taking into account both equity and efficiency considerations, as well as a geo-political factor, often stressed by the national government, reflecting a long felt preoccupation with populating sparsely settled frontier zones. The equity aspect was represented by the population of the area, and its level of development as measured by the set of indicators described in chapter II. Efficiency was to be calculated according to conventional benefit/cost ratios and net benefits were to be estimated for the productive components of the project packages. The geo-political factor was taken into account by a simple weighting system. In practice, as is explained in the conclusion, the choice of the first four areas to be financed was determined as much by outside circumstances as by these evaluation criteria.

Secondly, it also became clear that there were considerable discrepancies between macro-economic targets for sectoral investments and the pattern of investments required to meet sectoral and spatial priorities. The discrepancy was most obvious in the case of the resources to be allocated to road construction. The spatial analysis revealed that substantial funds were needed for this, although from a macro perspective it appeared less desirable since it was difficult to estimate the resulting impact on regional output. In the course of working through successive iterations of the investment plan, macro targets tended to become subordinated to other considerations, since the arguments in favor of expenditure on roads and other specific elements of project packages were easier to understand and defend than the more abstract macro-economic targets.

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To conclude this report, let us summarise what has so far been accomplished through the UFRD project in the Department of Potosi, and what is now being done to implement the strategy of spatially integrated development.

In the first instance, the three surveys of over one hundred urban centers, twenty periodic markets, and nearly two hundred households, have generated a substantial amount of original information. When added to the other material culled from existing sources used in the course of the UFRD study, this now represents a significant body of data rarely available in Bolivia at the regional level. Perhaps the most useful component of this data bank is the inventory of infrastructure, services and other facilities to be found in each of the settlements. Not only does this indicate what exists in each place, but it also details the most pertinent characteristics of the larger institutions such as schools, health facilities, and markets. Although some of this information was already documented prior to the UFRD surveys, much of it was out of date, incomplete and inaccurate. Now for the first time there exists an extensive body of data which is already proving itself invaluable not only for CORDEPO itself, but also for other agencies involved in the development of the region.

However, while some of this data has been processed and published in reports, the bulk of it has still not been organised in such a way that others can readily access it. The information from the original survey questionnaires has been transferred to computer disks, but the present format is not one that is compatible with the hardware at the University of Tomas Frias in Potosi. The transfer of survey data to the Potosi facility in a form that would be both secure and convenient for local users is a task that remains to be completed.

Second, the results of the UFRD study in the Department of Potosi have been published by CORDEPO in a two-volume report written by members of the project team. This report constitutes one of the few studies ever undertaken of the spatial dimensions of development in a region of Bolivia, and is probably the most comprehensive so far. Copies of the report, and an accompanying volume describing the UFRD methodology published jointly by the USAID Mission and the Ministry of Planning and Coordination, have been distributed among the

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regional development corporations and several other public agencies. The project team have also presented the results of the study at workshops in Potosi and La Paz to wide acclaim from planners and staff from government departments throughout the country.

One component of this study, however, the accessibility model, has yet to become operational in the way it was originally designed. As was mentioned in chapter V, this model can be used both for the purposes of defining effective service areas of the main settlements, as well as to evaluate alternative proposals for improving the access for the rural population to urban-based facilities. The model requires extensive computations which were originally done manually. Since these were extremely time consuming, the model was never used for the second task of evaluating proposals. Subsequently, however, a computer program has been written and successfully tested which greatly facilitates these calculations. It remains to set the model up in Potosi, and to train local staff in its use.

Thirdly, the UFRD project has lead to the preparation of a regional development plan for the Department of Potosi, covering the five year period 1983-87. This includes an investment plan, and outline proposals for project packages in selected areas of the Department. Not only is this the first time that the Corporation has published a development plan, but as was explained in chapters VII and VIII, the strategy adopted represents a radical shift away from the conventional approach based on a list of projects for each sector - agriculture, mining, industry, transport and so on - towards an integrated approach based on functional economic areas. While there have been various so-called "integrated" rural development projects in Bolivia in the past, this is the first time that a development corporation has adopted a regional plan based on the concept of area-based development. As such it has commanded considerable interest among officials in the Ministry of Planning and Coordination and elsewhere in the country.

The new thinking behind the regional development plan has already been demonstrated in two ways: through the annual operating plan for the year 1982, and more dramatically by negotiations which are currently under way with four international aid agencies. A large part of the 1982 operating budget is inevitably related to the continuation of projects initiated previously, notably the completion of a stretch of highway connecting the city of Potosi

to nearby Tarapaya, and the rebuilding of the city's airport runway. However, the first steps in implementing the new strategy are evident from the increased emphasis given to agriculture, the selection of highway links and feeder roads to be upgraded, and the location of new infrastructure in towns intended to serve as rural and local centers.

Of more significance, however, are the negotiations currently under way between CORDEPO, central government ministries, and international aid agencies, related to new projects in four areas of the Department.

The choice of these four areas was determined in part by the evaluation criteria referred to earlier, and in part by the interests of the international agencies concerned. In the first area, the north of Potosi, the interests of the Interamerican Bank coincided with the corporation's point of view. In a second area, Daniel Campos, CORDEPO was instrumental in directing the attention of the Andean Pact's Rural Development Program to that area. But the choice of the other two area-based projects was mainly due to outside interest: a subsidiary of the Food and Agriculture Organization wanted to work in the river valley of San Juan de Oro in the province of Tupiza; and the Interamerican Institute for Agricultural Cooperation had their eye on the plains of Lequezana in the province of Saavedra. Although the Corporation may not have regarded these areas as top priority, they were not at the bottom of their list either, and since both had good agricultural potential and a sizable population, CORDEPO was willing to go along with these suggestions.

While the starting point of each project was often quite different, all the agencies involved are interested in some variant of an area-based development approach. The coincidence of interests and the availability of financial assistance provides an excellent opportunity and incentive for the Corporation to embark on the next and most difficult stage of implementation.

Parallel to these negotiations, and in anticipation of this next stage, CORDEPO has begun to set up institutional mechanisms to facilitate inter-agency coordination. In 1980 a Departmental advisory council was established under the chairmanship of the president of CORDEPO consisting of representatives of local offices of central government ministries. Its purpose is to bring about a common approach to development problems in the region, and to coordinate plans and programs. In addition it has been proposed that advisory

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committees, answerable to the Departmental council, should be set up for each of the sub-regions, to provide knowledgeable expertise on local conditions and to secure agency collaboration in the field for the implementation and monitoring of project packages in specific areas.

In sum, it may be said that considerable progress has been made towards the original goals of the UFRD project; namely, to establish an ongoing planning process that would lead to the application of the concept of integrated regional development, with the objective of raising the standard of living of the rural poor. Whether CORDEPO, and the other organisations with whom it is working, will adhere to the UFRD approach, or maintain the course of action proposed in the medium term plan, remains to be seen. However, in this respect, there is an important role to be played by USAID - both through its Mission in Bolivia and through the Regional and Rural Development Division, inheritors of the UFRD project - in demonstrating their continuing interest in the project, and in providing sustained assistance to the Ministry of Planning and Coordination in La Paz, and through them to CORDEPO in Potosi.