URBAN IMPORTANCE AND URBAN SERVICES: AN ECUADORIAN CASE STUDY.

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AN ECUADORIAN CASE STUDY

By

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ABSTRACT:

The objective of the study is to explain the location or distribution patterns of urban services in Pichincha Province, Ecuador. It is hypothesized that these services are located in urban centres according to their level of importance, and the settlements of the province were evaluated in terms of ten different measures or indicators of relative importance. The distribution pattern of each of the fourteen services that cater to the rural areas of the province was compared with each measure, and, using additional background information where necessary, an attempt was made to formulate general principles which might explain the distribution of services in the province.

It was found that there was generally a close relationship between urban importance and the location choices that had been made by the various service administrations, but that distribution patterns were affected by urban shadow, by local initiative or apathy, and by in-migration from Quito by people buying suburban homes. It was also found that three of the indicators used, frequency of local markets and of bus departures, and the nature of a centre's highway link, do not provide any significant explanation beyond that given by the other seven indicators of relative importance. In addition, it was possible to classify the centres of the province into four distinct groups, based on population level and the number of services present.

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PREFACE

This research was carried out within a program known as "Proyecto Pichincha," a pilot study of the problems of regional development in a developing country with a view to formulating a model which might serve as a basis for recommendations on regional improvement, and which could help establish criteria for a nation-wide study of a similar type. The project is being conducted by the McMaster University Department of Geography, and the Instituto Geografico Militar, Quito, Ecuador, under the auspices of the Pan-American Institute of Geography and History, over a period of several years. The ideas developed here, and the data used are the result of two summers of field work (1970 and 1971) carried out in Pichincha Province, Ecuador (see Maps 1 and 2). The general focus of this particular work and the study area were thus determined by the larger project.

The format of this report is as follows. The problem is introduced and the approach developed in the first part. Using suitable criteria, measurements are made of the relative importance of the centres of the province in the second part. Part Three presents an analysis of the distribution pattern of each public service. Part Four contains a summary of the results and conclusions. To facilitate reference to the data used, as well as comparison of data and of spatial distributions of the various services, all raw data plus the results of the calculations based on the data are tabulated in Appindix A, while all maps are located in Appendix B. Appendix C contains a numbered bibliography, and the

bracketed references throughout the text refer to this bibliography. A glossary of local terminology follows this preface.

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Finally, special thanks are in order to the several hundred people interviewed who gave so willingly of their time and knowledge, and without whose friendly co-operation, this study would have been impossible to carry out.

Hamilton, January 1973. BRUCE E. RATFORD.

GLOSSARY

A - Currency

The basic unit of currency in Ecuador is the 'sucre', which is subdivided into 100 centavos. As of August 25, 1971, US.$ 1.00 was worth 25 sucres (S/ 25.00), and all prices and costs have been worked out using that rate of exchange.

B - Spanish Terms Used

Anexo, Barrio - 'annex, suburb' - in Ecuador, refers to outlying settlements of a parish.

Cabecera Cantonal - the administrative centre of a canton.

Cabecera Parroquial - the administrative centre of a parish.

Canton - 'canton', - political division analogous to a county in Ontario.

Ciclo Basico - 'basic cycle', - program that all students take during the first three years of their secondary education.

Ciclo Diversificado - 'diversified cycle',-the last three years of secondary education, when specialized programs are available, such as agriculture, arts, commerce, humanities, industrial, or general.

Colegio - 'college', - distinguishes a secondary school from an 'escuela' or primary school.

Comandancia - 'command post' - here refers to police headquarters.

Consejo Cantonal - 'cantonal council' - the decision-making body at the canton level.

Consejo Provincial - 'provincial council' - the decision-making body at the provincial level.

Corte Superior - 'higher court' - analogous to a provincial Supreme Court in Canada.

Corte Suprema - (the) 'Supreme Court' of the country.

Costa - 'coast' -the coastal plains of Ecuador (see 30, pp 1,2).

Cuerpo de bomberos - ' body of pumpers' - fire brigade.

Escuela de corte y confeccion - 'cut and putting-together school' - a post-primary school offerring a one-year program in tailoring, dress-making, household management and domestic arts, that is akin to the home economics courses offered in Canadian high schools.

Hacendero - the proprietor of a hacienda, which is a large farm or estate run by hired labour.

IERAC - 'Instituto Ecuatoriano de Reforma Agraria y Colonizacion' - an autonomous government agency charged with supervising land reform programs, and particularly with promoting colonization schemes in suitable un(der)developed areas of the Costa and the Oriente.

Juzgado Cantonal - analogous to a Division Court, or Small Claims Court, in Ontario, in that only small value civil suits are heard.

Juzgado Provincial - analogous to a County Court of Ontario, in that only medium value civil suits are heard.

Municipio - 'municipality' - often used to refer to the cantonal council, or the cantonal administration.

Nordoccidente - 'north-west' - the region of Pichincha comprising the parishes of Nono, Mindo, Los Bancos, Nanegalito, Nanegal, Gualea, and Pacto.

Oriente - 'east' - the Amazon basin (see 30, p. 3).

Provincia - 'province' - as in Canada, the highest level of political subdivision of Ecuador.

Oficina de Investigacion Criminal - Ecuador's 'F.B.I.' functionally, though it is a department under the Comandancia-General de Policia, rather than an autonomous agency.

Parroquia - 'parish' - the lowest level of political division. In rural areas. a parroquia is equivalent to a township in Ontario, whereas in urban areas, it is like a 'ward', or a 'district'.

Policia Rural - 'rural police' - the guarantors of law and order in the rural areas of Ecuador.

Ronda Nocturna - 'nightly round' - a night-watchman service that is available in the residential areas of Quito for a small monthly fee.

Sierra - The Andes (see 30, p. 2).

Teniente Politico - the top parish official. similar to a township reeve. He is appointed by the Ministerio del Gobierno(= Secretary of State), and is responsible for running the parochial government, for initiating projects, and for solving any problems that arise. The teniente politico also has limited police and judicial powers within his jurisdiction.

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PART ONE

THE PROBLEM DEVELOPED

1-1 Introduction

Any research into the problems of regional development will attempt to obtain answers to a multitude of small but important questions or aspects that relate to an overall objective. One such question usually concerns the provision of 'infrastructure', or what might be defined as public amenities or services from which no direct return or investment can be expected, but from which there would, or should be indirect benefits. In a developing country, where resource allocation is an acute problem, the question of what public services should go where is a highly important one. However, before one can prescribe a remedy, some diagnostic work must be carried out. It is necessary to know where service facilities are already located, and to determine why they are where they are.

To determine 'where' is simple and straight-forward. To determine 'why' is more complex. One might presume that there is an official policy governing the administration of each public service, and that this policy is followed to the letter. Were this ideal situation a reality, it would be valid to ask how the policy was established in the first place. Alternately, one would expect to find a given facility in the most important centres of an area, simply so that the greatest number of people could be served by the minimum investment

in facilities and manpower. It is recognized that this second possibility would really be simply a pragmatic policy, and as such, is more likely to provide the best level of explanation of existing service distribution patterns, since locational choices are often made as the result of a complex mix of many factors.

Thus the broad aim of this study is to explain the distribution patterns of urban services in Pichincha Province, Ecuador. Specifically, it is proposed to determine whether service facilities are located in centres according to their relative importance, and if not, why not.

The problem will involve an assessment of the relative importance of the urban centres in the province using suitable criteria. The locations of each service facility will then be tested against each criterion of urban importance to see whether any measure, alone or in combination, can explain the distribution that exists. Where a locational pattern, in part or in whole, is not explained by the criteria of urban importance, other explanations will be sought.

We shall take the existing distribution of public services as given, and as having been developed over time, by a combination of miscellaneous forces. In addition to the pragmatic desire to serve the greatest number for the least expense, the observed patterns may well have been shaped by isolated political pressure, by historical changes in the importance of settlements, by changes in transportation technology, or by factors affecting local agricultural production. However, while variations in level of service may develop over time, the

administration of any service would seek to fill any 'gaps' that may occur. Thus we may view the current distribution of facilities as representing a kind of steady-state condition, and proceed to determine whether there are any critical levels or thresholds of urban importance that appear to govern the existing distribution. By identifying any such values or thresholds, we shall have contributed to a better understanding of how various urban services function in a developing country, and particularly within the context of Ecuador. The ultimate purpose of the study is to aid in geographic planning, and the identification of threshold values for the provision of public services is important input information for the planning process. By determining effective demand levels for a service, any change in the relative importance of the centres in the region can be estimated, and the extent of the need for further facilities can then be easily worked out.

This approach does have limitations. Lösch observed, "If everything occured at the same time, there would be no development. If everything existed in the same place, there would be no peculiarity. Only space makes possible the particular, which then unfolds in time." (28, p 508). In any problem concerned with location, time and space are both involved, particularly at the regional scale, since no society remains static. A cross-section approach will be used, due to the paucity of data for any extended period into the past. While Marshall (29) and other authors have pointed out the need to introduce the time dimension into central place study, the present evaluation of the relative importance of actual centres in Pichincha will be limited to one

point in time, and thus has limited value as a predictor or harbinger of what may be the situation in future years. However, even a picture of the availability of services for a particular point in time would provide a basis from which one can argue whether the services are satisfactory for the interested parties concerned, and whether the distribution patterns observed should be considered as long-term guidelines.

It is also recognized that the introduction of a time dimension would give a historical overview of each service administration and of its policies in action, and would thus permit a more rigorous determination of those factors that determine the location and operation of facilities. Depending on the time period studied, one might be able to completely chronicle the development of a service network for a given service. While the historical perspective would be advantageous for recommending future courses of action for any particular entity, it will not be considered here for two reasons. First, and foremost, the present influences acting over time, and if our basic hypothesis is correct, historical variations will not substantially alter our results, except perhaps to modify some numerical values. Second, records for any extended period into the past are difficult to obtain, if extant, so that a time study would not be possible for every service.

Finally, our hypothesis suggests that services will be located in centres according to their relative importance. At the same time, it is realized that the location of any given service in a community is likely to contribute to the relative importance of that

community in some manner, ie. in promoting urbanization. While this latter cause-effect relationship will not affect our approach, it may be necessary to take it into consideration prior to any application of the results.

1-2 Relative Importance of Centres

Since we hypothesize that services will be locted in urban centres on the basis of their level of importance, the first task of the study will be the assessing of the relative importance of the urban centres of the province. This type of problem has been of concern to many geographers (see 04, for example), with the corresponding development of a plethora of central place hierarchy theories, each based on certain assumptions. It will not be argued whether the resulting hierarchies are good or bad, since they have in general been developed with some specific purpose in mind. It is simply proposed to use those models or methods that appear to be suitable for evaluating the importance of centres in Pichincha. In other words, it is proposed to use central place theory and techniques as one method of advancing towards an understanding of the distribution patterns of services in the province.

Central place studies are all concerned basically with two questions asked by Christaller in his landmark study of southern Germany (08, p 2 and 4): "How can we find a general explanation for the sizes, number and distribution of towns? How can we discover the laws? .... What is to be understood by the term town?" While Christaller coined his own terminology for the purpose of answering those questions, Hans

Carol has summarized (06) the operational definitions that have been evolved by European geographers from Christaller's work. He defines central place as "the location of a single function, or, as the term is generally interpreted, the location of a group of central functions. The service area is that area which is served by either a single central function, or by a group of central functions. A central place serves the population of its own settlement, the internal service area, and the area adjoining that settlement, the external service area or umland. Central services or central functions, such as the supply of consumer goods or medical care, are the outgrowth of personal contact between the central service and its consumers, thus leading to a close relationship between the residences of the consumers and the location of the service." (06, p 420).

Harris and Ullman recognized three categories of urban places: (1) central places performing comprehensive services for a surrounding area, (2) places performing break-of-bulk and allied services along transport routes, supported by areas which may be remote in distance but close in connection because of the city's strategic location on transport channels, and (3) specialized-function centres performing one service such as mining, manufacturing, or recreation for large areas, including the general tributary areas of hosts of other cities (16, p 7-9). If Carol's definition of the central place is based on the intrinsic properties of the centre, Harris and Ullman provide a complementary emphasis on external relationships.

For the purposes of this study, we define a central place

as a settlement that has definite central functions, or services serving itself and a definable umland. While the central services or functions provide a measure of importance of the centre, it is recognized that a centre's importance may very likely be affected by its external relationships.

A major task of central place studies is the measurement of the centrality of settlements, for which it is necessary to devise quantitative indices of centrality or of intensity of concentration. From such indices, it is possible to develop classes of centres, and several attempts were made to develop a hierarchy of centres for Pichincha. Unfortunately, Vining's comment on the arbitrariness and ad hoc nature of such hierarchies (37) was found to apply only too well to these attempts. Then too, while a particular yardstick might be of value to a particular study, the disparate natures of public services make it fatuous to try to understand service location in terms of a single factor.

Many indicators have been used as measures of centrality. We cite examples of the use of telephone connections (08), bus service (07, 12, 13, and 14), telephone calls and railway tickets (17), number of different types of business (02), as well as the use of conglomerate measures, based on commercial facilities (33), or on service and administrative facilities (01 and 15).

The most basic measures of importance of a centre are its area of influence and its own population, though Christaller noted that these do not express the meaning of the importance of the town very precisely

(08, p 17). Much of the work on central place studies has been carried out in areas approximating isotropic plains with uniform population distribution, for example in S.W. Iowa (02), Wisconsin (05), and on the Canadian Prairies (18), either for the purpose of model building or to demonstrate the validity of theoretical formulations. Pichincha is not so accommodating in that the province by no means resembles an istropic plain, and a uniform population distribution does not exist. Thus a feature of all of the studies cited, the areal distribution of centres or their displacement from each other, will not be used in evaluating centrality or relative importance. The other basic measure of importance, population, represents a market for a public service as much as for a commodity, and should therefore be considered.

The most obvious population figure would be that of the centre itself, since this represents the magnitude of the urban population, or the number of people who are the most likely to take advantage of an urban service. Any centre serves not only itself, but also the surrounding countryside, otherwise it is not a central place, and the goods and services available in the centre are also available to the inhabitants of the surrounding areas who visit the centre in order to avail themselves of the amenities. We might consider the number of people whose basic needs are served by a centre. It was found that rural people tend to go to their cabecera parroquial first in order to satisfy their economic needs, just as they must in order to fulfill their civic obligations. While there are many small centres that are below the level of a parish centre, we lack data for them and, usually, they function at only the

lowest level, so that for cabeceras parroquiales, we may equate the population of the immediate area served by the centre with the parish population. For those centres having no political status, we shall try to estimate the number of inhabitants of the immediate area served by the centre.

One might prefer to use an estimate of the total population actually served by the centre, this being the total number of people who would seek the satisfaction of at least one need in the centre. In a highly mobile society, the total population served by a centre, or its service area, can only be obtained through the extensive use of questionnaires or interviews. In Ecuador, an important feature of rural life is the country market to which people from the neighbouring areas go in order to buy and to sell, and it was reported that they frequently satisfy other needs or problems at the same time and place. Thus we can obtain a reasonable estimation of the total service area of a centre simply by knowing from which areas people go to a centre in order to buy and to sell. If one knows the population of the individual areas, the total population served becomes a simple calculation.

Population is only one basis for measuring the relative importance of urban centres. Measures of market activity take into account variation in economic levels, or at least their aggregation over an area. Data is available on the number and types of business establishments located in rural settlements, and there is a strong empirical basis for using such yardsticks as indicators of the importance of a centre as a market, or for the exchange of goods and services. Christaller consid-

ered marketing to be the prime principle involved in the development of a hierarchy of central places, and the work of Brush (05) and Berry (02) have refined this approach, though both studies cited ignore the fact that a settlement may have a non-marketing raison d'etre.

Berry argues that the best indicator of a centre's importance is the number of different types of business, on the basis that a given commodity has a certain general economic threshold below which it is not economic to offer it for sale. This implies that a centre offering, say, ten types of commodities has a larger market area than a centre offering only five, and is therefore more important. If we identify every different kind of commercial activity or every different kind of commodity offered for sale, we obtain the total number of business types present in the centre, and this figure can be used as an indicator of the relative importance of the market centre. However, we shall also consider other measures of a centre's commercial activity.

Various authors refer to functional units or number of establishments to specify the actual number of businesses engaged in commerce in a centre, though the former term usually considers one store offering two different types of commodity as two units rather than as one, while the latter enumerates only the number of commercial premises. We shall use the latter interpretation, since there are few examples of multi-purpose businesses in Pichincha, and establishments were classified according to what was assumed to be their prime function. The number of establishments might be used as a measure of the commercial importance of a centre, though it is realized that there is no uniformity in terms

of size or volume of trade conducted, and just as Smailes and Hartley found in the London area, we observed that the stores in the larger centres in Pichincha were generally larger than those in the smaller places and offered a greater range of goods, suggesting an 'economy of scale' effect. However, short of securing complete records of gross sales volumes, the number of establishments operating in a centre does give an indication of the volume of business being conducted there, ergo of its relative importance as a market centre.

Another indication of the economic importance of a centre is the existence and frequency of operation of an open-air market. A feature of life in pre-industrial societies that engage in trading, these '<u>mercados</u>' play an important role in the distribution of goods in the rural areas of Ecuador, and people flock to them from the surrounding countryside to buy and to sell. Thus the frequency and size of the market would be an indication of the importance of the host centre as a trading point.

A different type of indicator of the relative importance of any centre is its political status, that is to say, whether it is the national or a provincial capital, a chief town of a canton, a parish centre, or whether it has no political status at all. This is an important consideration in a highly centralized country like Ecuador, where public funds tend to trickle down through the various levels of government. One might expect that the greater power and resources available to centres higher up the political spectrum would make it inevitable, other factors aside, that they should be provided with more, and

higher order services.

Finally, let us consider transportation linkages as a measure of relative importance. Godlund (12) found that centrality was most pronounced in centres with the best road connections and bus services, whereas centres which lacked these facilities languished. Christaller had enunicated the traffic principle of spatial organization, 'Verkehr-prinzip', and his work was the theoretical starting point for the many highway impact studies that have been carried out in North America, and the 'bus studies' carried out in Europe, of which Godlund's is one of the most noted. We may justifiably ask whether services would be more likely located in those centres having better transportation linkages. This author found in an earlier study (30) that the transportation network of Pichincha may for practical purposes be equated with the road network connecting the centres of the province. It was further found that the centres of the province had different patterns of commercial development depending on whether they were located on an interprovincial highway, a road that served a region or linked a remote centre, or a terminal highway. It is therefore reasonable to suspect that service distribution patterns may show analogous differences.

We can assess transportation linkages in terms of traffic volumes for any given highway or point of departure. Highway traffic counts are not available except for seven points on the interprovincial highways, while estimates of the number of vehicles owned locally, the number of people departing by bus per week, and the number of bus departures per week were obtained from local informants. The number of pas-

enger departures for any centre is an educated guess, unless one does head counts, and this introduces the problem of choosing a representative sample time. Highway traffic counts pose a similar problem. The number of vehicles owned locally is also an estimation, but a considerably more reliable one than that for bus passenger volumes. However, vehicle ownership is rare in Ecuador (11 per 1,000 population), particularly in the rural areas of the country, and the local people invariably travel by bus. Thus Berry's comment with respect to Europe (03) is equally valid for Ecuador, namely that bus services are a suitable indicator of local traffic patterns. It is therefore proposed to consider only the number of bus departures, largely because these are the most reliable figures available, and as Green noted (14), bus services develop a steady state pattern in response to traffic generation over a period of many years. Thus the number of bus departures from a centre would provide an indication of that centre's interaction with other centres. However, a centre may be served by buses proceeding between two large centres, ie. in the case of any settlement on an interprovincial highway, in which case one can say that no buses depart from the town, or that they all do. While Ecuadorian bus companies have schedules, they are noted for the breach more than the observance, since it is common practice for a bus to depart from a centre when it has a full complement of passengers. Consequently, the number of buses that would stop en route might well be only a small percentage of those actually passing any given point. There are many feeder services into the large centres from outlying communities, and the number of these services reflects the volume of passenger movement from any given centre. Therefore, only those bus trips that originate in a given

centre are considered as being departures from that centre.

Another indication of the importance of the centre from the point of view of transportation considerations may be its potential for generating traffic. Such an estimate may be derived from Newton's Law of Gravitation and of mutual energy between two masses, which has been utilized by social scientists to give measures of demographic force and of demographic energy, mass of people being equated with mass of matter. The concept of potential has also been used extensively in social physics, as in the studies by Stewart (34) and Stewart and Warntz (35), while Schwartz (32) has outlined the theoretical development of this type of study. The concept of potential will therefore be used as an indicator of the likelihood of interaction between two centres, ie. of the potential to generate movement to or from each centre. Symon (36, p 225-6) gives a development of potential for an 'n-particle system', or the general case, where the gravitational potential at a point having a mass 'm' caused by a system of particles having mass 'm_i' is given by:

$$Pot = -\sum_i \frac{G\, m\, m_i}{|\bar{r}_i - \bar{r}|}$$

and where $|\bar{r}_i - \bar{r}|$ is defined as the scalar distance between the two points defined by 'r' and 'r_i', and 'G' is the gravitational constant.

Demographic potential can be operative only along the paths of the network, so that in the formula for gravitational potential, we could replace $|\bar{r}_i - \bar{r}|$ by the distance between the two points over the network. Since we are not dealing with an istropic plain, or even with an area of fairly uniform terrain, we cannot ignore the effect of topo-

graphy on getting from point A to point B, nor the condition of the road. Road user cost, or the cost of driving from A to B (see 30, Sec. 4-1), includes the effect of distance, along with those of surface condition, gradient, curvature, and driving time necessary, and will therefore be used in the formula instead of distance. The negative sign is a convention, and social physicists have yet to evaluate the gravitational constant. For these reasons, and since we are only evaluating the potential for the purposes of comparing that of one centre with that of another, we may ignore both the sign and the constant, and the calculation of potential becomes simply;

$$Pot_i = \sum_{\substack{j \\ i \neq j}} \frac{Pop_i \cdot Pop_j}{Cost(i,j)}$$

The population figure used will be that of the immediate umland of the centre, since this value includes all people who would, by definition, contribute to the demographic potential energy of a centre. It will be considered that everyone is located at the centre of the community in or near which they reside, since (a) a large proportion will live in the immediate vicinity of that central point, and (b) the rural population satisfy their basic needs in the centre, if possible.

The indicators that will be used for evaluating the relative importance of a centre will therefore be as follows: population of the centre; population of the immediate area; total population served by the centre; the number of business types in the centre; the number of business establishments in the centre; frequency of open-air markets; the political status or designation of the centre; whether the centre is on a

national, regional or terminal highway; the number of bus departures from the centre; and the 'potential' of the centre in terms of demographic energy.

These are, of course, not the only possible measures or indicators that one might use. Some possible measures, such as bus departures and the number of vehicles owned locally, were discarded in favour of an indicator that is either more accurately measured, or that is more germane to the study area. The choice is somewhat limited by the data available. We might have included manufacturing, since the location of local industries is known, but we have no data on non-agricultural or industrial employment. Then too, we would argue that an industrial plant, by providing employment and tax revenue to the local community, enhances the relative importance of the centre rather than merely indicating it, since an investor locates a factory primarily to take advantage of some resource. While it is doubtful whether the consideration of more detailed measures of relative importance would give significantly different results, the use of non-agricultural employment would be an appropriate addition, if statistics for individual centres were available.

It was found in our previous study that there is considerable inter-dependence between certain of the indicators that we shall be using. To test this statistically, a simple correlation test will be run, the results of which will be utilized in evaluating the role of each indicator of relative importance. More significant is the fact that high correlation or covariance between some indicators means that

a purely statistical approach to developing a composite criterion for explaining service location may be of questionable value, particularly if estimation techniques are involved, as in multiple regression.

1-3 Urban Services

The services to be examined are provided by the various levels of government either directly or through agencies. Government departments and agencies, both national and provincial, that are located in Quito because of a unique political consideration, namely that it is the national or provincial capital, will not be dealt with at all. Church operations will be included, since the Church is the only non-commercial entity operating throughout the rural areas of the province.

If we consider the three levels of education separately, fourteen different types of urban services are available in one or more centres in Pichincha. In order of increasing frequency of occurance within the province, they are: post-secondary education, fire protection, garbage collection, police, justice, secondary education, financial institutions, escuelas de corte y confeccion or home economics schools, religious institutions, telecommunications, health services, electricity, postal services, and primary education. The locational patterns of each service will be tested against each indicator of importance, since we hypothesize that a service will be located in urban centres in relation to their level of importance.

It is anticipated that there will be no absolute threshold

values below which no centre has a given facility, and above which every centre does have one, but that necessary and sufficient threshold values can be obtained. The necessary threshold value is the smallest occurring value for a centre to have the facility in question, while the sufficient threshold value is the largest occurring value for a centre not to have the given service. Thus we can specify the limit below which the service does not occur and the limit above which it always occurs, with a range of uncertainty between them.

A service may be found in some relatively unimportant centre, or not found in some relatively important place. In either case, an extra-large range of uncertainty for one or more of the indicators would result. We may well find that in spite of a large range of uncertainty, the necessary or sufficient threshold value for one or more indicators does isolate a large proportion of centres that respectively do not or do have the service in question. In looking for the greatest discrimination, we shall take both possibilities into consideration, and look for those indicators of centrality that best explain the spatial distribution of a given service, first alone, and then by combining criteria to further increase the number of centres falling into either group. Since we are interested in service locations, our perspective will tend to be directed more towards those centres that have a given facility than towards those that do not. When the addition of further indicators does not provide any extra explanation, we shall look at any remaining unexplained cases in order to determine whether other factors are operative. For such examples, it may be possible to determine further

constraints or factors that affect the operation of the service, and it will be possible to better understand the natures of the centre(s) involved, especially if there is any consistent pattern of over- or under-servicing in any particular area. This may also suggest necessary modifications to our location criteria. In any case, we should be able to say finally that if a centre does not have A_i and B_j, then an 'X' is not located there, or if any centre has more than C_i or D_j, then a 'Y' is always found there, where A_i is some level or density (A) of explanatory variable i.

This approach is perhaps simplistic, but it does provide a satisfactory method of separating out centres having a service from those that do not. A more sophisticated technique, such as discriminant analysis with two groups (see 09, BMD04M), was tested and found to give less satisfactory results, whether one used all or just a few of the measures of relative importance.

While our objective is to explain the location or distribution of urban services in terms of the relative importance of the centres of the study area, an important corollary of this objective will be an assessment of the indicators of importance used. We shall be particularly interested in identifying those indicators, if any, that do not contribute significantly to an understanding of service location.

1-4 Some Further Notes

In essence, the criteria that will be specified imply prerequisite population, commercial, or transportation levels (as the case

may be) that are sufficient to warrant the installation of a service facility in a community. If we have projections as to how the nature of any centre may change over a given period in the future, these criteria thus give a guide as to what further service facilities may be required to serve the community, and when they should be installed, or if we assume that the facilities are readily established in response to demand, we have a means of predicting service distributions at any time in the future.

There are limitations to these applications.

We are here viewing the services at one point in time and drawing conclusions from the observed distribution patterns. As mentioned in the first section, our results may have limited use as a tool for prognostication. Public services are funded by governments, and governmental priorities vary greatly over time. A service that is currently being developed rapidly may be quiescent in ten years time and vice versa. Without a historical perspective, not only of how the service has been administered over time but also of how the centres of an area have developed during a corresponding period, is impossible to know whether a service is highly susceptible to political or technological change, and whether such change would substantially affect the location pattern of the service at any particular point in time.

A further limitation to the application of our results is that only a limited number of factors governing service location is being considered. We hypothesize that services will be located according to the relative importance of centres, as measured by ten selected

indicators. While this approach can be applied to any service, it is realized that there may be other factors of a specialized nature that figure prominently in the operation and location of facilities of some services. Where possible, these other factors will be identified. However, before one could say definitively that a given centre under given conditions must have a given facility, any such additional factors would have to be analysed.

As mentioned at the end of Section 1-1, we are considering that the importance of centres affects the location of services, but not vice versa. While a given facility may be located to serve a given population, it is equally possible that the service will induce some people to relocate themselves in proximity to the facility. In other words, a service may contribute to urbanization, or to the increase in the relative importance of a centre. There is no data available as to how a given facility affects a community in terms of increasing population or economic or commercial levels, and we shall not look at this spin-off effect. In any application of our results, while we can suggest when and where certain facilities may be required, the regional developer must be aware that any given service may itself influence local growth patterns, causing a possible further increase in the demand for public services.

Our approach has a potential methodogical application. The problem of evaluating centres from the point of view of public services has been attempted by geographers (see 01 and 15). In each case, the problem of aggregation is overcome by a weighting system that is some-

what arbitrary in its assignment of values to individual services. Since we are identifying criteria that explain the location of services in Pichincha, it should be possible to adapt these criteria to develop a more rigorous method of obtaining a 'service score' for a centre than methods currently employed.

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PART TWO

THE URBAN CENTRES

In this part, we shall assess the relative importance of centres in Pichincha, using demographic, political, economic, and transportation criteria. Seventy settlements will be considered, namely the 65 parish centres, plus Quito, Chiriboga (Chillogallo), El Tingo (Alangasi), and Las Delicias and La Concordia (Santo Domingo de Los Colorados). These are central places by our definition, serving not only their inhabitants but a definable umland as well. In general, all other settlements in the province are dependent on these 70 centres, and seldom contain more than a small grocery store, and possibly a primary school. A further reason for not including the smaller settlements is that fairly complete and reliable data is available only for the 70 centres specified above.

2-1 Demographic Criteria

It was suggested in the author's earlier study (30) that the direct use of the population statistics of the 1962 census (27) left something to be desired in terms of accuracy, yet the figures of the 1972 National Census will not be ready until late 1974. To try to overcome this shortcoming, use has been made of population projections worked out by the Junta de Planificacion for both *parroquias* and for *cabeceras parroquiales* (25, 26). Based on observed changes over the period 1950 to 1962, the annual increment has been projected through

to 1975. Since field observations for the commercial sector were made in 1970, the 1970 projections for town and parish populations were used. For the centres for which no data is currently available, populations were estimated. Such centres, some of which have attained parish status since 1962, include: Los Bancos, Chiriboga, Alluriquin, Las Delicias, La Concordia, La Merced, Isidro Ayora, Juan Montalvo, and El Tingo,

In order to try to discover the limits of the trade areas of the central places, local informants in the rural centres were questioned as to where the rural people went in order to buy and sell, and from the replies it was possible to construct a map (Map 19) of such market areas. The population actually served by a centre is considered to be the population of the 'market area', which is simply the sum of the population of the parishes included in the area, Where people of a parish are divided in their movements between two centres, an estimate of the proportions involved has been made. In general, it was found that the cabeceras parroquiales have their corresponding parish boundaries as the limits of their trade areas. The parish centres have evolved, both ecclesiastically and politically, because they are accessible to and serve the surrounding countryside, and the designation of a centre as a cabecera parroquial will result in movement towards such a centre to use the offices of the teniente politico or of other local officials. It will be seen in Part Three that services are usually located only in parish centres thus reinforcing further the general traffic patterns between such centres and nearby rural areas.

Consequently, for lowest order needs, the parish boundary usually delimits fairly accurately the market area served by a parish centre. Centres with higher order functions cater to larger populations located in several parishes, and these are the areas shown on Map 19.

For each centre, the three population figures are listed in Table 1 in Appendix A, along with the values of the other indicators of relative importance that we are considering.

2-2 Political Criterion

The political division of Pichincha is unchanged from that indicated in our earlier study (30, pp 9-10), except that Los Bancos has been raised to parish status in Canton Quito, which now has 37 rural parishes. The political status of each centre studied is indicated in Table 1 as follows: NAT - national capital; CAN - cabecera cantonal; PAR - cabecera parroquial; N S - no political status.

2-3 Economic Criteria

For each centre studied, the different types of commercial activity and the number of establishments engaged in each type of activity were recorded. The number of business types and the number of establishments in a centre are simply the respective numerical totals.

Local informants cited the days on which a market was held, if any, and gave a qualitative indication of its size.

2-4 Transportation Criteria

The centres can be classified (N, R, and T, respectively) according to their major highway link, using as our operational definition, viz.:

- national highways are major through, inter-provincial routes linking the major cities of Ecuador,
- regional highways connect the centres of a region, but serve only that particular region, and
- terminal highways go only to a particular place, and to no other centre (see 30, p 38).

The number of buses departing from each centre was obtained from personal interview of local informants, and from traffic counts on the inter-provincial highways conducted by the (former) Consejo de Transito in September 1968. Bearing in mind Green's observation that bus services develop a steady state over a period of years, it is not unreasonable to assume that the number of buses observed passing these checkpoints in 1968, would not be substantially different from the number in 1970 or 1971, It should be noted that while informants in towns on the inter-provincial highways knew how many departures originated from their centres, they had absolutely no idea of the number of buses that actually served their communities.

To permit an examination of the effect of centres outside the province on the transportation network and on the demographic potential of centres on inter-provincial highways, distances were obtained and the corresponding road user cost estimated as accurately as possible for the larger centres of neighbouring provinces. These

include: Esmeraldas, Chone, Guayaquil, Latacunga, Ambato, Tulcan, and Papallacta (values are given on Map 1). It should be noted that a computational error originally made in the calculation of driving costs was corrected, so that the values used in this study do not correspond exactly to those cited in the earlier work. To facilitate the calculation of driving costs between centres in the province, all distances and costs for highways out of Quito were measured from the Ejido/Patria intersection, close to the centre of the city.

The resulting values for potential are given in Table 1. Because of the very large numbers involved (of the order of 10^{10}), logarithmic equivalents of the potential are used throughout this study.

2--5 Correlation Test

To test whether eight of the indicators used are statistically independent or not, a simple correlation test was done (see 09, BMD03D), and the resulting correlation matrix is given in Table 2, Appendix A. Political status and type of highway link were not included since these criteria are stated in terms of classes, rather than as measures, and the advantages of their inclusion in the correlation testing would be more than offset by the problem of trying to assign meaningful weightings to the different classes. In addition, Quito has been excluded since data is unavailable for four of the indicators. Also, it was found that the exclusion of Quito from the analysis considerably decreased the standard deviations and the means, without substantially affecting the values of the correlation coefficients.

It was found that the correlation coefficients for pairs of the eight indicators included ranged from .44564 (potential vs. no. of market days) to .98202 (no. of establishments vs. population of the centre), with most of the values being greater than .6. If we test at the .01 level of significance for a sample of 69 (11, p 278), we find that if 'r' is greater than .311. then statistically, there is less than one chance in a hundred that the two quantities are independent. Thus statistically, all eight indicators are interdependent.

The correlation coefficients obtained show that the population of the centre and the number of commercial establishments in the centre are the most highly intercorrelated with the other indices, and could well be used as surrogates for them. Later, in classifying the centres of the province, these two variables will be emphasized, to the exclusion of the others. Before this classification is attempted (see Part IV), a detailed analysis of the occurance of some fourteen urban services will be carried out, and in this analysis, consideration is given to all of the above eight indices, in addition to the other two non-quantifiable measures of urban importance.

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PART THREE

THE URBAN SERVICES

In this part, we shall attempt to explain the spatial distribution of each type of service facility by the determination of thresholds of urban importance. In Part I, it was stated that probably no absolute thresholds exist, but that one might identify necessary and sufficient values. The necessary threshold value may be defined as the absolute minimum value below which no centre will have a given service, while the sufficient threshold value is that level above which every centre will have the facility. From our observations, the two thresholds are, respectively, the absolute minimum level 'necessary' for the service to occur, and the minimum level that is 'sufficient' to universally warrant the provision of the service.

These two values for the eight quantified indicators of urban importance are given for each type of service facility in Table 3, Appendix A (cols. 2 and 3). Column 4 gives the difference between the two, or the 'range of uncertainty', the area in which the service may or may not occur. The remaining columns of Table 3 give the numbers of centres occurring within the specified field, and are included to give an indication of the relative strength of each measure as a discriminator between those centres that have a facility and those that do not. Were an absolute threshold value to exist, then one could explain service location in terms of that indicator of urban importance alone. In general, the indicator giving the smallest number of centres in the range of uncertainty will be taken first, and then other measures utilized to attempt to ob-

tain complete discrimination. To provide more insight into the spatial distribution of each type of facility, background information on factors that affect service location is also included. This information was obtained from personal interview with suitable administrative personnel, or from available records.

We shall examine the services individually, in order of increasing frequency of occurance within Pichincha Province. Maps showing the spatial distribution of each service or type of service facility can be found in Appendix B.

3-1 Post-Secondary Education

There are three institutions of post-secondary education in Pichincha: Universidad Central, Universidad Catolica, and the Escuela Politecnico, all of them located in Quito. Other such institutions in Ecuador are located in Guayaquil, Cuenca. Loja, Portoviejo. Ambato, Machala, and Esmeraldas (see Maps 1 and 3). It was possible to obtain reports for 1970 put out by the Universidad Central del Ecuador (21), and the Universidad Catolica (20).

The above mentioned locations suggest that universities are established in the largest centres of the country, serving a region up to 200 kilometres in radius that may include several provinces. A commission on post-secondary education which works under the Ministery of Education supervises the state universities, and it should be noted that the newer campuses that have been established offer a limited range of courses, in order to cater to the increasing number of would-be students from

those areas, who would otherwise be forced to move to a much more distant centre in order to continue their studies.

It was not possible to obtain complete data on the place of residence of the students, so that it is impossible to measure the likelihood of a person going to university in terms of local factors. The statistics obtained do, however, indicate the province of residence for students registered at the two universities in Quito, for the year 1967-68. Out of 6,960 students at the Universidad Central, 3,348, or 43.2% were from Pichincha, with a further 24.6% from Carchi, Imbabura, Cotopaxi, and Tungurahua, those adjacent provinces of the Sierra that would most likely be served by the institutions located in Quito. At the Universidad Catolica, 1.499, or 58.6%, out of 2,577 students were from Pichincha, with a further 16.3% from the other four northern provinces. For the country as a whole, one person in 300 was registered in post-secondary institutions whereas the two universities alone give a figure of one per 131 for Pichincha. It was found in a study of Pichincha's co-operative members (31) that the higher a person's education, the higher are his income level, and his educational aspirations for his children, and it is more likely that he resides in the Quito area than anywhere else in the province. This would suggest that while universities are located in the larger urban centres, they also act as an urbanizing force by providing a stimulus or reason for people to move into an urban area in which such an institution is located.

By January 1, 1971, the post-secondary enrolment had more than doubled to a total of 42,394 students, with 12,345 at the Universidad

Central de Quito, 5,583 at the Universidad Catolica de Quito, and 2,214 at the Escuela Politecnico de Quito. Detailed breakdowns of these figures were unfortunately not available, but they indicate a large improvement in accessibility, as one Ecuadorian in 151 was receiving higher education as of this later date.

3-2 Fire Protection

Found only in Quito and Santo Domingo, this service appears to be typical of only the larger communities. A look at the centres having a fire brigade that are located in other provinces (given in 24) suggests that in the Sierra, the threshold population for this service is around 20,000 inhabitants, whereas in the Costa, and the Oriente, some centres with only 600 boast a municipal fire protection unit. The data available does not distinguish in any way between levels of service offered. In general, Costa communities of more than 3,000 inhabitants usually have a cuerpo de bomberos. The difference in thresholds occurs because fires are relatively few and do little damage in the Sierra, where concrete, fired brick, or adobe are the principal building materials, whereas in the Costa, it is not uncommon for whole towns to burn down, as most buildings are constructed of wood, and there is therefore a much greater need for some sort of protective service. While the national Ministerio de Prevision Social is the administrative supervisor, the local municipalities underwrite the forces, funding being obtained from 0.1% of the property tax in the Sierra, and 0.15% in the Costa, the service itself being provided free.

Both of the fire-fighting forces in Pichincha serve just the urban area, the Quito force answering outside calls maybe five or six times a year. When time is of the essence, road conditions make going too far afield pointless! There are no plans for expanding the service to other towns, only for improvements to existing corps and equipment. The 12 volunteers in Santo Domingo combat about 30 serious fires a year, whereas the 125 professional fire-fighters in Quito's two corps provide a complete emergency service, attending to, during 1970, 735 fires of all kinds, 1,047 calls for first aid and inhalator unit, and 1,210 calls for providing water from a tank truck to those areas of the city that had no water pressure at all during the dry season. They also answered 46 false alarms.

Other centres resort to that time-honoured system, the bucket line, and manage as best they can. For example, there is no equipment available in Sangolqui, and for the occasional serious fire, help may be requested from Quito. Fire extinguishers are rarely found in the rural areas due to their relatively high cost, and the problem of having one in the right place at the right time.

In summary, it appears that there are two thresholds for the establishment of a fire protection force, one for the Sierra, and one for the Costa, and it would seem that the larger and more important the centre, the more complete is the emergency service offered by the force. Without looking at other large centres in the other provinces in both regions of the country, it is difficult to make further inferences.

3-3 Garbage Collection

This is another exclusively urban service requiring a moderately high capital investment. While Quito uses 50 garbage trucks that cost U.S.$ 14-16,000 each and which will each take up to 16 cubic yards of wastes, Santo Domingo and Sangolqui, the only other centres that have organized this service, both use two ordinary trucks for their collections. In all three centres, there is daily collection in the urban area, but not beyond, except that the Municipio de Quito provides biweekly pick-up in Chillogallo, Conocoto, Calderon, Cumbaya, Tumbaco, Pomasqui, San Antonio, and Calacali, while Sangolqui provides a weekly collection in San Rafael, San Pedro, and Cotogchoa (see Map 5). In each of these 11 cases, the extended service is offered only in the centre itself.

The rationale behind extended service is difficult to discern. In the case of Sangolqui, the three beneficiaries are located 2.1, 1.5, and 5.4 Km. respectively from the larger centre, and are compact communities, though only San Rafael (2.1 Km.) is linked by a paved highway. It seems that convenient access for a large truck is the sole prerequisite for extending service that is used by the Municipio de Quito, since Calacali is 35 Km. from Quito, yet much nearer centres like Nayon, reached by a narrow winding road, are not served at all. A further requirement would be that the truck can be manoeuvred through the streets of a centre seeking service; while one could speculate that service might be extended to Pifo once the Papallacta Highway has been completely reconstructed, that centre's narrow streets would inhibit the initiation of collection using the Municipio's trucks.

While the capital and labour required for this service sug-

gest that a large tax base is needed to pay for it, the larger a centre's population is, the more necessary some organized system of garbage removal becomes, as the figures given by the municipalities indicate that Ecuadorians produce about two pounds of garbage per person per day. About 10,000 people live in the conurbation of Sangolqui and neighbouring parishes and barrios, an area which also contains several factories, plus two subdivisions with housing of above-average quality.

Cayambe also has 10,000 people in its immediate area but they are somewhat more dispersed, and less wealthy than those of Sangolqui, while Machachi, the other large centre in the province, has only 5,000 persons in the urban area. It would seem that a population of 10,000 fairly compactly located in one centre or in several adjacent centres may tentatively be assumed to be the threshold for the provision of garbage collection. We can only speculate as to likely threshold values, as the provision of this service also depends on available revenues and on how necessary this service is perceived to be.

Everywhere else, people dispose of their own wastes, sometimes at community dumps, but more likely wherever convenient. Some attempts to start a local service using a mule or pack animal have been made, without enduring success, This would further suggest that garbage collection is organized only in response to a definite and obvious problem. In comparison with fire protection services, the findings suggest that, in the Sierra, this less capitalized service has a lower threshold population and will therefore be more widespread. In the Costa, on the other hand, it could be argued that while garbage pre-

sents more of a health hazard because of the warmer, more humid climate, fire protection would have a higher priority than garbage collection if municipal funds are limited.

For disposing of the collected garbage, Quito has a well-organized sanitary landfill program at four sites, using three tractors and a Pay-loader. Santo Domingo uses one landfill site, but dumps much of the collected refuse in the Rio Toachi. Sangolqui dumps all of its six truckloads a day in the Rio San Pedro. The pollution problem is recognized, but it is not perceived to be a significant one.

Finally, as part of its sanitation program, Quito has six Wayne 900 street-sweepers, which cost $28,000 each delivered to Quito. These machines are used on asphalted streets in the city only, mainly at night, and this street cleaning program is considered to be an important activity by the municipal health department, It is doubtful if any other than the largest cities in the country offer, or can even afford, this kind of service, though most parroquias do hire a few men to 'maintain' the streets, a very limited program at best.

3-4 Police

The maintenance of law and order is an area of responsibility of the teniente politico, who has definite powers to arrest, detain, and charge malefactors and miscreants located in his jurisdiction, and who works in co-operation with the Comandancia-General de Policia, located in the provincial capital. This latter has responsibility for maintaining law and order in the provincial capital, through the city police, and for patrolling the streets and highways, using the highway police,

both forces being stationed in provincial capitals only. The Comandancia also runs jails and prepares all criminal charges for presentation in the courts. In addition, the Oficina de Investigation Criminal handles the more difficult cases, as well as those involving foreigners, or cases of foreign origin that are referred to them by Interpol. The Ronda Nocturna operated by ex-police or ex-army personnel perform a night-watchman service in residential areas of Quito for a monthly fee of $1.25 per house. Private companies of security guards are available and are hired by banks, stores, and factories. The Rural Police patrol the rural areas of the provinces, providing a presence rather than an effective force, but at the same time, forming an important link between the teniente politico and the Comandancia-General. While the Rural Police has about 35 full time officers for serving the entire province of Pichincha, the crime rate is considered to be low, particularly in the Sierra, and they can and do call in reinforcements from Quito or elsewhere, if an emergency situation so warrants.

The location of police stations, and the deployment of personnel are decided by, and to suit the purposes of, the Comandancia-General in Quito. In general, police stations are established in cabeceras cantonales, Tabacundo being the only such centre in Pichincha that lacks this type of facility, presumably because it is easily served from Cayambe, located only 9.2 Km. away. It is estimated that there is one rural policeman per approximately 10,000 inhabitants in the Sierra, and one per 3-4,000 in the Costa, because of the substantially higher crime rates in the latter region. Since the four

largest centres outside Quito in Pichincha have police stations, each with at least three officers, and each serving in excess of 30,000 people, it would seem that in the Sierra at least, a centre should probably serve about 30,000 people, and would be a cabecera cantonal before it will have a police station of its own. While no data is available for the Costa except Santo Domingo, general observations made while travelling in other provinces would suggest that the threshold in this region is substantially lower, probably of the order of 10,000 to 15,000 persons served.

The Polica Rural do go out on patrol, but are based at the barracks or station. Even if a small centre has a high crime rate, or a troublesome population, it appears that the police would prefer to billet an officer or two there for a period, to support or assist the teniente politico, who also has police powers at the local level, rather than to establish a more permanent and independent operation in the community. In summary, we may say that police operations are located according to the political status of centres, but subject to a population constraint that varies according to the regional crime rate. We have no information that suggests that other possible factors such as the economic status or accessibility of a centre are important.

3-5 Justice

The system of justice is analogous to Canada's in that there is a hierarchy of authority and jurisdictional power ranging from the Supreme Court down to the magistrate, a role filled by the teniente politico, who has the power to try criminal cases at the local level,

providing the offence is minor. At the next higher level each cabecera cantonal in the country has a Juzgado Cantonal, where civil suits smaller than S/8,000 (this sum would buy four heavy-duty truck tires) may be heard, and estates may be settled (a judge's certificate thereof is required by a widow before she may remarry). The judge also performs duties similar to a notary public, such as the taking of statements and witnessing contracts, as well as carrying out judicial inspections.

Provincial capitals have a criminal court where all criminal cases for the province are tried, as well as a Juzgado Provincial (there are eight in Quito), where civil cases involving large values are heard. Finally, in the provincial capital, there is a Corte Superior, a still higher court for appeals, and in Quito, the Corte Suprema, the ultimate legal authority in the country. Court location is thus completely dependent on the political status of a centre.

Accessibility may be a problem in terms of obtaining legal counsel, in that while lawyers and notary publics abound in Quito (there are eight pages of listings in the yellow pages of the Quito telephone directory (10)), only twenty lawyers practice in rural Pichincha, of whom 17 live in Santo Domingo. Two who live in Sangolqui have offices in Quito, while the twentieth, a resident of Guayllabamba, practices almost entirely in Quito. The rural people do not generally have ready direct physical access to legal services, and they do not come cheaply, so that in the country there is more pressure to use the office of the teniente politico, or of the Juzgado Cantonal. While there is a system of legal aid for needy defendants, an informed source stated

that it is standard practice for lawyers to charge what the market will bear, so that it is difficult to determine the 'cost' of justice, beyond the statutory court fee assessed for all monetary claims. In fact, the only practical legal counsel, court of appeal, and up-holder and dispenser of justice for the country person of less-than-modest means is the teniente politico, whose authority is limited, and whose training is frequently negligible.

3-6 Secondary Education

(See also Tables 3a, 3b, 4 and 5 in Appendix A).

Thirteen centres in Pichincha have high schools offering the first three years, or ciclo basico, while in only six centres are the last three years, or ciclo diversificado available. This latter program contains various courses of specialization, though usually a particular school will only offer one or two such courses, and only in Quito are all available at one or more of the 89 schools offering ciclo diversificado. Most of the secondary schools are privately-run, though the role of the Ministry of Education is increasing, particularly as the national government plans to establish 40 new secondary schools in the near future. The basic policy towards the establishment of new schools is that a new colegio should have an initial enrolment of 50 to 60 students, with at least 60 to 70% of them continuing in course for subsequent years, in order to make the investment worthwhile. For the people, there is a fundamental difference in costs. Government schools charge only a registration fee

of S/ 100-200 whereas private secondary schools cost S/ 300-400 per month for a 10-12 month year.

Schools offering ciclo diversificado are found in the four largest and most important centres of the province, namely Quito, Santo Domingo, Cayambe, and Sangolqui, and also Conocoto and Uyumbicho. It is unknown if there is a specific policy governing the establishment of this type of school, but there are certain apparent locational factors involved. All eight necessary threshold values correspond to those of Uyumbicho, while the sufficient threshold values correspond to those of Machachi, except that for the number of bus departures, and for potential. Population of the centre, number of establishments, number of business types, and total population served all isolate the four largest centres in the province, while Conocoto and Uyumbicho fall in the range of uncertainty.

Machachi is a large centre lacking an advanced secondary school, but to some extent, this is compensated for by the centre having good access to Quito, and by it being only 14 kilometers from the large school located near the small community of Uyumbicho, a- bout a kilometer from the Pan-American Highway. This particular school was apparently located there because of the availability of land in an aesthetic setting, and there are facilities for both day and boarding students.

Therefore, let us suppose that the school in Uyumbicho were located instead in Machachi. We can then see that if a centre has a population of at least 2,765 inhabitants, or at least 28 different

business types, or at least 180 business establishments, then one can expect to find a school offering ciclo diversificado there. If a centre has no more than 2,600 inhabitants, and 26 business types, and 127 business establishments, then one would not expect to find such a school there at all. The difference between the corresponding values for each indicator occurs because of the limited number of cases available, so that we are unable to specify more precisely the exact cut-off point between these centres that have a school offering ciclo diversificado, and those that do not. The population threshold gives an indication of the population base required to provide an adequate number of students to make this type of facility practical, while the other two thresholds suggest a prerequisite economic level, which is, of course, largely dependent on population size. The other indicators give less satisfactory discrimination.

Outside of Quito, there is little choice of program; Santo Domingo offers agricultural and commercial subjects only, while other centres have only humanities or a general program available. The relatively small enrolments in centres away from Quito suggest that these schools serve a limited area, and that if it is necessary for a student to travel any great distance, or to board away from home, then he or she is more likely to go to Quito than to a nearer centre, in order to partake of the much greater opportunities available in the large city.

Schools offering ciclo basico are found in the six centres where ciclo diversificado is available, plus seven other centres that

are, for the most part, located close to the aforementioned six centres. It would seem that the schools of Aloag, Amaguana, San Rafael, Cumbaya, and Tabacundo were established to take advantage of the increased opportuntity for further education provided by a ciclo diversificado school located nearby. In these centres, the cost of education both real and perceived, would be substantially reduced, thus generating a greater demand than normal for facilities that will prepare students to take advantage of the advanced program offered at a distance small enough that they could easily commute from home, rather than board away.

Schools offering ciclo basico are not found in any centre that is not at least a cabecera parroquial, and are found in all cabeceras cantonales. A look at the necessary and sufficient threshold values for this service (Table 3b, Appendix B) shows that the population of the centre, the number of business types, and the number of business establishments give the smallest numbers of centres falling within the range of uncertainty, as was the case for schools offering ciclo diversificado. The three sufficient threshold values isolate eight centres, and a ninth if we note that a school at Cumbaya is located very near to Tumbaco, and could be considered as belonging to either parish. We can then specify that any centre with more than 23 business types or more than 112 establishments can be expected to have a secondary school, as will any centre having a ciclo diversificado school. The population threshold does not add any further explanation though it was noted in the correlation test that there is a close re-

lationship between commercial levels and population figures. Sending a child to school involves the direct costs plus the indirect cost of lost wages through him/her not working, costs which would require a certain economic threshold to sustain. Since the number of establishments in a centre is an indicator of relative economic as well as commercial levels, a higher number of establishments indicates a higher demand for goods and services, ergo for secondary education, though it is fully realized that the ready availability of advanced secondary education is probably a necessary catalyst for the establishment of a school offering ciclo basico.

The necessary threshold values for population of urban centres, number of business types, and number of establishments each cut off half of the centres studied, while other threshold values other than potential are of little value. Combining them adds little by way of explanation, so that we might consider that 23 business types or 112 establishments are the limits above which we expect to find a secondary school in a centre. The school at Aloag appears to have been established to take advantage of the facilities for higher education located at Uyumbicho, about nine kilometers away, which also has a ciclo basico school. Similarly, the school at San Rafael is close to the 'diversificados' of Sangolqui and Conocoto, and as we mentioned earlier in the section on garbage collection, San Rafael has a population with above-average income, which would doubtless create a higher demand for education facilities than one might normally expect for a centre of its size. The school at Pintag appears

to have been established in 1970 as a result of local initiative, in accordance with government policy, to serve a population which is located near enough to be accessible to Quito and Sangolqui (30 and 20 Km. away), but far enough to make commuting inconvenient as the road is poor to Alangasi, and there are only six buses daily each way. Even so, one of the students hikes in each day from his home, which is located eight kilometers away in the mountains.

No secondary school is found in the Guayllabamba to Pifo area, and it was suggested by some local informants that parents would in any case prefer to send their children to Quito. Another void is found in the north around San Jose de Minas, which is being considered as a location for one of the forty new secondary schools that the Ministry of Education is planning to build. The Nord-Occidente is another zone whose need for a secondary school has been stated very explicitly in petitions and deputations to Quito.

Thus while the locational pattern of schools offering ciclo diversificado is fairly simple, that for lower secondary schools is much less straightforward.

3-7 Financial Institutions

(See also Tables 3c and 6 in Appendix A).

As befits a national capital, Quito has a complete range of financial institutions, ranging from the Banco Central del Ecuador, the national reserve bank, through commercial banks, and a newly-opened stock exchange, to small co-operatives of various types. A

stock exchange is only found in Quito, while the reserve bank has branches in Quito, Tulcan, Ambato, Riobamba, Cuenca, Loja, Machala, Guayaquil, Esmeraldas, Manta, Bahia, and Jipijapa, Six commercial banks have head offices in Quito, five in Guayaquil, and one each in Cuenca (Azuay), and Machala (Machala). An examination of a list of centres having banks (given in 24) suggests that this service is located only in the larger commercial centres of the countryside. In Pichincha, ordinary banking facilities are found in Santo Domingo, and in Cayambe, as well as in Quito. Except for local money lenders, of which no information is available, and for savings and loan co-operatives, there are no other financial facilities or institutions located in the rural areas of Pichincha, For mortages and consumer credit, it is necessary for most rural people to go to Quito.

Savings and loan co-operatives (cooperativas de ahorro y credito) are found in fifteen centres in the province, while a new one is currently (mid-1971) being organized in San Jose de Minas. For all co-operatives, it was possible to obtain data concerning the number of members, the deposits, amount of credit extended, and the number of loans made. Information on the formation, organization, day-to-day administration, and the problems of these co-operatives was readily obtained from the Federacion de Co-operativas de Ahorro y Credito (FECOAC), the Banco de Cooperativas, and from two co-operative directors. One of the two is 'open' and any person in the area may belong to it (Atahualpa), while the other is 'closed' and only employees of one factory (El Progresso Cigarettes) are eligible to join.

The Federation of Savings and Loan Co-operatives (FECOAC) and the Banco de Cooperativas both encourage the formation and development of this type of service, and provide assistance to any co-operative requesting it. Nevertheless, the basic wish and initiative must come from the people of a centre, who must also be responsible for the day-to-day operation of their co-operative. Thus while auditing and financial assistance is arranged through entities in Quito, a co-operative is a locally organized response to locally perceived need.

Local initiative, drive, and effort, are indispensible for a savings and loan co-operative to be successful, the case of Atahualpa having been cited elsewhere (30, p 75), and these characteristics are perhaps more necessary than any population or economic considerations. One can observe on a map of financial institutions (see Map 9) that co-operatives are also a response to a lack of access to banking facilities. There is also another factor that is hard to pin down, but which was somewhat apparent in conversations with rural people, and that is that there is some distrust of institutions in Quito and a desire to control things locally, in order to keep all the benefits in the area. This, to some extent, is why the co-operative in Cayambe is such a thriving concern, even though it is in competition with a branch of the Banco de Fomento, and must explain why there are co-operatives in Aloag, Tumbaco, Cotocollao, San Rafael, and Sangolqui, as all these centres are readily accessible to Quito.

Finally, while a co-operative undoubtly has the greatest

impact on the centre in which it is located, it will serve a wider area as the membership breakdown by parishes for El Progreso de Atahualpa shows (as of June 30, 1971): Atahualpa - 247; Chavezpamba - 81; Perucho - 6; Puellaro - 17; and San Jose de Minas - 2. The 17 members from Puellaro indicate that there is probably some overlapping of the service areas of savings and loan co-operatives.

The necessary and sufficient threshold values of the eight indicators of relative importance obtained suggest that the factors cited above are indeed more significant since quite large centres such as Machachi and Amaguana lack a bank or co-operative, whereas small centres like Checa and Atahualpa have co-operatives. The sufficient threshold values isolate only a quarter of the centres having this type of service, either alone or in combination. Most of the necessary threshold values provide little separation of centres, though the number of establishments does give the best discrimination, or the lowest number of centres falling in the range of uncertainty. The number of business types adds nothing further, but including an urban population criterion isolates three more centres that lack a co-operative, so that we can say that a savings and loan co-operative will not be found in any centre that has less than 475 inhabitants and less than 16 business establishments. While the other intangible factors are perhaps more important in determining whether a centre has this type of facility or not, the commercial threshold suggests a minimum economic level for this service, while the population of the centre is the most likely source of membership.

3-8 Escuelas de Corte y Confeccion

(See also Tables 3d and 7 in Appendix A).

Escuelas de corte y confeccion are found in 30 parishes, and provide a one-year program in tailoring, dress-making, and household management for primary school graduates. They are organized and run either by the Church or by a parroquia, and there appears to be no general policy governing the establishment of this kind of facility, other than that they seem to depend largely on local initiative. No data was available on the size and enrolment of these schools.

What is apparent is that they may occur in all but the least important centres in terms of population served and economic activity. Their distribution suggests that they may require a population of at least 1,800 people from which to draw an adequate number of students, and a moderate level of commercial activity (at least five different business types and twelve establishments) in order to ensure adequate local financing. At the same time, one does not find this type of school in centres with no political status,

Local people did sometimes point out that one of the reasons for starting a home economics school was to provide post-primary education where none otherwise existed, but while ten out of the thirteen centres possessing a secondary school also have an escuela de corte y confeccion, it is not known which was established first in any of the cases.

3-9 Religious Institutions

(See also Tables 3e, 3f, 8, and 9 in Appendix A).

Just as the Teniente Politico is the political leader at the local level, so the parish priest is the religious one, and the rural people are perhaps more attuned to spiritual than to temporal matters. Thus the church, through its agent, the priest, has an important influence on local life, far beyond that suggested by the facilities and manpower deployed. Information concerning the church is contained in a handbook (19) listing all Catholic operations in Ecuador, the structural divisions of the church, the personnel involved at each level, and where they are located. As might be expected, the church issues no annual balance sheets, not for public perusal anyway, and no official statements on membership and the effectiveness of operations, nor on corporate policy in running and establishing facilities. Since Ecuador's current system of political subdivisions grew out of an ecclesiastical one, hence the term 'parish', it is natural to find that the organization of the Catholic Church in space bears a considerable resemblance to the political organization of space, and in the absence of data on operations or on policy, it is only possible to speculate on the rationale behind the location of parish priests, vicariates, and dioceses.

The headquarters of the church in Ecuador is the Curia Metropolitana in Quito, and the country is divided into three ecclesiastical provinces, centred around the archbishoprics of Quito, Guayaquil, and Cuenca. Quito contains the dioceses of Riobamba, Ibarra, Ambato, Guaranda, Latacunga, and Tulcan; Guayaquil contains the dioceses

of Portoviejo and Babahoyo (Los Rios); and Cuenca includes Loja, Azogues, and Machala (El Oro). There are 'vicariatos apostolicos' in the north-east Oriente. While the three largest cities in the country are the seats of archbishoprics, the bishoprics include almost all of the provincial capitals, and in fact the provinces were largely constituted from the dioceses.

There are ten vicariates in Pichincha, each containing anywhere from 16,000 to 70,000 people, and served by three to six parish priests, though the vicariate of Cotocollao has eleven parish priests. No vicariate is located in a centre on a terminal highway, and no centre that is not a cabecera parroquial is a vicariate, while all cabeceras cantonales are. It was found that demographic and commercial indicators give the least number of centres in the range of uncertainty. Since a vicariate serves an area that includes several parishes, the total population served by a centre would be a logical criterion, and it was found that if one excludes Puellaro from the group that are vicariates, any and every centre that serves more than 8,000 population and that has over a hundred business establishments there is a vicariate. Such a threshold is not as incongruous as it might seem, because it was pointed out repeatedly by local informants that with markets being held on Sunday, the rural people make their journeys multi-purpose trips by going to Mass at the market centre. While the Sacrament of First Communion is performed only at vicariates, this division is otherwise purely an administrative one. One could argue that the large market centres have

developed out of ecclesiastic centres but the fact that First Communion is celebrated only twice a year would indicate the reverse to be more likely, and that the threshold values suggested would be usable indicators for specifying whether one should expect a centre to be a vicariate or not.

The one exception, Puellaro, appears to have been chosen as a head-link for serving the remote parishes of the north, because it is the centre nearest to Quito. San Jose de Minas would be the logical choice, particularly in view of our threshold values, but this latter centre is the most inaccessible one of the five in the area. It can be seen from Map 11 that Cotocollao performs a similar head-link role for the isolated parishes of the Nordoccidente.

Many priests live in one centre, but visit other centres and barrios in the area on a regular basis for conducting masses and carrying out other pastoral duties. For example, the priest of Sangolqui visits eight chapels every two weeks for Mass, in addition to the eight masses on Sunday and Holy Days, and three on other days, that he celebrates in the main church in Sangolqui. His 'parish' comprises the five parroquias of Canton Ruminahui. Similarly, the priest of Cayambe caters to the spiritual needs of people in Tupigachi, Isidro Ayora, Juan Montalvo, in addition to Cayambe itself. By definition, every parroquia should have a parish priest, and the church tries to reach every part of the countryside, but there are only 47 centres in Pichincha that have parish priests. The four centres studied that have no political status also lack a parish priest.

The necessary and sufficient threshold values obtained do not in general show strong differentiation between those centres that have a priest and those that do not. However, if we take into account lack of political status and the above-mentioned cases of centralization, every centre of over 740 inhabitants has a parish priest, while with the exception of Oton, no centre with less than 343 inhabitants has one. In between these limits, 13 centres have a priest, and there are three centres that lack a priest besides those mentioned earlier. La Merced and Llano Chico are only about 3 Km. from Alangasi and Zambiza respectively, from which they are easily served. In addition,La Merced was raised to parroquia status only eight years ago. Lloa is a very small parish that is served by a visiting priest from La Magdalena in Quito. From the information available, there is no apparent reason to suggest why Oton should have a priest of its own, except that it is possible that in the past, Oton was relatively more important a centre than it is today.

Other indicators, such as umland population, population served, business types or number of establishments give poorer discrimination than is the case using the population of the centre alone. The transportation indicators do not effectively separate the groups at all. Since the church locates a priest in a centre from which he goes out to conduct occasional services at chapels located in the surrounding countryside, one might expect area population to be a significant factor governing the locational choice. However, the towns-people are more likely to go to Mass more than once a week,

because time and distance make this level of devotion impractical for the rural people, and therefore the larger the population of the centre, the much greater will be the 'volume of business' of the church, since the rural people generally go to Sunday Mass at a church in an urban centre anyway. If the centre or the parish is very large, an additional priest may be assigned to the post.

The Church also engages in social work, organizing and operating other types of facilities and services, but little data is available on these operations, and in general, their impetus and establishment seems to be due to the initiative of those local priests who perceive a need for some service that they see their way clear to be able to provide. Like the government, the Church finds lack of trained manpower and financial resources to be big handicaps to doing the level of work that it would like.

About 17 different Protestant groups operate churches and other facilities in Quito, but there is little pastoral work in rural Pichincha. For example, the consortium of groups to which the Southern Baptists belong runs only two small rural centres, one in Llano Chico parish, and the other near Santo Domingo. While some missionary work is carried on in the province, it is sporadic, and one could well consider rural Pichincha to be almost 100% Catholic, at least nominally.

3-10 Telecommunications

(See also Tables 3g, 3h, 10, and 11 in Appendix A).

The telephone is a highly centralized communication system, which provides its own lines, or connections, between all points in its network. In essence, customers are hooked in to a central switchboard or exchange, and these exchanges are linked to each other by trunk lines radiating from Quito, while Quito in turn is linked to other major centres in the country, and to overseas countries, by radio-telephone. Within Pichincha, there are four levels of service; an automatic exchange, a manually-operated exchange (switchboard type), and a public phone, or private lines connected to an exchange in another community. Some centres have no service at all.

Though a monopoly, the Empresa de Telefonos de Quito has a general policy of providing service to the entire area within its jurisdiction, subject to certain constraints, which seem to be most evident when one looks at the 15 centres in Pichincha that do not have any service at all. Nine communities in the Santo Domingo area (La Concordia, Las Delicias, Alluriquin, and Cornejo Astorga) and in the Nordoccidente (Pacto, Gualea, Nanegal, Mindo and Los Bancos) lack connection to the radio-telephone stations at Santo Domingo and Nanegalito (respectively) for technical reasons. In the Costa, a certain species of spider likes to weave thick webs strung between telephone wires, that in the wet, moist climate produce short-circuits, and to date, no effective counter-measure has been devised. Consequently, the 317 subscribers to the Santo Domingo exchange are all found within a five kilometer radius of the town, while Nanegalito has just a public telephone, and no private subscribers. With regard to

the other six centres lacking telephones, San Pedro is 1.5 Km. from Sangolqui, and Juan Montalvo is only 1.7 Km. from Cayambe, so that both can be easily served by the larger centre, as is also the case with Cotogchoa, which is more distant (5.4 Km.) from Sangolqui, but is also much smaller than San Pedro. Rumipamba and Chiriboga are very small and isolated centres that have no service. The existence of a link to El Chaupi suggests that a potential service area of 850 people is sufficient for a link 12 Km. long. Rumipamba has only half that population located at a distance of about 10 Km. from Sangolqui, while Chiriboga, with a very dispersed population of about a thousand people would require a link of approximately twenty kilometers. Finally ignored by just about every other entity, Cutuglagua also does not have any telephone service.

The necessary and sufficient threshold values for a centre to have at least a public telephone tell us little, since some of the least important centres have this level of service, while some relatively important ones do not. However, we can conclude that in the Sierra only very isolated centres or communities located close to a much larger centre do not have any telephone service, while there is almost no service in the Costa, except in centres where a radio-telephone station has been established.

The location of telephone exchanges has been conditioned partly by the relative importance of a centre, and hence the likely volume of business, but also by technical considerations. It is therefore not surprising that the necessary and sufficient threshold

values show the greatest degree of discrimination using levels of commercial activity, since it can be argued that many people in the country have a telephone primarily for promoting their business interests. The minimum distance between exchanges is 2.5 Km. (Alangasi to La Merced), and it was found that if a centre is not at least 2.5 Km. from another larger centre, and does not have at least 21 establishments, and a potential of at least 8.275, then it will not have a telephone exchange. If a centre has a population of over 1,384, or more than 75 establishments, or a potential in excess of 9.188, then one would expect it to have an exchange. There are exceptions: Chillogallo and Guapulo are both adjacent to the built-up area of the city of Quito, and are included in the area served by the Quito exchange (they are less than 2.5 Km. from the nearest part of the urban telephone system, though much further from the centre of the city). We mentioned earlier the technical problem of serving the Costa, and it is apparent that besides those cited, other criteria govern the location of radio-telephone stations: Santo Domingo obviously has a large volume of calls from other parts of the country, but La Concordia, Alluriquin, Las Delicias, and Cornejo Astorga may lack a station either because of their good surface communications, or more likely because of their smaller size. In the Nordoccidente, only Nanegalito is served by a radio channel, probably because geographically it is the most central community of the region, but also because the doctor for the region is stationed there, and the Instituto Ecuatoriano de Reforma Agraria y Colonizacion (IERAC) has a regional centre located

there, thus creating a demand for a reasonably prompt system of communication with Quito in view of the otherwise atrocious links that the region has with the rest of the province. Finally, the only readily apparent explanation for the lack of an exchange in San Jose de Minas is that locating an exchange in the much smaller centre of Atahualpa cuts down enormously the length of wiring required to link up the three northernmost parishes of the province to an exchange, and to link the exchange to Puellaro.

With an exchange serving one telephone line or 44,884 lines, or located as little as 2.5 Km. from another exchange or as much as 45.2 Km. by direct link (Calderon to Cayambe), or else serving a parish 2.1 Km. away (San Rafael from Sangolqui) or up to 35 Km. away (Papallacta from Pifo), much of the rationale behind the location of telephone exchanges must depend on local factors. There remain thirteen centres which lie between the absolute necessary threshold and the suggested sufficient condition for having a telephone exchange.

The exchanges located at El Tingo, Alangasi, and La Merced appear to be an example of over-servicing, since these communities are located within about five kilometers of each other, and not much more distant from Sangolqui. Both La Merced and El Tingo are tourist centres (hot springs resorts) and for their size, have a large number of subscribers (32 and 19) and a high volume of calls. Yet with the recent increase in capacity of the automatic exchange in Sangolqui, there is no apparent reason why El Tingo could not be served by this better type of facility, just as San Rafael is now, and there is no

apparent reason why La Merced could not be served more economically and just as efficiently by stringing the 32 'pairs' of wires from the La Merced subscribers into the Alangasi switchboard, or vice versa. Ascazubi and Uyumbicho clearly do not have exchanges because of proximity, being only 3.1 Km. from El Quinche and 3.7 Km. from Tambillo, respectively. Cangahua does not have an exchange because this fairly large centre can probably be adequately served by a public phone hooked into the Cayambe exchange, only 6.4 Km. away. Aloag is a borderline case for all three sufficient threshold values, yet has no exchange, possibly because of its proximity to Machachi, from which it can be served easily by a 5.5 Km. line, though one would expect the level of demand from a centre of Aloag's size to warrant a separate exchange, as appears to be the case with Puembo, which is a much smaller centre located a similar distance from Pifo. We might also consider the case of Calacali, which has a similar population to Aloag, but only half the number of business establishments, and a lower potential. It is located 9.4 Km. from San Antonio, and has its own exchange. It would seem that while there is some local demand for service, Puellaro has an exchange basically because it is a junction point in the telephone network, from where one branch goes to Atahualpa, while the other goes to Malchingui. Other lines run to nearby Perucho and to Coyagal and Aloguincho in Puellaro parish. It would seem that the smaller centres of Olmedo and Nono have a sufficient demand for service to warrant an exchange, possibly because of distance and poor accessibility. Finally, Yaruqui is served by a

line into the Pifo exchange, located ten kilometers away, yet by all of the operational constraints that we have discerned, this centre should have an exchange of its own. If Puembo should have an exchange, then Yaruqui deserves one even more, since it scores higher than Puembo in terms of every indicator. In fact, we would argue that the exchange at Puembo should really be located in Yaruqui in order to provide a more even distribution of this type of facility, as well as to reduce the length of wiring required to reach the points of the area that need servicing.

In summary, if a centre does not have 21 business establishments and a potential of 8.275 and is not at least 2.5 Km. from a larger centre, it will not have a telephone exchange. If a centre has a population of over 1,384 or more than 75 business establishments, or a potential of over 9.188, it will have a telephone exchange, unless there are over-riding technical factors involved. In addition, if a centre lies between these threshold limits and is more than eight kilometers from a centre that has an exchange, it will also have an exchange. If the distance is less than eight kilometers, in general the centre will not have an exchange unless there are mitigating circumstances, such as an unusually high local demand for service, such as might be found in a tourist centre. Other indicators were found to provide no additional explanation.

There is a continuing program to improve service and provide better facilities, so that the telephone network is not a fixed structure. Change is most noticeable in the introduction of automatic equipment, which is found in Santo Domingo, Cayambe and Machachi,

centres with a high volume of local calls and which are linked to Quito by radio channels. With the installation of automatic equipment in Conocoto, Sangolqui, and in the smaller exchanges of Tambillo and Amaguana, there is now an automated system from Quito to Machachi and Sangolqui.

By the end of 1971, it was planned to automate the Cumbaya and Tumbaco exchanges, and to provide direct dialling to Quito, while it was hoped to extend similar service to Pomasqui and San Antonio sometime in 1972. While the manual exchanges attract very few new subscribers, the growth in use in areas having automatic exchanges is remarkable. Machachi jumped from 103 subscribers in 1970 to 164 in 1971: similar figures for Amaguana are 30 and 50, for Cayambe 66 and 74, Conocoto 282 and 382, and Sangolqui 100 and 251 (this exchange was enlarged from 100 lines capacity to 400 capacity during the year). In summary, only the largest and most important centres in the province have automatic telephone exchanges, but the use of automatic equipment is spreading outward from Quito.

The telephone network exhibits a radial pattern centred on Quito which can be seen most strikingly in terms of the number of telephones per thousand population served by the individual exchanges. The number falls dramatically from a high 81.2 per thousand in Quito, to 0.82 per thousand in Ataĥualpa, or 0.07 if one considers that the public telephone in Nanegalito 'serves' the entire Nordoccidente (See Map 13). Only Cayambe and Santo Domingo deviate from the general pattern in any way, because the size of each centre results in a higher level of service, qualitatively and quantitatively.

3-11 Health

(See also Tables 3i, 3j, 3k, 31, 12, and 13 in Appendix A).

One of the most fundamental services in its importance to human well-being, the provision of health care is one of the most fragmented in terms of the agencies and agents catering to the needs of the people of Pichincha, and complete information was difficult to obtain. Detailed statistics on hospitals for the latest available year, 1968, were obtained from the Instituto Nacional de Estadistica (23), but these tell little about where the people come from. The Ministry of Health was either unwilling or unable to provide any information on its operations in the province, beyond the locations of its health centres and planned new locations. Canton Quito has endeavoured to establish a dispensary in every parish, and the Rural Medicine Service made available their records, as did the Centro de Salud de Canton Ruminahui, which is a centralized dispensary serving the entire canton and some of the neighbouring areas.

The 32 specialized hospitals in the country are located in 14 different cities, 12 of which are provincial capitals, the other two being Santa Rosa (instead of Machala), and Manta. Similarly, the Red Cross operates an ambulance service and blood transfusion service in most of the provincial capitals. Most cabeceras cantonales have hospitals that range in size from the 7-bed Centro de Salud in Cotocachi to the 1,040-bed Hospital Luis Vernaza in Guayaquil, so that it is difficult to determine threshold values for the provision of this service.

In Pichincha, in addition to a wide range of public and private facilities in Quito, a psychiatric hospital run by the Catholic Church is in Conocoto, general hospitals are found in Santo Domingo and in Cayambe, and a maternity clinic in Pifo. In addition, the Ministry of Health is currently building a hospital in Machachi which is to be opened in 1973. One could thus infer that the threshold for general hospital facilities in Pichincha is 35,000 inhabitants in the area served by the centre (see Maps 14 and 15), and a town population of 5,000 inhabitants, which Machachi has attained only very recently. In addition a hospital serves an area of at least 20 Km. radius, though the facilities of Santo Domingo serve the countryside for 60 Km. around. The mental hospital in Conocoto was located there because of the isolated, rural setting, which it was felt would be conducive to recovery, while the maternity clinic in Pifo was originally set up by the consortium of Protestant groups running Radio VozAndes (Voice of the Andes), to care for the operators of the transmitting station located just south of Pifo, and to provide some service to the people of the area as well. Sangolqui has only a small private clinic simply because the facilities of Quito are readily accessible, only 22 Km. away.

The Ministry of Health has a policy that any new dispensary that it constructs must be able to serve a potential 'market' of at least 2,000 people, but as can be seen from the necessary and sufficient threshold values, dispensaries are found in the smallest centres, while some large communities lack such a facility. In principle, it is considered desirable to have a dispensary located in every parish

and the Rural Health Service of Quito operate a dispensary in every cabecera parroquial of the Canton, except Guapulo, which is virtually a suburb of Quito. There are also dispensaries at El Tingo and Palma Real, the former, it seems, because many people visit this hot springs resort, while the latter was established to serve the population of an extremely isolated area of San Jose de Minas parish. There is no dispensary in Chiriboga. As mentioned earlier, the five parishes of Canton Ruminahui are served by the central facility in Sangolqui. Health facilities in the rural areas of Canton Santo Domingo are still in the process of being developed on a fairly widespread scale. Alluriquin and Las Delicias both have a dispensary, while La Concordia does not. Locational policies of the other three cantons with respect to dispensaries are unknown. Isidro Ayora and Juan Montalvo which both lack a dispensary of their own, are relatively new parishes that are less than three kilometers from Cayambe, and can be easily served by the facilities located in the large centre. Similarly, Tupigachi and Ascazubi are located seven kilometers from Cayambe and 5.3 Km. from El Quinche respectively, so that the people of those parishes can fairly easily attend the facilities in the larger centres. Cornejo Astorga, El Chaupi, and Cutuglagua are small centres in Canton Mejia that lack a dispensary, either because of their size or access to larger centres.

In summary, dispensaries are located in every parish of Canton Quito as a matter of policy, as is the situation in Canton Pedro Moncayo (except for Tupigachi). Cantons Cayambe and Mejia

have dispensaries in about half of their parishes; Canton Ruminahui has a central facility only, and Canton Santo Domingo is still developing its network of health facilities. In general, every centre that has a population of more than 636 inhabitants, or an umland population of more than 1,944, has a dispensary.

Let us now look at two other elements of the health care system: doctors and drug stores.

From the necessary and sufficient threshold values obtained for the distribution of medical practitioners, the population of the immediate area can be seen to have the most discriminating limit, separating out 13 of the 21 centres having doctors, whereas the number of business types gives the least number of centres falling within the range of uncertainty. If we combine the two sufficient limits we can separate out two more centres, and the use of potential will incorporate a third additional community that has a doctor. There remain five other centres that can be considered as special cases, since the other indicator thresholds add no further explanation, and the necessary threshold values, either alone or in combination, were found to provide a less satisfactory way of determining which centres do not have a doctor. Therefore, if a centre serves an immediate area population of more than 6,100, or has more than 21 business types, or has a potential in excess of 9.307, one can expect to find a doctor resident there. Five other centres have a resident doctor though Alluriquin should perhaps be excluded, since its doctor has a regular practice in Quito, and he returns to Alluriquin only on

week-ends. The doctors in El Tingo and Nanegalito live in these centres to facilitate visiting outlying dispensaries on behalf of the Municipio de Quito's Rural Health Service. Finally, Pifo's doctor supervises the local maternity clinic, and Tocachi has a doctor because he was brought in to look after the workers at Hacienda Cochasqui, a pyrethrum plantation.

Turning to drug stores, it is perhaps understandable that since this is a type of business, levels of commercial activity provide the best discrimination between those centres that have this facility and those that do not. Number of business types separates out 14 of the 20 centres that have a 'farmacia', as well as having the smallest range of uncertainty. Since the number of business establishments isolates the same 14 centres, let us turn to the size of a drug store's immediate market, the urban population. which alone isolates eleven centres having drug stores. The sufficient threshold value adds no further explanation, but an examination of the nine centres falling within the range of uncertainty revealed that any centre that had at least 18 different business types and an urban population of at least 750 inhabitants has a drug store. Oton, which does not satisfy this condition, and which causes the low necessary threshold values that were obtained, has a drug store, a subsidized operation which is really just an extension of the dispensary. Los Bancos is the only other centre in Pichincha which has a drug store and which does not satisfy the stated condition. While the doctor of Nanegalito visits Los Bancos once a week, the centre is the most remote of those

of the region, yet it serves one of the larger parish populations. Raised to parroquia status last year, Los Bancos had the drug store long before the recently established dispensary was opened, and the drug store would have been a response to the lack of a resident doctor in the immediate area, since Ecuadorian drug stores frequently perform minor diagnostic and therapeutic services that would normally be performed by a doctor. This feature was observed not only in Los Bancos itself, but also in La Concordia, which has no dispensary or resident nurse, but does have three drug stores, a resident dentist (who owns one of the stores), and a doctor on week-ends.

3-12 Electricity

(See also Tables 3m, 3n, and 14 in Appendix A).

It was possible to obtain information on the technical aspects of the three power grids that serve Pichincha; one is centred on Quito, and serves the Quito area and south and east Pichincha, while the Cayambe area is served by a link to the Imbabura-Carchi grid, and the Santo Domingo area is the centre of a grid that will extend by 1974 from Quevedo to Quininde. The first two grids will be linked together by 1975 when the Pisayambo scheme currently being built near Ambato is operative, and this new station will become the nucleus of a national power grid. Lacking any data on power consumption or number of households supplied in any given community, it was possible only to look at the overall policy of providing electricity, particularly as the Instituto Ecuatoriano de Electrificacion

(INECEL), has a long-term plan for extending service in the northern part of the country. The existing power grids and the planned extensions are shown on Map 17, and it is readily apparent that they started from the needs of servicing the large urban centres. While some rural people can and do profit from an electricity service, this is basically an urban service, and because of limited resources and the scattered distribution of rural people, service, in general, covers only the urbanized areas of the countryside, and the systems have been extended as large thermal or hydro generating stations were developed..

For convenience of installation and repairs, power lines tend to follow the general alignment of the highway system, which also permits hacenderos to arrange for individual service, if they are located near the right-of-way. While INECEL does allocate funds for extensions of the power system, local communities are required to raise a portion of the cost themselves, so that the administrative policy is accelerated or retarded to some extent by local initiative or poverty or apathy as the case may be. For this reason, Llano Chico, Zambiza, and Nayon are still waiting to be linked to Calderon, though this link is planned.

It should be noted that the link to Cutuglagua serves only the Santa Catalina Experimental Farm, and the link to El Chaupi serves only households located beside the Pan-American Highway, but in neither case is the cabecera parroquial served. In principle, it is planned to link up every parish in the Sierra part of Pichincha into

a power grid by 1973, but while lines go to outlying barrios of Sangolqui and Cotogchoa parishes, Rumipamba itself will not be hooked into the Quito grid, probably because it is not worth constructing a line at least eight kilometers long just to serve about a hundred people. Also, it is not planned to link Tupigachi, Olmedo and Cangahua into the Tulcan-Imbabura grid. Since none of these centres have any service of their own at present. this may simply indicate an unwillingness on the part of the local people to invest anything in the provision of this service. In the Costa, power lines follow the interprovincial highways radiating out from Santo Domingo, serving all centres en route, but there are no plans at the present time for providing any sort of grid linkage to any of the communities of the Nordoccidente. Finally, Cornejo Astorga is not scheduled to be joined to either the Quito or the Quevedo-Santo Domingo grid, but this centre has 24-hour service provided by its own generator.

The major power lines that remain to be constructed are ones to Guayllabamba, to Malchingui, and to San Jose de Minas, all of which are large centres with 1,661, 2,249, and 2,149 inhabitants respectively, though the latter two are relatively isolated. While the power grids are being extended outwards from the nuclear centre, to some extent INECEL's priorities might be said to reflect the relative importance of centres, and yet the small centres of Santa Rosa de Cusabamba and Oton will be served before Malchingui and San Jose de Minas. Similarly, the links to the former two centres will each be about 5 Km. long to serve a town population of 250, yet it is not planned at all to erect

an 8 Km. line to serve the 1,150 inhabitants of Cangahua, or the 961 people of Olmedo, who are 8 line-kilometers from Isidro Ayora. Since local communities must assume a portion of the construction costs of power lines to serve them, we must presume that INECEL's priorities are strongly influenced by local ability and willingness to raise the required sum. It is also clear that topographic barriers restrict the grid systems, as there is no link to Cotopaxi Province yet, nor a link across the Guayllabamba or Pisque Canyons. In fact, Guayllabamba is to be served via Pifo and El Quinche, Malchingui via Cayambe and Tabacundo, and the line to Puellaro and the north is not planned until 1973.

Communities not linked into a power grid at the present time have either a motor generator operating for a few hours a day, or no public service at all. The necessary and sufficient thresholds for provision of any electricity service show that even some of the least important centres have some service, while a few centres having high indicator values lack any service. Cantons usually give funds to the parroquias to assist in providing this facility, but in Cantons Cayambe and Pedro Moncayo, Ascazubi is the only centre not located on a grid which has its own generator. Olmedo, Malchingui, Santa Rosa de Cusubamba, Oton, Cangahua, Tupigachi, and Tocachi have no service at all, along with El Chaupi, Chiriboga, Mindo, Rumpamba, Cutuglagua, and Nayon. Astride the Pan-American Highway, and beside the Santa Catalina Experimental Farm, which has electricity, Cutuglagua's lack of power is an enigma, as to some extent is Nayon's deficiency, though the problem of raising the necessary local funds in this latter case has been mentioned earlier. The

first four centres have populations of less than 300, and fewer than five business types or ten establishments, and are at least 8 Km. from a grid, which suggests they are too small and poor to be able to afford to run a generator.

Ecuadorians are not so dependent on electricity as Canadians are, and rural people generally cannot afford to either buy or maintain large appliances. A permanent supply does prompt some people to buy refrigerators and radios, and a few television sets, but the biggest benefit of having electricity for even just a few hours in the evening is improved lighting. In this regard, it was interesting to learn that some households in Sangolqui pay Empresa Electrica de Ruminahui a fixed monthly rate of S/ 4.69 per bulb or light socket, rather than a metered S/ 0.50 per kilowatt hour. The average bill in Sangolqui is S/ 18 per month covering about 36 KWH, which is about a fifth the consumption of the average Canadian apartment dweller.

3-13 Post Office

(See also Tables 3o, 3p, and 15 in Appendix A).

This is a highly centralized communications service that sets its own goals and policies, subject to three constraints: (a) government decree or directive, (b) financial resources available, and (c) level of demand for service. The basic principle of the post office is to provide a cheap and reliable means of communication to all parts of the country. There should therefore be a post office in every centre, but there isn't.

Of the necessary and sufficient threshold values for post

offices in Pichincha, we notice that for all eight indicators, the necessary limit is the lowest or lowest but one value found among the 70 centres studied, while the sufficient thresholds isolate at most only a half of the centres having postal service. Ten centres have no post office and fall into two groups. The first includes small centres that are far off the main roads, such as El Chaupi, Rumipamba, and Chiriboga. The second are centres located on a terminal highway, but close to another larger centre: La Merced is 3.8 Km. from Alangasi, Isidro Ayora (3.1 Km.) and Juan Montalvo (1.7 Km.) were formerly part of Cayambe parish and these new cabeceras parroquiales do not have their own post offices. Cotogchoa and San Pedro are served by neighbouring Sangolqui, located 5.4 Km. and 1.5 Km. away respectively. Llano Chico is only 3.2 Km. from Zambiza, while Cutuglagua is bypassed, even though it is on the Pan-American Highway. The only apparent threshold is that a centre located on a terminal highway must have at least 250 inhabitants in order to have a postal service.

A feature of the Ecuadorian postal system is that rural offices do not always offer daily service (see Map 18). The volume of mail going between Quito and other provincial capitals means that all centres on interprovincial highways (except Cutuglagua) can have pick-up and delivery every day. Daily service was inaugurated to the entire Sangolqui area in July 1971, while most other centres with post offices have thrice-weekly service, except for centres in the north and the Noroccidente, which have delivery only once or twice a week because of the poor road links, and the relatively sparse population. These reasons

also apply to Cangahua, Guangopolo, Olmedo, and Tabebela, which all have only twice-weekly service.

No centre on a terminal highway has daily service, whereas every cabecera cantonal in Pichincha does. In general, a post office will serve the people of a parish, and we would therefore expect the population of the immediate area to be a good basis for isolating those centres that have daily service, and it does isolate 11 out of 23, more than any other indicator. However, the number of business types, number of establishments, and potential all have a smaller number of centres falling within the range of uncertainty. Daily service is maintained between provincial capitals, and therefore any centre that has a post office, and which is located between another centre which has daily service and a provincial service should have daily service itself, since this level of service can be provided to such a centre at no extra cost. However, of the seven other indicators, only population of the centre, number of business types, and number of business establishments add anything further, and then only to add Tabacundo to the eleven centres already isolated.

Umland population is by far the most important criterion for determining whether a centre will have daily postal service, and any centre with over 7,394 inhabitants in the immediate area will have daily service, as will any centre that is a cabecera cantonal, that has over 2,249 inhabitants, over 22 business types, or more than 112 business establishments. Any centre that has a post office and which lies en route between these centres and a provincial capital will also

have daily service. It is unknown why Cumbaya has only twice-weekly service, even though it lies between Tumbaco and Quito. Alangasi has daily service as part of the policy to upgrade service in the Sangolqui area, even though the post office only serves 6,000 people, and handled only 130 pieces of mail in 1970. It is possible that the subdivisions in the La Merced area would result in a larger number of letters being received. The third centre that does not obey the criteria is San Antonio de Pichincha, which has daily service even though it falls well below the specified thresholds. Being the location of the Equator Monument (Mitad del Mundo), this centre is a tourist attraction from where many post-cards are sent. However, the number of letters sent from San Antonio that is given in Table 15 does not include mail postmarked "Mitad del Mundo", which is sent directly to Quito.

We can simplify our criteria if we take into account that no centre on a terminal highway has daily service, and that while a post office normally serves only the population of the parish or of the immediate area, that of Alangasi also serves La Merced, or a total population of 5,761 people. Then any centre that has a post office that serves more than 5,012 people will have daily postal service, along with any centres lying between such centres and a provincial capital. In this case, only Cumbaya and San Antonio do not satisfy the criteria.

The post office has plans for improving service. It is hoped to initiate daily service to Malchingui and to the Nordoccidente in the near future, if the initial venture in the Sangolqui area is successful. Another proposal is to install a mailbox in each centre,

with an agreement with a local store-owner to give out mail to the addressees and sell stamps, while a mobile post-office would visit the centre for a specified period each day to pick up mail and perform other postal service functions.

However, in any decision to improve or change service, there are conflicting influences. It seems virtually impossible to close post offices, even if they are hardly jusified economically. For example, Aloasi handled a total of 66 letters in 1970, yet it is just a 25-minute walk from Machachi, which could easily handle the "volume" without any great hardship to those 66 people. The low figure might be taken to suggest that most people use the post office in Machachi anyhow, but, in fact, post office use is at a very low level throughout rural Pichincha. Data supplied by the post office in Quito indicated that rural post offices in Pichincha handled a total of 119,162 pieces in 1970, or 326 per day between 59 post offices. Santo Domingo and Cayambe accounted for two-thirds of the total, so that the other 57 averaged 2 letters per day each. Under these circumstances, it is difficult to justify innovation in rural service.

Postal officials all cited poor roads and transportation services as being the biggest bane in providing service to areas away from the Pan-American and Santo Domingo Highways. As door-to-door letter delivery is offered only in the larger centres, it is not surprising that country people observed that it frequently took three weeks for them to receive replies to letters sent to other parts of the province. The time involved in extricating a parcel or registered

letter from the Central Post Office in Quito can be astounding, yet at the same time, letter service can be incredibly fast between the larger centres of the country.

3-14 Primary Education

Virtually every settlement has a primary school and as they are so widespread throughout the province, it is not proposed to examine their spatial distribution in depth. In general, the Direccion Provincial de Educacion will not locate a new school within seven kilometers of another one, unless there is a river valley in between, or other extenuating circumstances exist. A school will not be established unless there is a guarantee of enrolment of at least 30 pupils, though there is no upper limit, some schools in Quito having 500 pupils. In addition, the Consejo Provincial tries to locate schools so that no child will have to go more than 10 Km. to class, lunches being provided through CARE to those going such distances. Due to the larger land-holdings in the Santo Domingo area, this upper limit is in practice about 15 Km., presenting a transportation problem. One suggested solution to the problem of accessibility in the Santo Domingo and Nordoccidente regions would be to build centralized schools in a co-operative, with 500-1,000 boarding students, and 100-200 day students. As yet this is still just a proposal being considered by the Consejo Provincial.

To obtain a school, local people must first make a formal request, and the site is then checked out by the Consejo Provincial

or by the Ministerio de Educación Publica. The local people donate the site, and prepare it (clearing, levelling, etc. - if necessary), and if the site is not accessible by truck, they must transport the construction materials themselves from the nearest road. Engineering and construction is carried out by trained workers of the Consejo Provincial, the whole process taking from five months to one year. A four-room school would cost about S/ 120,000 or US$ 4.800.

It should be noted that many of the larger urban centres have several schools, which may be run by different entities, such as the Municipio, the Church, the Consejo Provincial, or private organizations. With no data available on the place of residence of the students, it is unknown whether the students of a given school come from the parish in which the school is located or not, though this would in general be a valid assumption, since all primary schools offer the first four grades, and most of them now offer the last two years.

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PART FOUR

SERVICE DISTRIBUTION PATTERNS AND URBAN CENTRE CLASSIFICATION

4-1 The Distribution of Urban Services in Pichincha

In this part, we now summarize our findings concerning the distribution of urban services in Pichincha. A classification of the centres is then presented, and finally, conclusions are drawn from the analysis.

Universities and other post-secondary Institutions are found only in the largest cities of the country. Since this service operates at a supra-provincial level, a precise definition of the principles governing the location of universities is beyond the scope of this study. It was found that they are not located in any centre that has a population less than 36,800, or that of Loja.

Fire protection service normally covers only the urban area of those larger centres that have a cuerpo de bomberos. We can tentatively suggest that in order to organize a fire protection service, a centre needs a population of 3,000 in the Costa, or 20,000 in the Sierra, these limits representing a balance between the necessity of having the service, and an ability to pay for it. It would seem that the larger the centre is, the more complete will be the emergency service that is offered. Given data from other provinces it may well be true that other indicators of importance give a more exact method of defining the distribution of this service.

The same is equally true for garbage collection, which is another exclusively urban service. A population of 10,000 people

living either in the centre or in adjacent centres is apparently required in order to make this service a necessity, and in order to provide an adequate tax base for paying for it. The rationale for extension of this service to neighbouring centres varies for each particular case.

Police are usually stationed in every cabecera cantonal. It was apparent that in the Sierra, a station serves a population of the order of 30,000 people, and of the order of 10,000 to 15,000 people in the Costa. Comandancias are located in each provincial capital as is a city police force, so that the location of police stations depends primarily on the political status of centres.

The judicial system is located entirely according to the political status of centres, in that the highest courts are found in Quito; a higher court, a criminal court, and the juzgado provincial, equivalent to an Ontario county court, are located in each provincial capital; a small claims court, or juzgado, is located in each cabecera cantonal; and the teniente politico who has the power of a magistrate, is found in every parish.

Secondary education is available in two three-year stages. The upper one, ciclo diversificado, is available to every centre having at least 2,765 inhabitants, 28 or more business types, or at least 180 business establishments. In Pichincha, these limits are synonymous in terms of discrimination. The lower stage, or ciclo basico is found in any centre where the advanced program is available, and in any centre that has more than 23 business types or more than 112 estab-

lishments. A school offering ciclo basico is found in a few smaller centres due to localized factors.

While we can only state the truism that banks are located in the larger commercial centres, a centre should have at least 475 inhabitants and 16 business establishments for a savings and loan co-operative to be found there. While we noted that these co-operatives tend to fill voids in the banking system, their location is more dependent on local initiative, drive, and effort, than on urban importance per se, as they represent a locally-organized answer to a locally-perceived need.

Escuelas de corte y confeccion appear to be random in their distribution. It was found that they are not located in any centre serving an immediate area population of less than 1,800, or with less than five business types and twelve establishments, nor in one that is not a cabecera parroquial.

The Catholic Church's location in space resembles the political system, in that the Curia Metropolitana is located in Quito, and the bishoprics are in provincial capitals, the archbishoprics being the three largest cities of the country. Vicariates were found to be located in any centre that serves more than 8,000 inhabitants, and which has over a hundred business establishments, or in certain head-link centres in the case of some inaccessible areas. Parish priests are found in any centre that is a cabecera parroquial, and that has at least 343 inhabitants, except for some recently designated cabeceras parroquiales, or some local cases of centralization.

In the Sierra, only very isolated centres, or those located

very close to a much larger centre will have no telephone service at all, whereas in the Costa, service is available in few centres due to technical reasons. If a centre does not have 21 business establishments, and a potential of 8.275, and is not at least 2.5 kilometers from a larger centre, it will not have a telephone exchange, whereas if it has a population of over 1,384 inhabitants or more than 75 business establishments, or a potential in excess of 9.188, it will have a telephone exchange, unless there are overriding technical factors involved. Between these limits, a centre will have an exchange if it is located more than eight kilometers from another centre that has an exchange. Automatic equipment is found in the largest centres of the province, though its use is increasing in centres in the vicinity of Quito.

Specialized hospitals are found in provincial capitals, while general hospitals are found in cabeceras cantonales, subject to the apparent constraint that they should serve a radius of at least twenty kilometers, a population of 35,000, and a centre population of 5,000 inhabitants. In principle, dispensaries should be found in every parish, but there is variation due to differences in policy between the various administrative agencies. In general, every centre with a population of over 636 or an immediate area population of more than 1,944 has a dispensary.

Doctors are found in all centres having an immediate area population of more than 6,100, or more than 21 business types, or a potential in excess of 9.307, as well as in a few smaller centres,

due to localized factors. Drug stores are found in all centres that have at least 18 business types and an urban population of at least 750 inhabitants.

When the rural electrification program is complete in 1973, only the Nordoccidente and some isolated centres in the Sierra will not be linked to one of the three grids serving Pichincha. Of the communities not linked to a power grid at the present time, those that have less than 300 inhabitants, and fewer than five business types or ten business establishments, and are at least eight kilometers from a grid do not usually have a generator of their own, probably because they are too small and poor to be able to afford it, or to construct a link to the grid.

In principle,every centre should have a post office. However, a centre located on a terminal highway must have at least 250 inhabitants in order to have one, and any centre located very close to a larger centre will not have a post office of its own. Any centre that has a population of over 5,012 in the immediate area and that is not at the end of a terminal highway will have daily service, as well as any other centre that has a post office and which lies en route between such a centre and a provincial capital.

Finally, primary schools are found in every centre that was studied, and are established in any settlement that can guarantee a steady enrolment of at least 30 pupils.

4-2 Local Variations

In discussing the distribution patterns of the different services, we encountered cases which did not conform to the general patterns, and which did not suggest per se that the postulated criteria should be modified to accommodate them. Discussed in detail for each service, these special cases indicate that service distribution patterns are somewhat modified by certain influences, which will now be looked at briefly.

Centralization of facilities in another centre was frequently cited as a reason why a particular community did not otherwise have a given facility. In our earlier study, we discussed the effect of urban shadow on commercial development (30, pp76-7), and it is evident that a similar effect occurs in the service sector. We noted many times the lack of a facility in communities located close to the large urban centres of the province, particularly those near Sangolqui, and near Cayambe. The consumer will opt for the greater variety of goods offered in the larger centre to the detriment of commercial growth development in the smaller centre. In the case of urban services, the same choice is made inevitable. The administrator seeks to serve the greatest number of people from a given location, so long as reaching that location is not grossly inconvenient for a large number of people, level of inconvenience and large number being defined separately for each type of facility. It was noted that the distances involved were no more than 5.4 kilometers, which a man can walk in an hour. Christaller and other authors have suggested that an hour is the maximum time that a person is willing

to spend travelling to a centre in order to satisfy most needs. Thus we can say that services located in an urban centre will serve any other smaller centre located within a radius of approximately five kilometers.

There is one caveat, which we might define simply as relative affluence. We mentioned several times that the population of San Rafael has above-average income, largely due to an influx of people from Quito. There are several other examples of communities that host a 'suburban' population, and we can say that any such community will have an above-average demand for health, education, and communications services, as a result of personal choice and because such people can afford to pay for them. Thus while Conocoto is within the spheres of influence of both Quito and of Sangolqui, and should therefore have below-average levels of service, local affluence creates additional compensating demand.

In areas where communities are scattered and relatively isolated, the problem of achieving a reasonable level of utilization of manpower and resources can be an acute one, if the population of the area involved is not particularly large. In such cases, one again finds centralization. The location of a telephone exchange in Atahualpa to serve the three northern parishes of the province has been cited, but centralization can best be observed in the case of doctors or parish priests, where they locate in one centre as a base of operations, from which they systematically visit other centres of the region, thus serving a total market that makes their presence in the area justifiable to their superiors in terms of

return on the investment involved. This phenomenom is observed in the San Jose de Minas area of the province, in the Nordoccidente, and to some extent in the Santo Domingo area. In this last case, the area involved is large rather than inaccessible. We noted that the service area of the hospital is much wider than is the case for those in the Sierra, and it was observed in the field that the centres of the region are spaced farther apart than in other parts of the province. With excellent transportation services along the four highways radiating out from Santo Domingo, the facilities in town can and do serve a substantially larger area than is the case in the Sierra, and it was apparent from conversations with local informants that people are quite willing to travel into Santo Domingo rather than expect the service to go to them.

Local initiative was cited as a prime factor in the development of savings and loan co-operatives and escuelas de corte y confeccion, as well as an important factor in the locating of a secondary school in Pintag. Unfortunately, we have no formula for specifying where, when, and under what circumstances this phenomenon will occur.

The converse, local apathy, may result in impeding the establishment of service facilities. The necessity of raising funds locally in order to partly finance a link to a power grid was mentioned in Sec. 3-12, but it is axiomatic that an administration will never locate a facility in any centre that does not in the first place indicate some enthusiasm for obtaining it. Local apathy, plus the fact that the

cabecera parroquial is small and accessible to Quito and to Machachi, are two readily evident reasons as to why Cutuglagua has been ignored by every service administration.

4-3 The Urban Centres Classified

Earlier, in Part Two of this study, the relative importance of the urban centres in the province was measured in terms of ten urban indicators, eight of which were quantifiable, the other two being expressed in terms of discrete classes. The high intercorrelations between the eight quantifiable measures suggested that one or two of them could be used as surrogates for all of them. This was true for the 'population of the centre' and for 'the number of commercial establishments in the centre', which were themselves highly intercorrelated, but which provide quite different perspectives for measuring the importance of a community. It is proposed now, to examine further the urban centres of the province, using these two surrogate variables, and to comment on certain groupings of the centres that appear to show up. These two variables are particularly appropriate since the urban population is an index of the size of the immediate market served by an urban centre, while the number of commercial establishments gives some insight into functional performance, at least in the economic sphere, which may in turn shed light on variations in the level of urban services found.

In regard to the population size variable, a rank-size plot for the centres of Pichincha (see Fig. A p 89) yields the characteristically shaped curve, although certain distinct breaks can be observed. On this basis alone, one might argue that there are different levels or types

of urban communities found in the province.

Its role as national capital aside, Quito is obviously in a primate class of its own, since it has 34 times more inhabitants than the next larger centre, Santo Domingo de los Colorados.

On the graph, there is a definite break between Machachi and Conocoto, and this suggests that Santo Domingo, Cayambe, Sangolqui, and Machachi form a separate grouping since they are all cabeceras cantonales and function at a higher level commercially than do the other centres. It should be noted that while Machachi has only 39 more commercial establishments than does Conocoto (219 to 180), it has a substantially greater diversity of business types (41 to 28 respectively), and compares very favourably in this regard to the other centres of the province.

There is a further break between El Quinche and San Antonio, and a smaller one between Calacali and Uyumbicho, thus suggesting three further groupings of centres. The first set of six generally have a large number of commercial establishments, and perhaps could be considered as being sub-regional centres. There is little, however, that distinguishes the other two groups from one another. Thus, on the basis of population rank-size alone, we can classify the centres with more than 5000 inhabitants, the six sub-regional centres with between 2000 and 3000 inhabitants, and the other 59 centres.

If we now plot the number of urban services (one to fourteen) that are found in a centre against its population size, there is strong correlation. Excluding Quito from the sample, since we have not considered every type of service that is available in that centre, the correl-

ation coefficient between the two variables is .763. The corresponding regression line is 'log(POP) = 2.130 + .131(NO. OF FUNCTIONS)', and the scatter diagram is shown in Fig. B (p 90). Given the scatter of points (urban centres) on this graph, it is possible to comment informally on possible classifications of the centres.

It should be noted that if a proper grouping were to be done according to the relative location of the points on such a two-dimensional scatter diagram, then the axes should be rotated to remove the effect of correlation, and the axes should be measured in standard units, namely in terms of the standard deviation of the respective variables. However, for present purposes this level of statistical sophistication is unnecessary.

The information summarized in Fig. B is given in more detail in Table A (pp 92-3), in which the centres are listed in order of decreasing urban population, and the services are listed across the top in order of decreasing occurance.

On both the graph and the table, Quito's dominance is obvious. It possesses all fourteen services, plus additional ones that were not included in this study, and isclearly distinct from the other centres. The regional centres, Machachi, Cayambe, Sangolqui, and Santo Domingo, have respectively 10, 11, 12, and 13 of the services, and are also clearly distinct from the other centres on both dimensions. The six sub-regional centres identified in terms of population size, have from six to eight urban services, Tabacundo having ten largely because it is a cabecera cantonal. On Fig. B, these six centres do not in fact show up clearly as a distinct group. The graph shows also that the remaining smaller

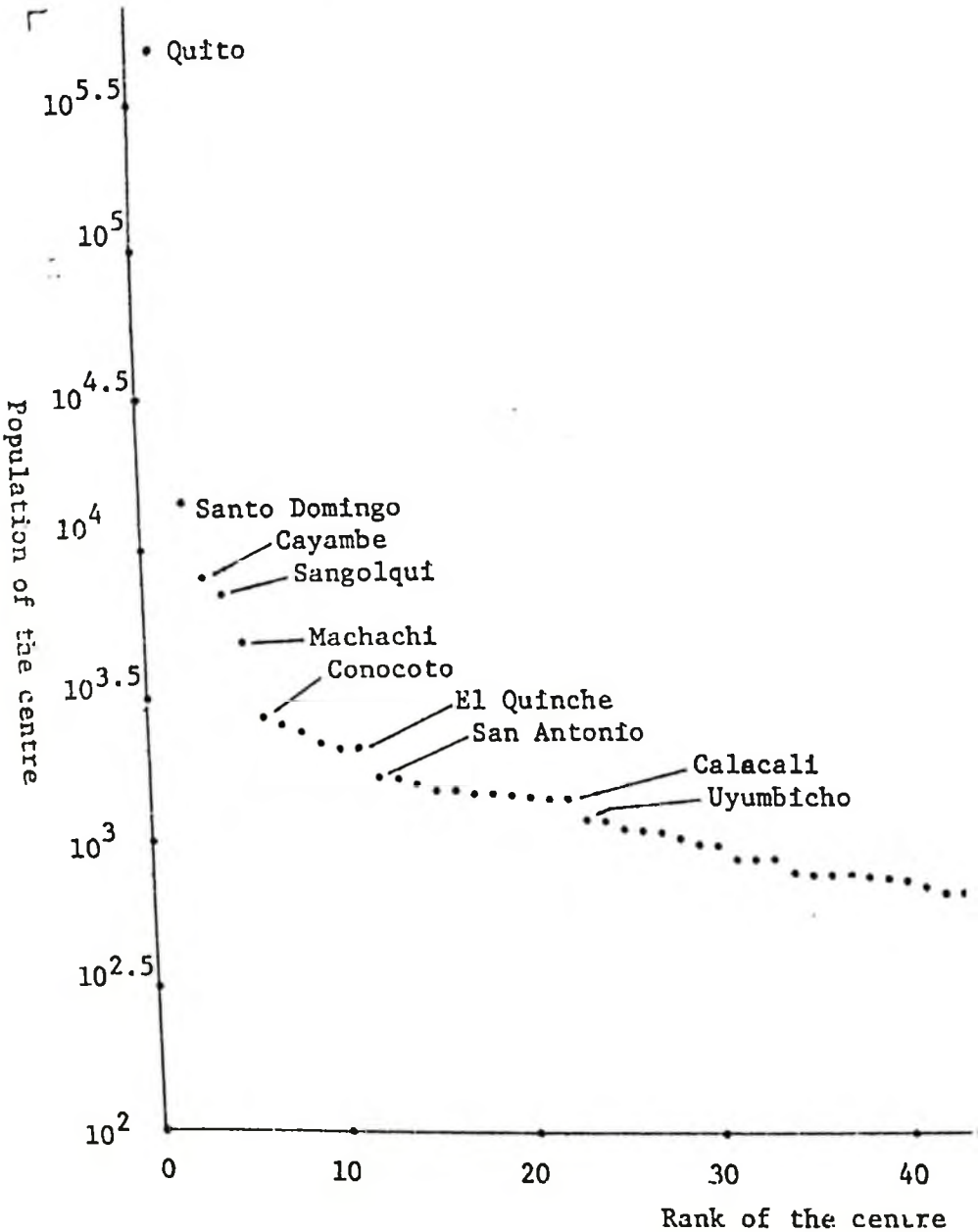
Quito
Santo Domingo
Cayambe
Sangolqui
Machachi
Conocoto
El Quinche
San Antonio
Calacali
Uyumbicho
$10^{5.5}$
10^{5}
$10^{4.5}$
10^{4}
$10^{3.5}$
10^{3}
$10^{2.5}$
10^{2}
Population of the centre
0
10
20
30
40
Rank of the centre

FIGURE A - RANK/POPULATION SIZE PLOT FOR THE CENTRES OF PICHINCHA.

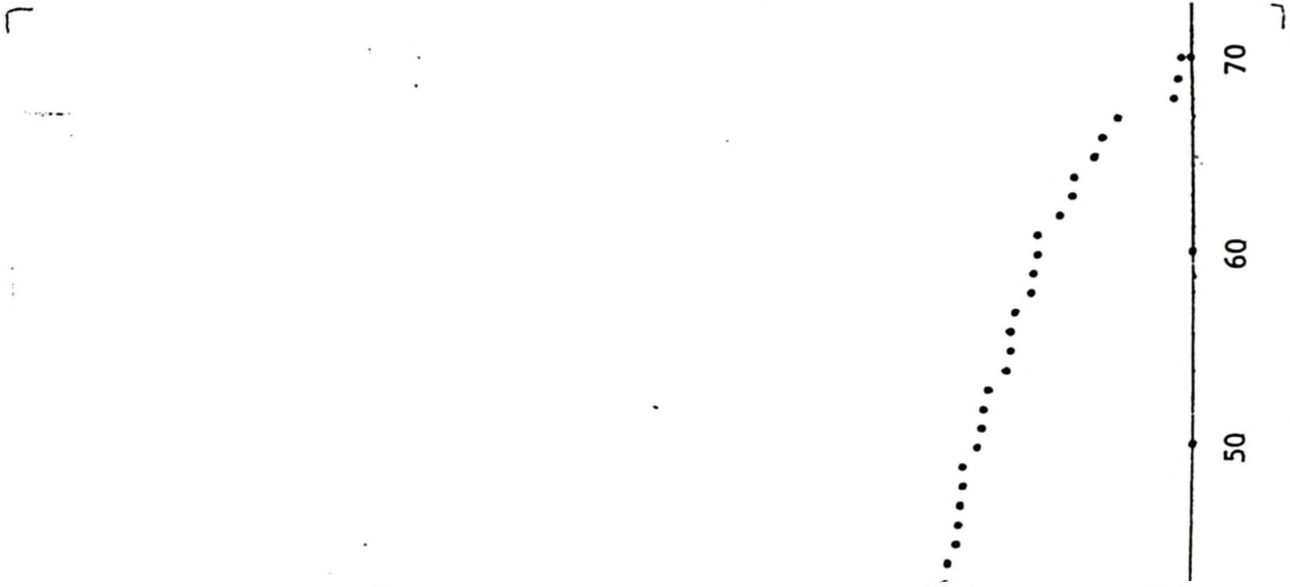

FIGURE B - SCATTER DIAGRAM - NUMBER OF SERVICES AND URBAN POPULATION.

FIGURE C - SCATTER DIAGRAM - NUMBER OF SERVICES AND NUMBER OF COMMERCIAL ESTABLISHMENTS.

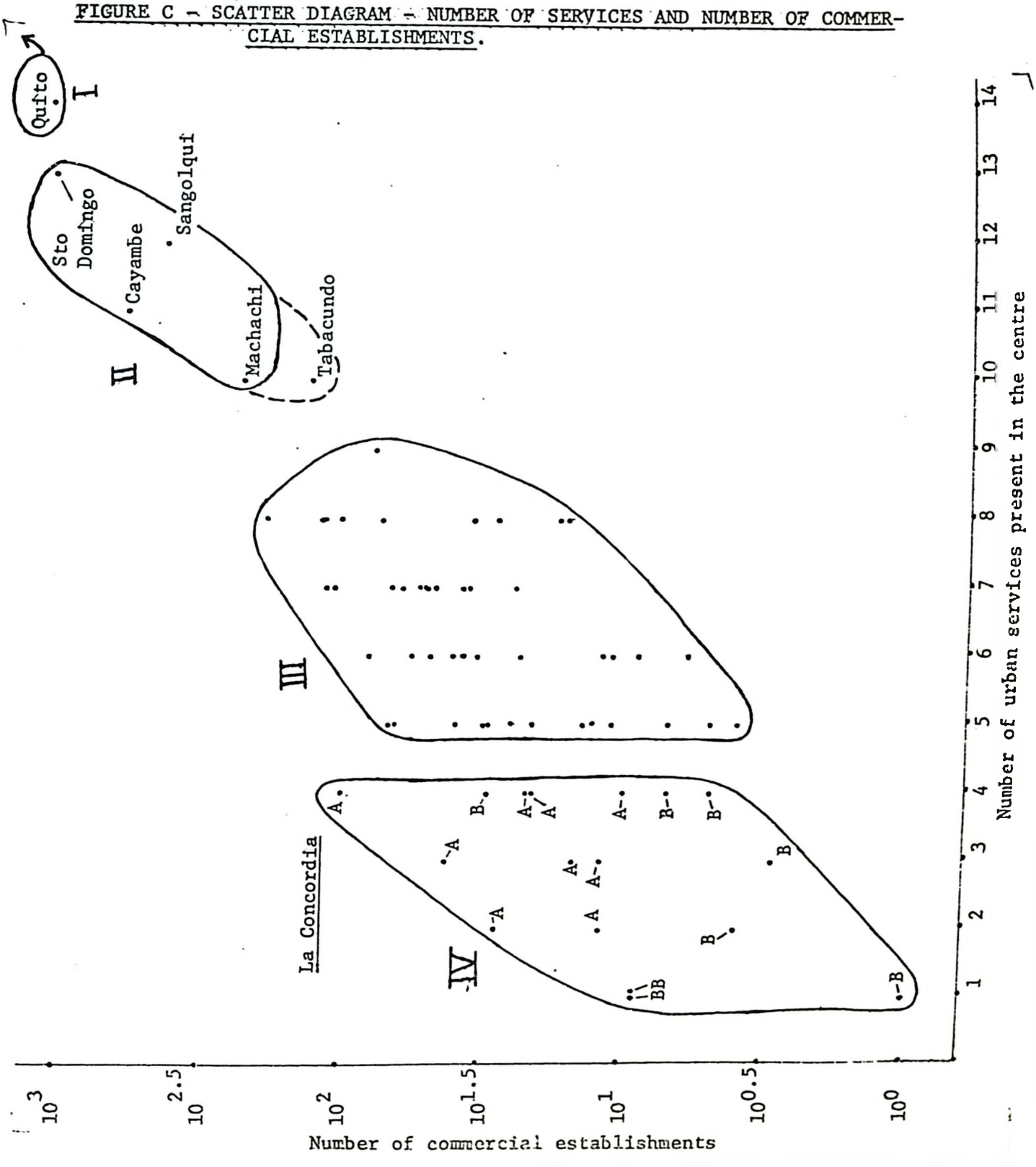

TABLE A - SUMMARY OF URBAN SERVICE LOCATIONS

No. of centre	Centre	Population of the centre	No of commercial establish.	Classification of centre	Primary school	Post office	Electricity	Health service	Telecommunications	Religious institutions	Home economics schools	Financial institutions	Secondary education	Justice	Police	Garbage collection	Fire protection	Post-secondary education	No of services present
A	B	C	D	E	a	b	c	d	e	f	g	h	i	j	k	l	m	n	F
1	Quito	528094	-?-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
2	Santo Domingo dl Col.	15460	974	2	1	1	1	1	1	1	1	1	1	1	1	1	1		13
3	Cayambe	8472	552	2	1	1	1	1	1	1	1	1	1	1	1				11
4	Sangolquí	7419	406	2	1	1	1	1	1	1	1	1	1	1	1	1			12
5	Machachi	5026	219	2	1	1	1	1	1	1	1		1	1	1				10
6	Conocoto	2765	180	3	1	1	1	1	1	1	1		1						8
7	Tabacundo	2600	127	2a	1	1	1	1	1	1	1	1	1	1					10
8	Chillogallo	2439	66	3	1	1	1	1	1	1	1								7
9	Malchingui	2249	56	3	1	1		1	1	1	1								6
10	San Jose de Minas	2149	112	3	1	1	1	1	1	1	1								7
11	El Quinche	2149	104	3	1	1	1	1	1	1	1								7
12	San Antonio de Pichin	1691	79	3	1	1	1	1	1	1									6
13	Guayllabamba	1661	99	3	1	1	1	1	1	1	1	1							8
14	Nayon	1587	13	3	1	1		1	1	1									5
15	Pintag	1507	52	3	1	1	1	1	1	1			1						7
16	Amaguana	1503	113	3	1	1	1	1	1	1	1		1						8
17	Pifo	1455	50	3	1	1	1	1	1	1		1							7
18	Pomasqui	1449	104	3	1	1	1	1	1	1	1								7
19	Tumbaco	1432	115	3	1	1	1	1	1	1	1	1							8
20	Guapulo	1416	25	3	1	1	1		1	1									5
21	Aloag	1384	75	3	1	1	1	1	1	1	1	1	1						9
22	Calacali	1384	37	3	1	1	1	1	1	1									6
23	Uyumbicho	1173	46	3	1	1	1	1	1	1			1						7
24	Cangahua	1150	64	3	1	1		1	1	1									5
25	San Pedro de Taboada	1093	28	4A	1		1												2
26	Zambiza	1069	9	3	1	1	1	1	1	1									6
27	San Rafael	1060	48	3	1	1	1		1			1	1						6
28	La Concordia	1000	98	4A	1	1	1	1											4
29	Olmedo	961	40	3	1	1		1	1	1	1								6
30	Calderon	952	60	3	1	1	1	1	1	1	1								7

TABLE A (CONTINUED)

A	B	C	D	E	a	b	c	d	e	f	g	h	i	j	k	l	m	n	F
31	Alangasi	851	49	3	1	1	1	1	1	1	1								7
32	Tambillo	849	46	3	1	1	1	1	1	1	1								7
33	Pacto	847	39	3	1	1	1	1		1									5
34	Puellaro	770	28	3	1	1	1	1	1	1	1	1							8
35	Alluriquin	750	67	3	1	1	1	1		1									5
36	Cumbaya	750	34	3	1	1	1	1	1	1	1		1						8
37	Isidro Ayora	750	42	4A	1		1		1										3
38	Llano Chico	740	10	4A	1		1	1	1										4
39	Yaruqui	729	71	3	1	1	1	1	1	1	1	1							8
40	Puembo	719	33	3	1	1	1	1	1	1									6
41	Guangopolo	678	12	3	1	1	1	1	1	1									6
42	Los Bancos	650	30	3	1	1	1	1		1									5
43	La Merced	650	21	4A	1		1	1	1										4
44	Ascazubi	636	24	3	1	1	1		1	1	1	1							7
45	Juan Montalvo	600	12	4A	1		1				1								3
46	Atahualpa	586	35	3	1	1	1	1	1	1		1							7
47	Tupigachi	581	15	4A	1	1			1										3
48	Nono	575	37	3	1	1	1	1	1	1	1								7
49	Tocachi	573	14	3	1	1		1	1	1									5
50	Nanegal	516	21	3	1	1	1	1		1									5
51	Las Delicias	500	22	4A	1	1	1	1											4
52	La Esperanza	493	17	3	1	1	1	1	1	1	1	1							8
53	Checa	475	16	3	1	1	1	1	1	1	1	1							8
54	Cotogchoa	415	12	4A	1		1												2
55	El Tingo	400	31	3	1	1	1	1	1										5
56	Lloa	399	7	3	1	1	1	1	1										5
57	Aloasi	391	11	3	1	1	1	1	1	1									6
58	Perucho	343	6	3	1	1	1	1	1	1									6
59	Tabebela	341	4	3	1	1	1	1	1										5
60	Chavezpamba	331	5	3	1	1	1	1	1										5
61	Nanegalito	330	23	3	1	1	1	1	1		1								6
62	Mindo	279	3	4B	1	1		1											3
63	Oton	253	11	3	1	1		1	1	1									5
64	Santa Rosa de Cusubam	251	7	4B	1	1		1	1										4
65	Cornejo Astorga	213	30	4B	1	1	1			1									4
66	Chiriboga	200	9	4B	1														1
67	Cutuglagua	177	9	4B	1														1
68	El Chaupi	115	4	4B	1				1										2
69	Gualea	112	5	4B	1	1	1	1											4
70	Rumipamba	108	1	4B	1														1

n.b. "1" indicates that the service is found in the centre.

sized centres all have at least one service (primary school), and as many as eight additional services, with a centre as small as Checa (475 inhabitants) having eight different facilities.

From the scatter diagram, it can be seen that only six of the centres studied have nine or more services, while seventeen have four or less urban services. Indeed, an examination of this diagram suggests an alternative classification of the urban centres in Pichincha Province to that which has been proposed on the basis of population size alone. The classes are indicated by the lines drawn on the scatter diagram Fig. B, and on Fig. C (p 91), which is a scatter diagram using the number of commercial establishments in a centre instead of its urban population. They are described as follows.

I - City(Quito). This centre has all the fourteen types of urban service examined in this study. Such a centre would have a population in excess of 36,000 (the apparent threshold for a university to be present in a centre), but other characteristics are difficult to definitively identify, since we have not determined to what extent Quito is similar to other very large Ecuadorian urban centres.

II - Regional Centre(Santo Domingo, Sangolqui, Cayambe, and Machachi). This type of centre has from ten to thirteen types of urban service, a population in excess of 5000 inhabitants, and at least 219 commercial establishments and 41 business types. These centres serve as economic, political, religious, and social service centres for the surrounding countryside. For example, they are cabeceras cantonales politically and vicariates of the church. They have large open air markets held one or more days a week to which a potential population in excess of 30,000 may come in

order to buy and sell. They have a large range of commercial functions available, and higher level public services, such as in-patient hospital facilities (Machachi's hospital is currently under construction), a police station, or an automatic telephone exchange. Tabacundo might be designated a regional satellite, since it is located only 9.2 Km. from Cayambe. It has ten services only because it has been designated a cabecera cantonal and therefore possesses a juzgado. Except for being a vicariate, Tabacundo does not have any of the characteristics of a regional centre outlined above.

III - Towns (47 centres) are the most characteristic centre studied, and are defined as having between five and nine different types of services. Such centres range in population size from 253 to 2765 inhabitants, with from five to 180 commercial establishments, and are cabeceras parroquiales (except El Tingo). Such centres typically have at least five of the following: a primary school, a post office, electricity service (permanent or evenings), a dispensary, telephone service, and a parish priest. An escuela de corte y confeccion, a savings and loan co-operative, and a secondary school may or may not be present.

IV - Villages are centres that have from one to four urban services. A primary school is always present, while a post office, electricity service, a dispensary, and telephone service may or may not be available. No such centre has a parish priest, but two (Juan Montalvo and Cornejo Astorga) do have an escuela de corte y confeccion. No other type of service is found. We can divide the seventeen centres so designated into two sub-groups (IVA+IVB). Group IVA comprises San Pedro de Taboada, La Concordia, Isidro Ayora, Llano Chico, La Merced, Juan Montalvo, Tupigachi, Las Delicias, and Cotogchoa

With the exception of La Concordia, these centres are all located no more than seven kilometres from a larger urban centre, in most cases a regional centre. They have from 415 to 1093 inhabitants, and from 10 to 98 commercial establishments, or 10 to 42 if one excludes La Concordia. La Concordia and Las Delicias are not cabeceras parroquiales, though La Merced, Isidro Ayora, and Juan Montalvo were raised to parroquia status only in the past ten years. Thus group IVA might be called Satellite Villages, since it is clear that their inhabitants are served by the additional service facilities available in the nearby larger centre, as was noted in Part Three when specific centres lacked specific services. This point was also summarized in the previous section as an urban shadow effect. La Concordia is somewhat different in that it is a fairly large commercial centre about halfway between Santo Domingo and Quininde, and like most centres in the Santo Domingo area, serves a population that is expanding rapidly due to local colonization schemes. While the commercial sector responds fairly quickly to market changes, administrations react slowly, and there is a time lag before demand for facilities is satisified. Quite simply, it is apparent that La Concordia should be logically raised to parroquia status, in which case an extension of services would doubtless follow. In this regard, it should be noted that Santo Domingo was raised to cantonal status only in 1967, and Alluriquin to a parish in 1970, so that the area is still being politically organized.

Group IVB, which we might designate simply by the term village, comprises the centres of Mindo, Santa Rosa de Cusubamba, Cornejo Astorga, Chiriboga, Cutuglagua, El Chaupi, Gualea, and Rumipamba. These centres have less than 300 inhabitants, and except for Cornejo Astorga, less than ten

commercial establishments. Whereas the satellite villages all have at least two services, these villages may possess only a primary school (Chiriboga, Cutuglagua, and Rumipamba), though a centre as small as Gualea (112 inhabitants) does have a post office, an electricity generator, and a dispensary, no doubt largely because Gualea was designated as a cabecera parroquial, as may be the explanation for the presence of a public telephone at El Chaupi.

A case might be made for designating a fifth group comprised of 'hamlets', being centres that have a primary school, and perhaps one other service at the most. Thus Chiriboga, Cutuglagua, and Rumipamba might be so classified, suggesting that hamlets would have up to 200 inhabitants. Or one might call any other nucleated settlement a hamlet. In any case, the bulk of the centres studied fall in the middle of our classification system, contrary to the patterns obtained in other empirical studies (ie. 02, 08). It was pointed out at the beginning of Part Two that only those centres for which reliable and extensive data exists were included in this study, and since virtually no data concerning the anexos of each parish were available, they were omitted. While the cabecera parroquial is the only nucleated settlement of some parishes (ie. San Rafael, Guapulo, Rumipamba), others may have a dozen or more anexos (ie. Sangolqui, and Santo Domingo de Los Colorados).

4-4 The Indicators of Urban Importance

In classifying the centres, we have used two variables as surrogates for the ten that we used in the analysis of individual service patterns in Part Three. It is now proposed to review all ten variables

to determine to what extent they contribute to our understanding of service location.

It will be observed in Table 3 that the number of market days gives the lowest level of discrimination for every service except vicariates. In each case, the number of cases falling in the range of uncertainty is highest, and except for hospitals and vicariates, the necessary threshold is zero, the minimum value possible. For the two exceptions cited, the five demographic and commercial indicators all do a better job of distinguishing between those centres that have the service and those that do not. We could therefore drop the number of market days per week as contributing nothing per se to an understanding of service location.

However, there are two aspects of this indicator that should be considered. One is that days are large, discrete intervals in a small range (zero to seven), so that we are dealing with a classified rather than a quantified variable. This may be very significant if we consider the volume of business or the impact of the market, since the large weekly market of Cayambe that serves the entire north-eastern part of the province has been equated with the small weekly market (mainly in cattle) held at Chillogallo. A more realistic or exact use of markets may be in terms of volume of business conducted (which presents a prodigious problem in data collection), or in terms of the number of sellers (which makes the assumption that the value of transactions per vendor would be fairly uniform).

The second aspect is that the mercado could be considered as an urban service itself. Local informants stated repeatedly the tend-

ency of rural people to journey to a centre on Sunday for the express purpose of going to the market, to Mass, and possibly to a dispensary where as much as fifty per cent of the weekly traffic is handled on Sundays. An excellent example of the multi-purpose trip, the individual seeks to maximize satisfaction at minimum travel cost, the market being viewed as a service. At the same time, a market does have some impact as a clearing house for the surrounding countryside, and this impact lends importance to the centre where the market is located, making it more of a 'centre'.

The number of bus departures per week can be viewed similarly. The level of explanation is only marginally better than it is using market days, and except for hospitals, vicariates, and ciclo diversificado schools, the necessary threshold is the absolute minimum. For the three exceptions, demographic or commercial indicators can in any case give a higher level of understanding. Thus the number of bus departures does not contribute significantly as an indicator of urban importance to our understanding of the distribution of urban services. In the case of an electricity supply of any kind, the number of bus services did give a slightly greater level of discrimination than when using other variables. However, except that better bus service means that it would be easier to transport diesel oil to power a motor generator or to service a power line that follows the highway, no direct causative relationship is likely.

Bus departures are viewed as an indicator of importance somewhat intuitively, since the more important a centre is, the more

people will travel to take advantage of its amenties, ergo a corresponding increase in the number of buses serving that centre. It is recognized that there are two problems with the data available, namely (a) they are reliable estimates rather than statistical counts, and (b) not everyone travels by scheduled bus. An Ecuadorian bus has a capacity of up to 115 passengers,so that we are again not dealing with uniform units.

We might also consider buses as an urban service since the rural person will tend to go to the centre that has the best transportation links from his point of origin. Our use of bus services as an indicator of importance implies that transportation links to a centre are good because people want to go there. One can argue both directions of this cause-effect relationship. It should also be noted that Santo Domingo has 1,050 bus departures a week because it is an important regional centre, whereas Chillogallo's 784 departures per week is symptomatic of the latter centre's dependence on nearby Quito. Bus services must therefore be viewed as a complex variable.

The use of potential did not contribute greatly to the results, and was of less significance than had been anticipated. In general, the sufficient threshold value isolated fewer centres having the facility than did other indicators, while only in certain cases did the necessary threshold value isolate out as many or more centres than did other indicators. The presence of a parish priest, a post office, a dispensary, and a public telephone in Perucho resulted in the necessary threshold for these services being the minimum for the province. One

interesting result did emerge, and that is for services that depend on a network. For telephone service of any kind, (and to a lesser extent for telephone exchanges), for a 24-hour electricity supply, and for daily postal service, potential gave the best or second best level of discrimination between centres. For centres having doctors or parish priests, potential gave the third best level of discrimination, and it could be argued that since such personnel move around in the course of serving the population, they are dependent on a transportation network. We can therefore conclude that since potential is calculated over the paths of a network, it will be of value in understanding the distribution pattern of any service that requires a network in order to function, in contrast with a facility like a dispensary, or a hospital, which functions basically as a self-sufficient entity. When combining indicator thresholds in order to more fully understand service distribution, we found that potential only increased the level of explanation for two services, doctors and telephone exchanges.

Depending on the services under study, one might omit potential from the analysis without much loss in generality. The calculation of potential might be modified by using the population actually served by a centre instead of that of the immediate area, or the population of the centre itself, though the former introduces a form of bias into the data, while the latter ignores the rural population entirely. One could make the calculation for a population surface, rather than for discrete nodes as was done in this study, but it is doubtful whether any increase in accuracy would offset the considerably increased problem of data collection and data manipulation.

Political status was found to contribute in two ways. On the one hand, some services, such as home economics schools, post offices, and parish priests, are not found in any centre that does not have parroquia status. In other words, lack of political status indicates in which centres one will not find more widespread services. On the other hand, the judicial system, the Church, and to some extent, the police, all base their operations on the political status of a centre. Thus the distribution of hierarchical services is based largely on the basis of the political status of centres, where a hierarchical service is one that has all levels under one administration. This contrasts with health or education where the dispensary sends patients to the hospitals and the primary schools prepares pupils for secondary education and for post-secondary education in turn, but at each level, the facility comes under different management.

While political status has a direct application, the type of highway link that a centre has contributes in a more modest way. We found that no centre on a terminal highway has daily postal service, but that otherwise, the type of centre highway link that a centre has adds nothing further in the way of explaining service distribution patterns. However, that is not to say that there is not an indirect contribution. Centres on interprovincial highways were found to have undergone greater commercial development than those at the end of terminal highways, and that level of commercial development has an influence of the location of services, so that it may well be possible to prove a direct relationship above and beyond that noted in the case of daily postal service. In general, it was found that this

variable did not contribute significantly to this study, and that it could be omitted from any further work of this type. Certainly in a region where daily postal service is the norm, the nature of the highway link to a centre would be of very questionable value as a variable.

Since urban services are established to serve a population, it would be incongruous if the resulting location patterns did not exhibit some relation to population magnitude. Three population figures were used in this study; that of the centre itself, that of the immediate area or umland, and the total population served by the centre. While the first two were available for nearly all centres from the census data, the third was based on local information and census data. The value of urban population as a surrogate variable has already been dealt with. Individually, it gave the greatest discrimination for five service facilities out of sixteen, as did total population served for another three. The population of the immediate area appears to be less significant, and a good argument could be made for discarding it, since for most centres, population of the immediate area and the total population served are synonymous. In view of the difficulty of obtaining anything more than an approximation of the total population served, and that there is high intercorrelation between this variable and the two surrogate variables (.95 and .96), it could be argued that while the total population served does indeed contribute to the development of apparent operational thresholds for individual services, it could be omitted without seriously affecting the results obtained.

A similar argument would hold for the two measures of com-

mercial activity, the number of business types and the number of commercial establishments. They give maximum individual discrimination between centres for six service facilities, and appear frequently as explanatory variables, which is logical, since they measure the commercial development of a centre, ergo local economic levels, and are therefore a measure of the ability to pay the actual and hidden costs of services. The high correlation between urban population and the number of commercial establishments suggest that the commercial indicator should be dropped, since it can be argued that the population of the centre would be the independent variable. However, the commercial indicators are the most reliable way of identifying an urban shadow zone (compare Nayon with Amaguana for urban population and commercial development), and help us identify centres that might have sufficient population to warrant having some facility, were they not located close to some larger centre. Just as the number of commercial establishments correlates to a greater degree with the other variables than does the number of business types, we also found the number of establishments to be more useful in our findings with regard to individual services.

In summary, we find that the number of market days per week and the number of bus departures per week could be dropped from this type of study as contributing nothing, though it is recognized that they should perhaps be more logically considered to be urban services themselves. The nature of a centre's highway link could also be omitted without affecting the analysis very significantly. The other seven variables do contribute somewhat to understanding the distribution pat-

terns of urban service location, though the two variables which we chose as surrogates, urban population and the number of commercial establishments, are of most value in understanding the location patterns of individual services.

4-5 Conclusions

The objective of this study was to explain the location of urban services in Pichincha Province, Ecuador, using as a working hypothesis that such services will be located in urban centres in relation to their level of importance. Ten measures of importance were utilized, namely the urban population, the population of the immediate centre, the total population served, the number of different business types found in the centre, the number of establishments located in the centre, the number of market days per week, the number of bus departures per week, the demographic potential, the political status of the centre, and the nature of the highway linking the centre. Some other variables were disregarded as being of little value, while a few, particularly in the commercial sector, might give somewhat more satisfactory results, but would make data acquisition much more difficult.

The following fourteen services that cater to the needs of the rural people of Pichincha were examined: the three levels of education, fire protection service, garbage collection, police, justice, savings and loan co-operatives, escuelas de corte y confeccion, religious institutions, health facilities, telecommunications, electricity, and the post office. Other services and agencies, such as government de-

partments, which are found in Quito or which are located according to unique political considerations, were ignored.

Except for savings and loans co-operatives and escuelas de corte y confeccion, it was found that the distribution patterns of urban services can be explained in terms of the relative importance of the centres in which any service is located, as has been hypothesized. While relative importance has been measured in various ways , the resulting criteria that explain service location do shed some light on the nature of individual services, and suggest further avenues for investigation. This is seen to be the major contribution of this study, particularly within the operational context within which this research was done. An exploratory overview of urban services in Pichincha Province has been carried out, which is an important step towards a complete understanding of the operation of those services. A by-product is the bringing together of a wealth of information concerning urban services and Pichincha Province, thereby contributing to a more comprehensive knowledge of the region.

While the major emphasis of this study has been on the urban services, a significant contribution has been made towards an understanding of the urban hierarchy of Pichincha. Four major groups of centres were identified, and the characteristics of each group were specified. Such a classification provides a basis on which specific recommendations for additions or modifications to the service networks might be made. For example, it is clear that La Concordia should be raised to parroquia

status, while Tabacundo should be demoted from its position as a cabecera cantonal. A savings and loan co-operative and a ciclo diversificado school should be started in Machachi, whereas one might argue that the priest, the post office, and probably the dispensary too, should be withdrawn from Perucho, since this small parish could almost certainly be served from nearby Puellaro, about 5 Km. away. It should be noted that changes are being made all the time. The electricity grid is being extended, a hospital is being built in Machachi, and a savings and loan co-operative is being organized in San Jose de Minas, where it is also proposed to locate a new secondary school.

The results obtained do have a direct application in that we have provided an initial answer to the thorny question of what should go where, even though the final answer is the solution to a complex equation of many social, political, and economic variables. There is another possible application of our findings. For example, in a regional development plan, if a centre will acquire at least 18 different types of business and an urban population of at least 750, then one can predict from our results that there will be sufficient demand for a drug store to be established in that centre. Given projections of the variables used as indicators of importance, one can thus estimate future service needs for the province. There are limitations to this usage. It will have been observed that while we can specify thresholds for any service, there are frequently cases that are not covered by the stated criteria. These special cases or exceptions suggest that other factors may influence to some extent the establishment of facilities,

and that these factors should be investigated further before any estimation of a future distribution pattern be finalized. We can,say, identify which relatively important centres would be expected to have a secondary school, but we have as yet little basis for positively identifying those smaller communities which may also happen to acquire this type of facility.

Another limitation to the application of the results of this study to regional development is that we have not considered the effect that a service facility may have on a centre. It was hypothesized that services are located in centres according to their relative importance, and services have been considered only in the role of a dependent variable. To cite an example, it was suggested that universities may contribute to urbanization, and there is evidence to suggest that population migration is influenced to some extent by the location of educational facilities (31). However, we have no evidence as to how a given facility will affect the growth of a community in terms of number of people attracted as a result, the number of jobs or the amount of increased business that the service and its personnel will generate, or in terms of increased demand for other services. It was posited that the telephone exchange at Nanegalito was installed to serve the local doctor and the IERAC delegation located in the town, as much as the town itself. There are doubtless other examples of one service located largely as a support facility for another service, but we lacked a means of positively identifying such cases.

These limitations could be largely taken care of by incorporating a historical perspective into the study, so that we would then be

able to know exactly when and where each service facility was introduced, and the rationale behind each choice. With demographic and economic data for each centre for the time period involved, one could attempt to measure the impact on the centre of a new service facility, as well as to suggest more rigorous threshold criteria for each type of facility. Obtaining such further information would present difficulties, but not insurmountable ones, and the lack of this kind of input is a major shortcoming of this study.

While an overview of urban services has been presented, a look at other factors, such as local initiative, centralization, or the effect of size on the cost of services and whether threshold values seem to be associated with some minimum cost, would give a more complete understanding of how the various services function today. The lack of this additional perspective is the other major shortcoming of this study. These two deficiencies arose from a disordered research procedure, coupled with the problem of being located 4000 miles from one's study area.

The shortcomings noted suggest immediate areas for further work. First and foremost, a historical perspective is required in order to determine whether the locational criteria obtained from our study reflect a current status quo or are empirically valid as general principles. This would simply be an extension of the work already carried out.

Further work should be carried out to determine the effect of other factors on service location, particularly for savings and loan co-operatives and escuelas de corte y confeccion, which are not

located in centres according to their relative importance, local initiative having been cited as a prime factor in their establishment. Initiative is the outcome of need and perception thereof on the part of local people, but these concepts are also relevant to the success of any service facility.

Further work might be done on the economics of service provision. The threshold criteria determined by this study suggest some minimum market or economic level below which it is impractical or uneconomic to offer the service in question. One might ask whether size of market affects the cost of services, and whether one could achieve real economies by centralization of facilities, or alternatively by dispersion of facilities.

Finally, it was suggested in Part One that the results of this study might be used to develop a more rigorous method of deriving a 'service score' for measuring the importance of a community as a service or administrative centre. The fact that so many of the service distribution patterns can be explained by demographic or commercial indicators suggests that it would be relatively straightforward to determine an empirically valid weighting or scoring system for services. At the same time, if services are dependent on a 'market', then it would appear to be more to the point to evaluate centres in terms of that market alone. If services are located by administrative fiat, then evaluating communities purely as service centres becomes rather a meaningless exercise, since the result is a foregone conclusion.

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APPENDICES

APPENDIX A - DATA USED

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Table 1 - Indicator Values Used

Note: "-0" indicates an unknown value.

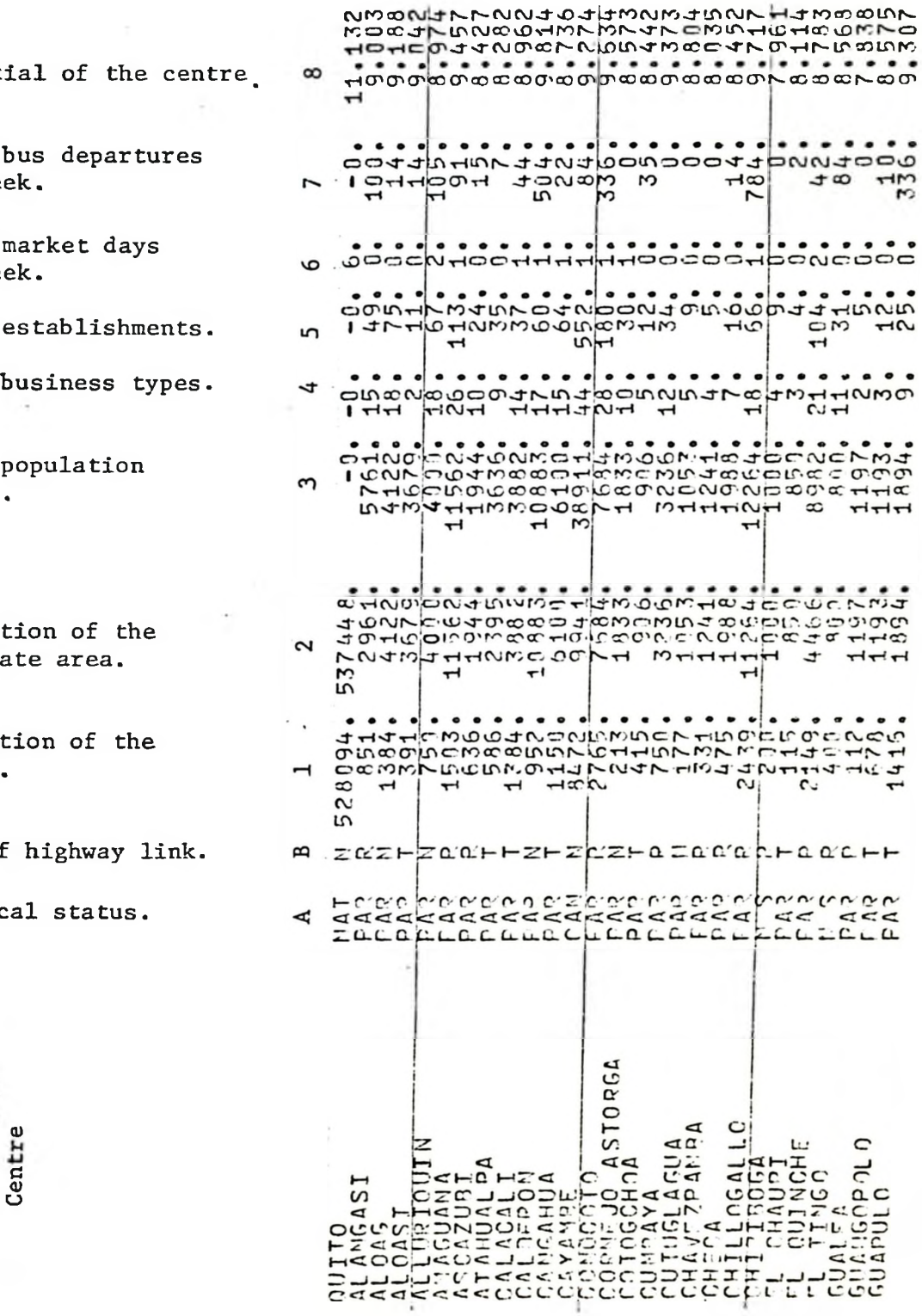

Table 1 (continued)

Name of centre	A	B	1	2	3	4	5	6	7	8
GUAYLLABAMBA	PAR	N	1661.	4190.	4190.	20.	99.	0.	14.	8.993
ISIDRO AYORA	PAR	P	750.	3100.	3090.	12.	42.	0.	3.	8.531
JUAN MONTALVO	PAR	T	600.	2200.	2200.	5.	12.	0.	7.	8.479
LA CONCORDIA	N S	T	1000.	7500.	7500.	23.	98.	1.	0.	8.907
LA ESPERANZA	PAR	T	493.	2239.	2239.	9.	17.	1.	7.	8.303
LA MERCED	PAR	T	650.	2000.	2000.	8.	21.	0.	35.	8.756
LAS DELICIAS	N S	T	500.	5000.	5000.	9.	22.	1.	0.	8.889
LOS BANCOS	PAR	T	650.	4000.	4000.	14.	30.	0.	7.	8.319
LLANO CHICO	PAR	T	740.	2057.	2057.	3.	10.	0.	154.	8.899
LLOA	PAR	T	299.	1192.	1192.	2.	7.	0.	21.	8.539
MACHACHI	CAN	NR	5026.	14083.	34338.	41.	219.	1.	175.	9.810
MALCHINGUI	PAR	RT	2249.	3105.	4058.	15.	56.	1.	4.	8.437
MINDO	PAR	T	279.	1160.	1160.	2.	3.	0.	2.	7.831
MANEGAL	PAR	TR	516.	2417.	5026.	11.	21.	1.	7.	8.166
MANEGALITO	PAR	TR	330.	2609.	2609.	9.	23.	0.	0.	8.275
MAYON	PAR	TR	1587.	2767.	2767.	5.	13.	1.	12.	9.106
MONO	PAR	TR	575.	2288.	2288.	9.	37.	0.	0.	8.554
OLMEDO	PAR	R	961.	5012.	5012.	15.	40.	1.	14.	8.571
OTON	PAR	TT	253.	1261.	1261.	6.	11.	1.	0.	8.169
PACTO	PAR	TT	847.	2849.	4046.	15.	39.	1.	14.	8.158
PERUCHO	PAR	TR	343.	583.	583.	3.	6.	0.	0.	7.619
PIFO	PAR	TR	1455.	3397.	5671.	17.	55.	1.	56.	8.935
PINTAG	PAR	TR	1507.	7394.	7394.	14.	52.	0.	42.	9.182
POMASQUI	PAR	TR	1449.	3667.	3667.	22.	104.	1.	0.	9.214
PUELLARO	PAR	TR	770.	4314.	4314.	12.	28.	1.	7.	8.706
PUEMBO	PAR	TR	719.	2274.	2274.	11.	33.	0.	14.	8.800
PUMIPAMBA	PAR	TR	108.	432.	432.	1.	1.	0.	11.	7.872
SAN ANTONIO DE PICHI	PAR	TR	1691.	3542.	3542.	16.	79.	0.	630.	9.083
SANGOLQUI	CAN	R	7419.	14233.	43637.	46.	406.	2.	504.	9.778
SAN JOSE DE MINAS	PAR	TT	2149.	7346.	7346.	22.	112.	0.	21.	8.631
SAN PEDRO DE TABOADA	PAR	TR	1093.	3011.	3011.	8.	28.	0.	0.	9.118
SAN RAFAEL	PAR	R	1660.	1084.	1084.	15.	48.	0.	0.	8.768
STA ROSA DE CUSUBAMB	PAR	T	251.	1340.	1340.	4.	7.	0.	2.	8.335
STO DOMINGO OLCOL	CAN	N	15460.	49657.	67573.	58.	974.	3.	1050.	9.968
TABABELA	PAR	T	341.	1402.	1402.	1.	4.	0.	0.	8.461
TABACUNDO	CAN	TR	2600.	5449.	8642.	23.	127.	1.	9.	8.696
TAMBILLO	PAR	TR	849.	3003.	3003.	14.	46.	0.	0.	9.213
TOCACHI	PAR	R	573.	1907.	1907.	7.	14.	0.	3.	8.141
TUMBACO	PAR	TR	1432.	9667.	9667.	20.	115.	1.	336.	9.731
TURIGACHI	PAR	TR	591.	2755.	2755.	4.	15.	0.	9.	8.425
UYUMBICHO	PAR	TR	1173.	2821.	2820.	13.	46.	0.	56.	8.946
YARUQUI	PAR	T	729.	3070.	6136.	18.	71.	1.	21.	8.855
ZAMBIZA	PAR	T	1069.	2832.	2832.	4.	9.	0.	42.	9.180

Table 2 - Test for Correlation Between Indicators of Importance

1. Population of the centre (000's).
2. Population of the immediate area (000's).
3. Total population served (000's).
4. Number of business types.
5. Number of commercial establishments.
6. Number of market days per week.
7. Number of bus departures per week.
8. Potential of the centre (log Pot).

VARIABLE	MEAN	STANDARD DEVIATION	NUMBER OF ITEMS
1	1.3852	2.2327	69
2	4.4857	6.3711	69
3	6.1821	10.8956	69
4	13.2754	10.8964	69
5	69.9130	139.7814	69
6	.4783	.6555	69
7	85.9710	194.3608	69
8	8.7535	.5335	69

CORRELATION MATRIX
(SAMPLE SIZES IN PARENTHESES)

VARIABLE NO.	1	2	3	4	5	6	7	8
1 *	1.00000 (69)	.89824 (69)	.96387 (69)	.86072 (69)	.98202 (69)	.62348 (69)	.67337 (69)	.54998 (69)
2 *	.89824 (69)	1.00000 (69)	.89713 (69)	.79519 (69)	.90200 (69)	.65903 (69)	.75410 (69)	.59552 (69)
3 *	.96387 (69)	.89713 (69)	1.00000 (69)	.88052 (69)	.95144 (69)	.64874 (69)	.66110 (69)	.57054 (69)
4 *	.86072 (69)	.79519 (69)	.88052 (69)	1.00000 (69)	.86561 (69)	.69780 (69)	.57732 (69)	.67326 (69)
5 *	.98202 (69)	.90200 (69)	.95144 (69)	.86561 (69)	1.00000 (69)	.62625 (69)	.64476 (69)	.51793 (69)
6 *	.62348 (69)	.65903 (69)	.64874 (69)	.69780 (69)	.62625 (69)	1.00000 (69)	.47810 (69)	.44564 (69)
7 *	.67337 (69)	.75410 (69)	.66110 (69)	.57732 (69)	.64476 (69)	.47810 (69)	1.00000 (69)	.62378 (69)
8 *	.54998 (69)	.59552 (69)	.57054 (69)	.67326 (69)	.51793 (69)	.44564 (69)	.62378 (69)	1.00000 (69)

Table 3 - Necessary and Sufficient Threshold Values for the Presence of a Service in Terms of Each Indicator of Importance.

Variable:
1. Population of the centre.
2. Population of the immediate area.
3. Total population served.
4. Number of business types.
5. Number of commercial establishments.
6. Number of market days per week.
7. Number of bus departures per week.
8. Potential of the centre (log Pot).

Column:
1. Variable number.
2. Necessary threshold value.
3. Sufficient threshold value.
4. Range of uncertainty.
5. Number of centres below the necessary threshold value.
6. Number of centres within the range of uncertainty - without.
7. " " " " " " " " - with service.
8. Number of centres above the sufficient threshold value.

a) schools offering Ciclo Diversificado

1	2	3	4	5	6	7	8
1	1173.000	5026.000	3853.000	47	17	2	4
2	2820.000	14383.000	11563.000	32	32	5	3
3	2820.000	34338.000	31518.000	30	34	2	4
4	13.000	41.000	28.000	38	26	2	4
5	46.000	219.000	173.000	42	22	2	4
6	0.000	2.000	2.000	0	64	4	2
7	56.000	784.000	728.000	52	12	4	2
8	8.946	9.814	.868	44	20	4	2

(assuming Machachi has such a school and Uyumbicho does not)

1	2765.000	2600.000	0.000	64	0	0	6
2	7684.000	11562.000	3878.000	60	4	2	4
3	7684.000	12284.000	4580.000	58	6	1	5
4	28.000	28.000	0.000	64	0	0	6
5	120.000	127.000	0.000	64	0	0	6
6	1.000	2.000	1.000	41	24	3	2
7	84.000	784.000	700.000	54	11	3	2
8	9.274	9.814	.540	58	7	3	2

b) schools offering ciclo basico

1	750.000	2439.000	1689.000	33	24	6	7
2	1084.000	11264.000	10180.000	7	50	8	5
3	1084.000	12264.000	11180.000	7	50	8	5
4	12.000	23.000	11.000	35	22	6	7
5	34.000	115.000	81.000	35	22	6	7
6	0.000	2.000	2.000	0	57	11	2
7	0.000	784.000	784.000	0	57	11	2
8	8.696	9.814	1.118	31	26	11	2

Table 3 (continued)

c) savings and loan cooperatives

1	475.000	5026.000	4551.000	17	37	12	4
2	1084.000	14083.000	12999.000	7	47	13	3
3	1084.000	34338.000	33254.000	7	47	12	4
4	7.000	41.000	34.000	20	34	12	4
5	16.000	219.000	203.000	21	33	12	4
6	0.000	2.000	2.000	0	54	14	2
7	0.000	784.000	784.000	0	54	14	2
8	8.282	9.814	1.532	12	42	14	2

d) home economics schools

1	213.000	1691.000	1478.000	5	35	19	11
2	1833.000	7500.000	5667.000	16	24	20	10
3	1833.000	7500.000	5667.000	16	24	18	12
4	5.000	23.000	18.000	15	25	23	7
5	12.000	98.000	86.000	15	25	17	13
6	0.000	2.000	2.000	0	40	28	2
7	0.000	630.000	630.000	0	40	27	3
8	8.275	9.307	1.032	11	29	20	10

e) vicariates

1	770.000	2765.000	1395.000	36	24	5	5
2	4314.000	11264.000	6950.000	50	10	5	5
3	4314.000	12264.000	7950.000	47	13	5	5
4	12.000	28.000	16.000	35	25	5	5
5	28.000	180.000	152.000	29	31	5	5
6	1.000	2.000	1.000	41	19	8	2
7	7.000	784.000	777.000	23	37	8	2
8	8.696	9.814	1.118	31	29	8	2

(if we exclude Puellaro)

1	1432.000	2765.000	1333.000	51	10	4	5
2	4466.000	11264.000	6798.000	51	10	4	5
3	8642.000	12264.000	3622.000	59	2	4	5
4	20.000	28.000	8.000	56	5	4	5
5	104.000	180.000	76.000	58	3	4	5
6	1.000	2.000	1.000	41	19	8	2
7	9.000	784.000	775.000	29	32	7	2
8	8.696	9.814	1.118	31	29	8	2

f) parish priests

1	253.000	1093.000	840.000	7	16	23	24
2	583.000	7500.000	6917.000	1	22	37	10
3	583.000	7500.000	6917.000	1	22	35	12
4	2.000	23.000	21.000	2	21	40	7
5	6.000	98.000	92.000	6	17	34	13
6	0.000	1.000	1.000	0	23	42	5
7	0.000	154.000	154.000	0	23	37	10
8	7.619	9.118	1.499	0	23	30	17

1 2 3 4 5 6 7 8

Table 3 (continued)

g) telephone service of any kind

1	115.000	1093.000	978.000	2	13	31	24
2	583.000	7500.000	6917.000	1	14	45	10
3	583.000	7500.000	6917.000	1	14	45	12
4	1.000	23.000	22.000	0	15	48	7
5	4.000	98.000	94.000	2	13	42	13
6	0.000	2.000	2.000	0	15	53	2
7	0.000	105.000	105.000	0	13	44	11
8	7.619	9.118	1.499	0	15	38	17

h) telephone exchanges

1	330.000	2439.000	2109.000	9	32	22	7
2	800.000	11264.000	10464.000	2	39	24	5
3	800.000	12264.000	11464.000	2	39	22	5
4	8.000	23.000	15.000	2	19	22	7
5	21.000	112.000	91.000	23	18	25	9
6	0.000	2.000	2.000	0	41	27	2
7	0.000	784.000	784.000	0	41	27	2
8	8.275	9.717	1.442	11	30	23	6

(excluding Chillogallo and Guapulo)

1	330.000	2149.000	1819.000	9	31	21	9
2	800.000	7500.000	6700.000	2	38	20	10
3	800.000	7500.000	6700.000	2	38	18	12
4	8.000	23.000	15.000	22	19	22	7
5	21.000	112.000	91.000	23	18	20	9
6	0.000	2.000	2.000	0	41	27	2
7	0.000	154.000	154.000	0	39	21	10
8	8.275	9.188	.913	11	28	17	14

i) hospitals and clinics (in-patient facilities)

1	1455.000	5026.000	3571.000	53	11	2	4
2	3397.000	14083.000	10686.000	41	23	3	3
3	5671.000	34338.000	28667.000	51	13	2	4
4	17.000	41.000	24.000	59	14	2	4
5	50.000	219.000	169.000	46	18	2	4
6	1.000	2.000	1.000	41	23		
7	56.000	784.000	728.000	52	12	4	2
8	8.935	9.814	.879	43	21	4	2

j) dispensaries

1	112.000	1416.000	1304.000	1	13	37	13
2	583.000	7500.000	6917.000	1	13	46	13
3	583.000	7500.000	6917.000	1	13	44	12
4	1.000	23.000	22.000	0	14	49	7
5	3.000	98.000	95.000	1	13	42	13
6	0.000	1.000	1.000	0	14	51	5
7	0.000	336.000	336.000	0	14	52	6
8	7.619	9.307	1.688	0	14	46	10

1	2	3	4	5	6	7	8

Table 3 (continued)

k) doctors

1	330.000	2249.000	1919.000	9	40	13	8
2	800.000	6100.000	5300.000	2	47	8	13
3	800.000	8982.000	8182.000	2	47	12	9
4	7.000	21.000	14.000	20	29	10	11
5	14.000	104.000	90.000	19	30	11	10
6	0.000	2.000	2.000	0	49	19	2
7	0.000	630.000	630.000	0	49	18	3
8	8.141	9.307	1.166	7	42	11	10

l) drug stores

1	253.000	1691.000	1438.000	7	43	9	11
2	1261.000	10883.000	9622.000	13	37	14	6
3	1261.000	10883.000	9622.000	13	37	13	7
4	6.000	18.000	12.000	19	31	6	14
5	11.000	79.000	68.000	13	37	6	14
6	0.000	1.000	1.000	0	50	15	5
7	0.000	630.000	630.000	0	50	17	3
8	8.169	9.814	1.645	10	40	18	2

m) 24-hour electricity supply (grid connection)

1	213.000	2249.000	2036.000	5	24	33	8
2	800.000	7346.000	6546.000	2	27	29	12
3	800.000	7346.000	6546.000	2	27	27	14
4	1.000	22.000	21.000	0	29	32	9
5	4.000	112.000	108.000	2	27	32	9
6	0.000	1.000	1.000	0	29	36	5
7	0.000	154.000	154.000	0	29	31	10
8	8.303	9.180	.877	13	16	25	16

n) electricity supply of any kind

1	112.000	2249.000	2137.000	1	12	49	8
2	583.000	6100.000	5517.000	1	12	44	13
3	583.000	6100.000	5517.000	1	12	41	16
4	1.000	15.000	14.000	0	13	36	21
5	4.000	64.000	60.000	2	11	38	19
6	0.000	1.000	1.000	0	13	52	5
7	0.000	22.000	22.000	0	13	32	24
8	7.619	9.106	1.487	0	13	39	18

o) post office

1	112.000	1093.000	981.000	1	9	36	24
2	593.000	3011.000	2428.000	1	9	29	31
3	593.000	3011.000	2428.000	1	9	26	34
4	1.000	12.000	11.000	0	10	28	32
5	3.000	42.000	39.000	1	9	32	28
6	0.000	0.000	0.000	0	10	31	29
7	0.000	154.000	154.000	0	10	50	10
8	7.619	9.118	1.499	0	10	43	17

p) daily postal service

1	213.000	2249.000	2036.000	5	42	15	8
2	800.000	7394.000	6594.000	2	45	12	11
3	800.000	8982.000	8182.000	2	45	14	9
4	9.000	22.000	13.000	24	23	11	9
5	22.000	112.000	90.000	25	22	11	9
6	0.000	2.000	2.000	0	47	21	5
7	0.000	336.000	336.000	0	47	17	9
8	8.568	9.373	.805	26	21	14	

1 2 3 4 5 6 7 8

4 - Centres with schools offering ciclo diversificado	Number of schools offering each program Number of students enrolled in program 1	2	3	4	5	6	Total no of students
QUITO	-0 -0	1 33	36 5536	55 8213	4 779	8 2205	16766
CAYAMBE	-0 -0	-0 -0	-0 -0	1 99	-0 -0	1 94	193
CONOCOTO	-0 -0	-0 -0	-0 -0	2 136	-0 -0	-0 -0	136
SANGOLQUI	-0 -0	-0 -0	-0 -0	1 75	-0 -0	-0 -0	75
STO DOMINGO DLCOL	1 26	-0 -0	3 62	-0 -0	-0 -0	-0 -0	88
UYUMBICHO	-0 -0	-0 -0	-0 -0	-0 -0	-0 -0	1 305	305

Programs: 1 - Agricultural
2 - Arts
3 - Commercial
4 - Humanities
5 - Industrial
6 - General

QUITO	128.	30935.
ALOAG	1.	137.
AMAGUANA	1.	97.
CAYAMBE	1.	368.
CONOCOTO	3.	239.
CUMBAYA	1.	193.
MACHACHI	2.	235.
PINTAG	1.	57.
SANGOLQUI	3.	474.
SAN RAFAEL	1.	64.
STO DOMINGO DLCOL	5.	583.
TABACUNDO	1.	75.
UYUMBICHO	1.	234.

Table 5 - Centres with schools offering ciclo basico.

Figures indicate the number of such schools in the centre, and the total number of students enrolled.

Table 6 - Savings and Loan Cooperatives

Location	No. of Members	Savings (S/.)	Loans (S/.)	Total Assets	Loans to date No.	Loans to date Amount	Name of the Cooperative
QUITO	125	634367	565493	769049	690	2043257	COTOCOLLAO
ALOAG	144	199514	176499	212886	304	547064	SANTA ANA/8 DE SEPTEMB
ASCAZUBI	32	20985	10200	27939	18	17200	16 DE JULIO
ATAHUALPA	261	463398	497967	589930	296	897759	PROGRESSO DE ATAHUALPA
CAYAMBE	1311	4154804	4574522	5613708	2392	14111166	24 DE MAYO
CHECA	113	135642	128117	156806	226	355780	CHECA
GUAYLLABAMBA	190	314579	362098	427079	720	1261001	GUAYLLABAMBA
LA ESPERANZA	327	289912	284311	364185	855	1199987	BUENA ESPERANZA
PIFO	44	30146	19800	29446	62	55900	SAN SEBASTIAN
PUELLARO	125	115503	136447	151061	151	209266	PUELLARO
SANGOLQUI	110	86583	60736	93920	68	95061	ALIANZA DEL VALLE
SAN RAFAEL	86	111408	106635	126531	211	334489	14 DE MARZO
TABACUNDO	360	624409	687790	743280	1127	1783000	PEDRO MONCAYO
TUMBACO	145	265955	345899	459753	245	807110	PAULO VI
YARUQUI	229	646287	894686	1022285	2550	3573348	YARUQUI

Note: The figures quoted for Aloag include values for both cooperatives located in that centre.

Table 7 - Locations of Home Economics Schools

QUITO
ALANGASI
ALOAG
AMAGUANA
ASCAZUBI
CALDERON
CAYAMBE
CONOCOTO
CORNEJO ASTORGA
CUMBAYA
CHECA
CHILLOGALLO
EL QUINCHE
GUAYLLABAMBA
JUAN MONTALVO
LA ESPERANZA
MACHACHI
MALCHINGUI
NANEGALITO
NONO
OLMEDO
POMASQUI
PUELLARO
SANGOLQUI
SAN JOSE DE MINAS
STO DOMINGO DLCOL
TABACUNDO
TAMBILLO
TUMBACO
YARUQUI

Table 8 - Vicariates

QUITO
AMAGUANA
CAYAMBE
EL QUINCHE
MACHACHI
PUELLARO
SANGOLQUI
STO DOMINGO DLCOL
TABACUNDO
TUMBACO

Table 9 - Locations of Parish Priests

QUITO
ALANGASI
ALOAG
ALOASI
ALLURIQUIN
AMAGUANA
ASCAZUBI
ATAHUALPA
CALACALI
CALDERON
CANGAHUA
CAYAMBE
CONOCOTO
CUMBAYA
CHECA
CHILLOGALLO
EL QUINCHE
GUANGOPOLO
GUAPULO
GUAYLLABAMBA
LA ESPERANZA
LOS BANCOS
MACHACHI
MALCHINGUI
NANEGAL
NAYON
NONO
OLMEDO
OTON
PACIA
PERUCHO
PIFO
PINTAG
POMASQUI
PUELLARO
PUEMBO
SAN ANTONIO DE PICHI
SANGOLQUI
SAN JOSE DE MINAS
STO DOMINGO DLCOL
TABACUNDO
TAMBILLO
TOCACHI
TUMBACO
UYUMBICHO
YARUQUI
ZAMBIZA

Table 10 - Telephone Exchanges

Location	0 Manual 1 Automatic	No of Subscribers	3 min Call to Quito(S/)
QUITO	1	44884	.30
ALANGASI	0	4	2.60
AMAGUANA	0	50	2.10
ATAHUALPA	0	9	3.50
CALACALI	0	6	3.00
CALDERON	0	28	1.50
CAYAMBE	0	70	4.80
CONOCOTO	1	382	2.20
CUMBAYA	1	30	2.10
EL QUINCHE	0	20	2.60
EL TINGO	0	19	2.10
GUAYLLABAMBA	0	14	2.60
LA MERCED	0	32	2.10
MACHACHI	1	164	2.10
MALCHINGUI	0	1	5.50
NANEGALITO	0	1	4.50
NONO	0	8	2.60
OLMEDO	0	10	4.80
PIFO	0	28	2.60
PINTAG	0	7	2.60
POMASQUI	0	58	2.10
PUELLARO	0	9	3.20
PUEMBO	0	28	2.60
SAN ANTONIO DE PICHI	0	23	2.10
SANGOLQUI	1	251	2.20
STO DOMINGO OLCOL	1	317	10.40
TABACUNDO	0	9	4.80
TAMBILLO	1	74	2.10
TUMBACO	1	40	2.10

Table 11 - Public Telephones in Other Centres

Location	Cost of a 3 min call to Quito.
ALOAG	2.10
ALOASI	2.10
ASCAZUBI	2.60
CANGAHUA	4.80
CHAVEZPAMBA	3.50
CHECA	2.60
CHILLOGALLO	.30
EL CHAUPI	2.10
GUANGOPOLO	2.20
GUAPULO	.30
ISIDRO AYORA	4.80
LA ESPERANZA	4.80
LLANO CHICO	1.50
LLOA	.30
NAYON	1.50
OTON	2.60
PERUCHO	3.20
SAN JOSE DE MINAS	3.50
SAN RAFAEL	2.20
STA ROSA DE CUSUBAMBA	2.60
TABABELA	2.60
TOCACHI	4.80
TUPIGACHI	4.80
UYUMBICHO	2.10
YARUQUI	2.60
ZAMBIZA	1.50

Table 12 - Health Services in Pichincha

Centre	Hospital	Clinic	Dispensary	No. of Doctors	No. of Drug Stores
QUITO	1	1	1	97	10
ALANGASI	0	0	1	-	-
ALOAG	0	0	1	-	-
ALOASI	0	0	1	-	-
ALLURIQUIN	0	0	1	2	1
AMAGUANA	0	0	1	-	-
ATAHUALPA	0	0	1	-	-
CALACALI	0	0	1	-	-
CALDERON	0	0	1	2	0
CANGAHUA	0	0	1	-	-
CAYAMBE	1	1	1	4	2
CONOCOTO	1	0	1	6	1
CUMBAYA	0	0	1	1	0
CHAVEZPAMBA	0	0	1	-	-
CHECA	0	0	1	-	-
CHILLOGALLO	0	0	1	3	1
EL QUINCHE	0	0	1	-	-
EL TINGO	0	0	1	1	0
GUALEA	0	0	1	-	-
GUANGOPOLO	0	0	1	0	0
GUAYLLABAMBA	0	0	1	-	-
LA CONCORDIA	0	0	0	1	1
LA ESPERANZA	0	0	1	-	-
LA MERCED	0	0	1	-	-
LAS DELICIAS	0	0	1	-	-
LOS BANCOS	0	0	1	-	-
LLANO CHICO	0	0	1	-	-
LLOA	0	0	1	-	-
MACHACHI	0	0	1	6	2
MALCHINGUI	0	0	1	-	-
MINDO	0	0	1	-	-
NANEGAL	0	0	1	-	-
NANEGALITO	0	0	1	1	0
NAYON	0	0	1	-	-
NONO	0	0	1	-	-
OLMEDO	0	0	1	-	-
OTON	0	0	1	-	-
PACTO	0	0	1	-	-
PERUCHO	0	0	1	-	-
PIFO	1	0	1	1	0
PINTAG	0	0	1	1	0
POMASQUI	0	0	1	2	0
PUELLARO	0	0	1	-	-
PUEMBO	0	0	1	-	-
SAN ANTONIO DE PICHI	0	1	1	7	2
SANGOLQUI	0	1	1	2	1
SAN JOSE DE MINAS	0	0	1	-	-
STA ROSA DE CUSUBAMB	1	1	1	2	0
STO DOMINGO DLCOL	1	1	1	7	3
TABABELA	0	0	1	-	-
TABACUNDO	1	0	1	3	1
TAMBILLO	0	0	1	-	-
TOCACHI	0	0	1	1	0
TUNBACO	0	0	1	-	-
UYUMBICHO	0	0	1	-	-
YARUQUI	0	0	1	-	-
ZAMBIZA	0	0	1	-	-

Table 13 - Dispensaries in Pichincha

Location	Water?	Toilet?	Electricity?	No of patients per year	No of years in operation.
QUITO	-0	-0	-0	0.000	-0
ALANGASI	1	1	1	203.867	18
ALOAG	-0	-0	-0	0.000	-0
ALOASI	-0	-0	-0	0.000	-0
ALLURIQUIN	-0	-0	-0	0.000	-0
AMAGUANA	1	1	1	599.700	23
ATAHUALPA	1	1	1	386.233	20
CALACALI	1	1	1	273.167	22
CALDERON	1	1	1	328.267	21
CANGAHUA	-0	-0	-0	0.000	-0
CAYAMBE	-0	-0	-0	0.000	-0
CONOCOTO	1	1	1	625.967	24
CUMBAYA	1	1	1	431.467	20
CHAVEZPAMBA	1	1	1	0.000	1
CHECA	1	1	1	276.633	20
CHILLOGALLO	1	1	1	560.967	3
EL QUINCHE	1	1	1	382.667	25
EL TINGO	1	1	1	301.600	20
GUALEA	1	1	1	240.500	18
GUANGOPOLO	1	1	1	341.167	20
GUAYLLABAMBA	1	1	1	362.633	22
LA ESPERANZA	-0	-0	-0	0.000	-0
LA MERCED	1	1	1	121.467	5
LAS DELICIAS	-0	-0	-0	0.000	-0
LOS BANCOS	-0	-0	-0	0.000	-0
LLANO CHICO	1	1	1	183.433	22
LLOA	1	1	1	0.000	-0
MACHACHI	-0	-0	-0	0.000	-0
MALCHINGUI	-0	-0	-0	0.000	-0
MINDO	0	0	0	205.967	20
NANEGAL	1	1	1	401.900	20
NANEGALITO	1	1	1	459.633	22
NAYON	1	1	1	259.500	23
NONO	1	1	1	449.600	22
OLMEDO	-0	-0	-0	0.000	-0
OTON	-0	-0	-0	0.000	-0
PACTO	1	1	1	361.033	20
PERUCHO	1	1	1	131.800	22
PIFO	1	1	1	183.900	23
PINTAG	1	1	1	625.700	23
POMASQUI	1	1	1	491.533	24
PUELLARO	1	1	1	394.600	23
PUEMBO	1	1	1	406.900	23
SAN ANTONIO DE PICHI	1	1	1	333.833	-0
SANGOLQUI	1	1	1	2124.300	-0
SAN JOSE DE MINAS	1	1	1	624.733	24
STA ROSA DE CUSUBAMB	-0	-0	-0	0.000	-0
STO DOMINGO DLCOL	-0	-0	-0	0.000	-0
TABABELA	1	1	1	155.967	23
TABACUNDO	-0	-0	-0	0.000	-0
TAMBILLO	-0	-0	-0	0.000	-0
TOCACHI	-0	-0	-0	0.000	-0
TUMBACO	1	1	1	438.700	24
UYUMBICHO	-0	-0	-0	0.000	-0
YARUQUI	1	1	1	473.267	24
ZAMBIZA	1	1	1	194.100	22

Note: "-0" indicates an unknown value.

QUITO	24	HOURS A DAY
ALANGASI	24	HOURS A DAY
ALOAG	24	HOURS A DAY
ALOASI	24	HOURS A DAY
ALLURIQUIN	24	HOURS A DAY
AMAGUAÑA	24	HOURS A DAY
ASCAZUBI	12	HOURS A DAY
ATAHUALPA	8	HOURS A DAY
CALACALI	24	HOURS A DAY
CALDERON	24	HOURS A DAY
CANGAHUA	0	HOURS A DAY
CAYAMBE	24	HOURS A DAY
CONOCOTO	24	HOURS A DAY
CORNEJO ASTORGA	24	HOURS A DAY
COTOGCHOA	24	HOURS A DAY
CUMBAYA	24	HOURS A DAY
CUTUGLAGUA	0	HOURS A DAY
CHAVEZPAMBA	4	HOURS A DAY
CHECA	24	HOURS A DAY
CHILLOGALLO	24	HOURS A DAY
CHIRIBOGA	0	HOURS A DAY
EL CHAUPI	0	HOURS A DAY
EL QUINCHE	24	HOURS A DAY
EL TINGO	24	HOURS A DAY
GUALEA	4	HOURS A DAY
GUANGOPOLO	24	HOURS A DAY
GUAPULO	24	HOURS A DAY
GUAYLLABAMBA	4	HOURS A DAY
ISIDRO AYORA	24	HOURS A DAY
JUAN MONTALVO	24	HOURS A DAY
LA CONCORDIA	24	HOURS A DAY
LA ESPERANZA	24	HOURS A DAY
LA MERCED	24	HOURS A DAY
LAS DELICIAS	24	HOURS A DAY
LOS BANCOS	12	HOURS A DAY
LLANO CHICO	4	HOURS A DAY
LLOA	5	HOURS A DAY
MACHACHI	24	HOURS A DAY
MALCHINGUI	0	HOURS A DAY
MINDO	0	HOURS A DAY
NANEGAL	4	HOURS A DAY
NANEGALITO	4	HOURS A DAY
NAYON	0	HOURS A DAY
NONO	4	HOURS A DAY
OLMEDO	0	HOURS A DAY
OTON	0	HOURS A DAY
PACTO	6	HOURS A DAY
PERUCHO	4	HOURS A DAY
PIFO	24	HOURS A DAY
PINTAG	24	HOURS A DAY
POMASQUI	24	HOURS A DAY
PUELLARO	5	HOURS A DAY
PUEMBO	24	HOURS A DAY
RUMIPAMBA	0	HOURS A DAY
SAN ANTONIO DE PICHI	24	HOURS A DAY
SANGOLQUI	24	HOURS A DAY
SAN JOSE DE MINAS	5	HOURS A DAY
SAN PEDRO DE TABOADA	24	HOURS A DAY
SAN RAFAEL	24	HOURS A DAY
STA ROSA DE CUSUBAMBA	0	HOURS A DAY
STO DOMINGO OLCOL	24	HOURS A DAY
TABABELA	24	HOURS A DAY
TABACUNDO	24	HOURS A DAY
TAMBILLO	24	HOURS A DAY
TOCACHI	0	HOURS A DAY
TUMBACO	24	HOURS A DAY
TURIGACHI	0	HOURS A DAY
UYUMBICHO	24	HOURS A DAY
YARUQUI	24	HOURS A DAY
ZAMBIZA	4	HOURS A DAY

Table 14 - Electricity Service in Pichincha.

Table 15 - Postal Service in Pichincha

Location of Post Office	Days per week	Pieces of mail in 1970	H'way type	Potential of the centre.
QUITO	6	-0	N	11.132
ALANGASI	6	139	R	9.003
ALOAG	6	202	N	9.188
ALOASI	3	66	T	9.042
ALLURIQUIN	6	1779	N	8.974
AMAGUANA	6	2834	R	9.457
ASCAZUBI	3	808	R	8.427
ATAHUALPA	2	749	T	8.282
CALACALI	2	486	T	8.962
CALDERON	6	1126	N	9.814
CANGAHUA	2	950	T	8.736
CAYAMBE	6	40248	N	9.274
CONOCOTO	6	910	R	9.634
CORNEJO ASTORGA	6	474	N	8.573
CUMBAYA	2	-0	R	9.373
CHAVEZPAMBA	2	364	R	8.035
CHECA	3	328	R	8.452
CHILLOGALLO	6	1122	R	9.717
EL QUINCHE	2	894	R	8.783
EL TINGO	6	879	R	8.568
GUALEA	2	732	R	7.838
GUANGOPOLO	2	36	T	9.575
GUAPULO	2	1192	T	9.307
GUAYLLABAMBA	6	1302	N	8.993
LA CONCORDIA	6	1808	N	8.907
LA ESPERANZA	3	270	N	8.303
LAS DELICIAS	6	486	N	8.889
LOS BANCOS	1	1050	T	8.319
LLOA	3	-0	T	8.539
MACHACHI	6	3629	N	9.115
MALCHINGUI	3	486	R	8.437
MINDO	1	332	T	7.831
NANEGAL	1	1110	T	8.166
NANEGALITO	1	-0	T	8.275
NAYON	2	40	T	9.106
NONO	1	90	T	8.554
OLMEDO	2	892	R	8.571
OTON	3	-0	T	8.169
PACTO	2	664	T	8.158
PEDUCHO	2	122	R	7.619
PIFO	3	116	R	8.935
PINTAG	3	-0	T	9.182
POMASQUI	3	948	R	9.214
PUELLARO	1	1052	R	8.706
PUEMBO	3	1184	R	8.809
SAN ANTONIO DE PICHI	6	5662	R	9.683
SANGOLQUI	6	2358	R	9.778
SAN JOSE DE MINAS	2	1140	T	8.631
SAN RAFAEL	6	544	T	8.768
STA ROSA DE CUSUBAMB	3	-0	T	8.335
STO DOMINGO DL COL	6	29234	N	9.968
TABABELA	2	898	T	8.461
TABACUNDO	6	2154	R	9.696
TANBILLO	6	3962	N	9.213
TOCACHI	3	238	R	8.141
TUMBACO	6	820	T	9.731
TUPIGACHI	3	404	T	8.425
UYUMBICHO	6	3526	R	9.946
YAPUQUI	3	994	R	8.855
ZAMBIZA	2	32	T	9.180

Note: "-0" indicates an unknown value.

APPENDIX B - MAPS

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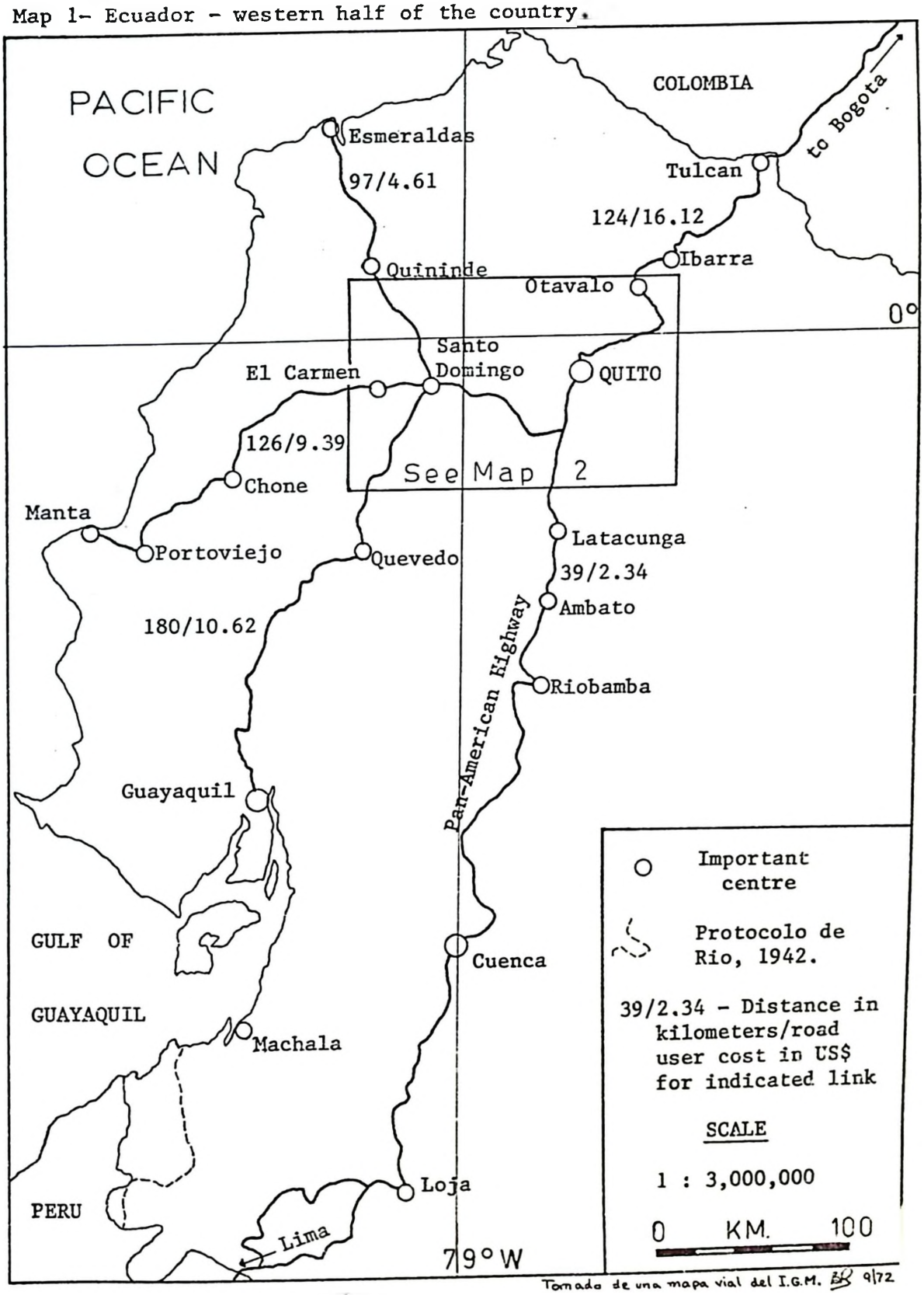
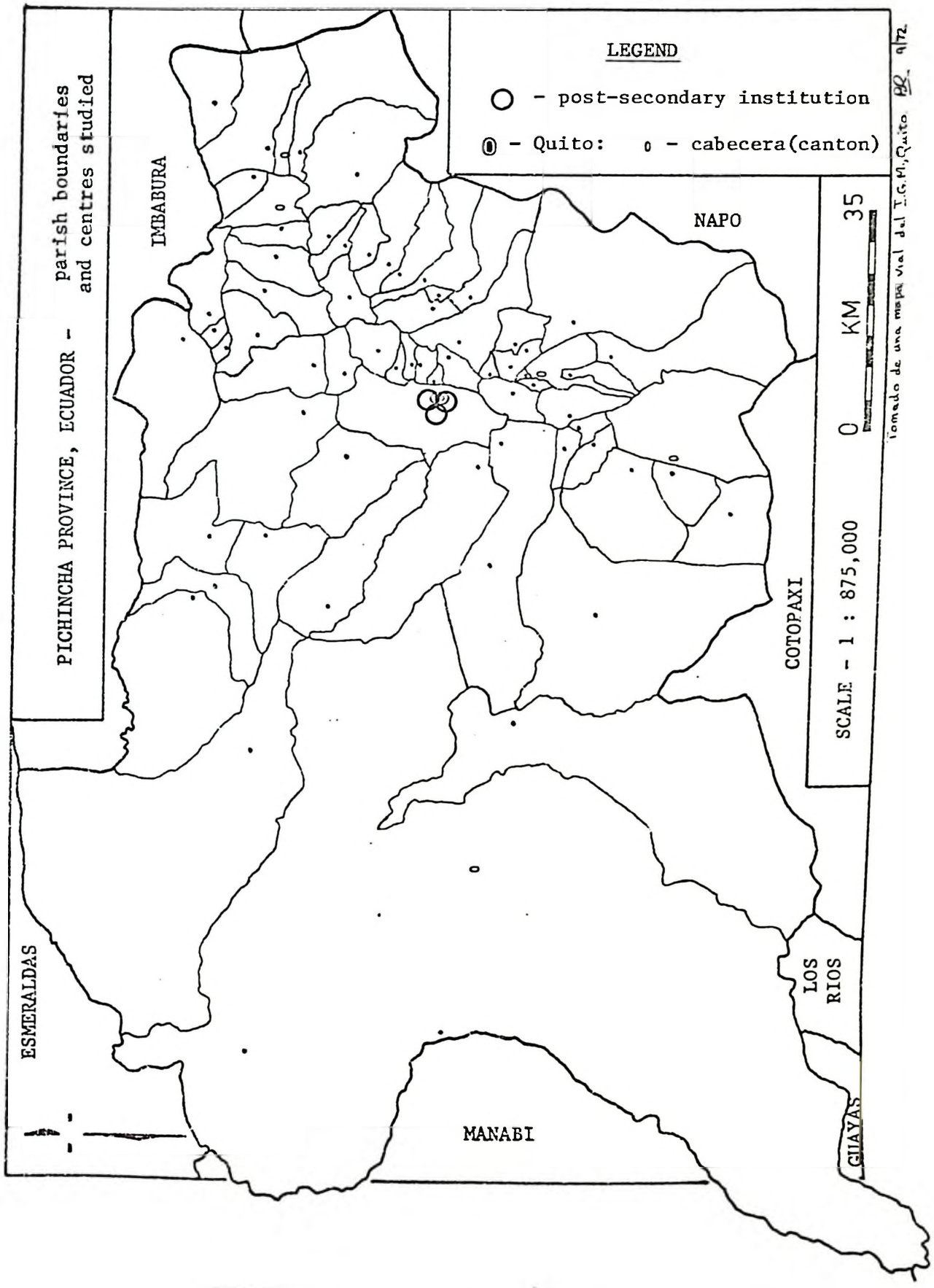
Map 1- Ecuador - western half of the country.



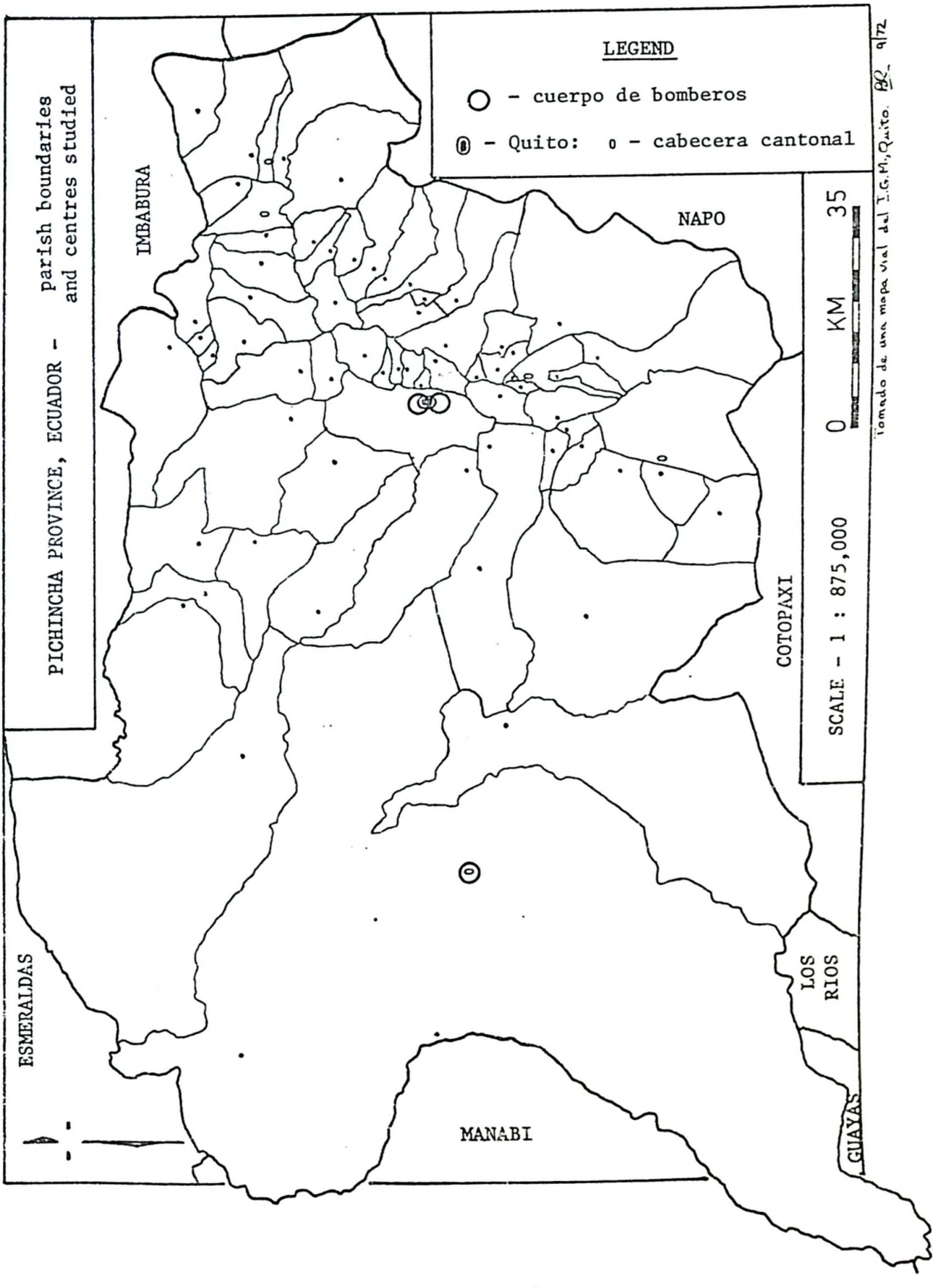
Map 2 - Pichincha Province, Ecuador - Road user costs for a 5-ton truck.

= Map is located inside the back cover =

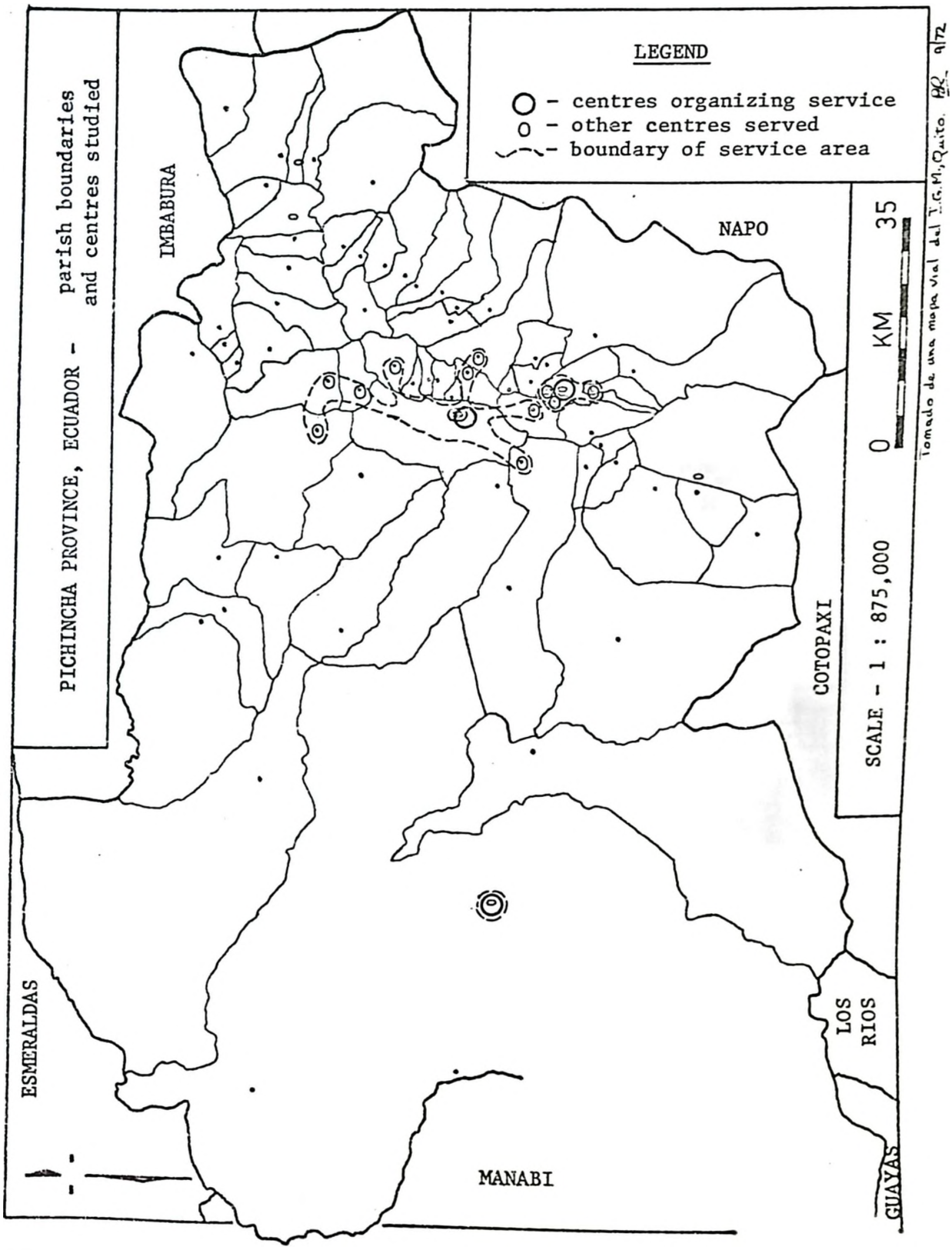
Map 3 - Location of post-secondary institutions in Pichincha.



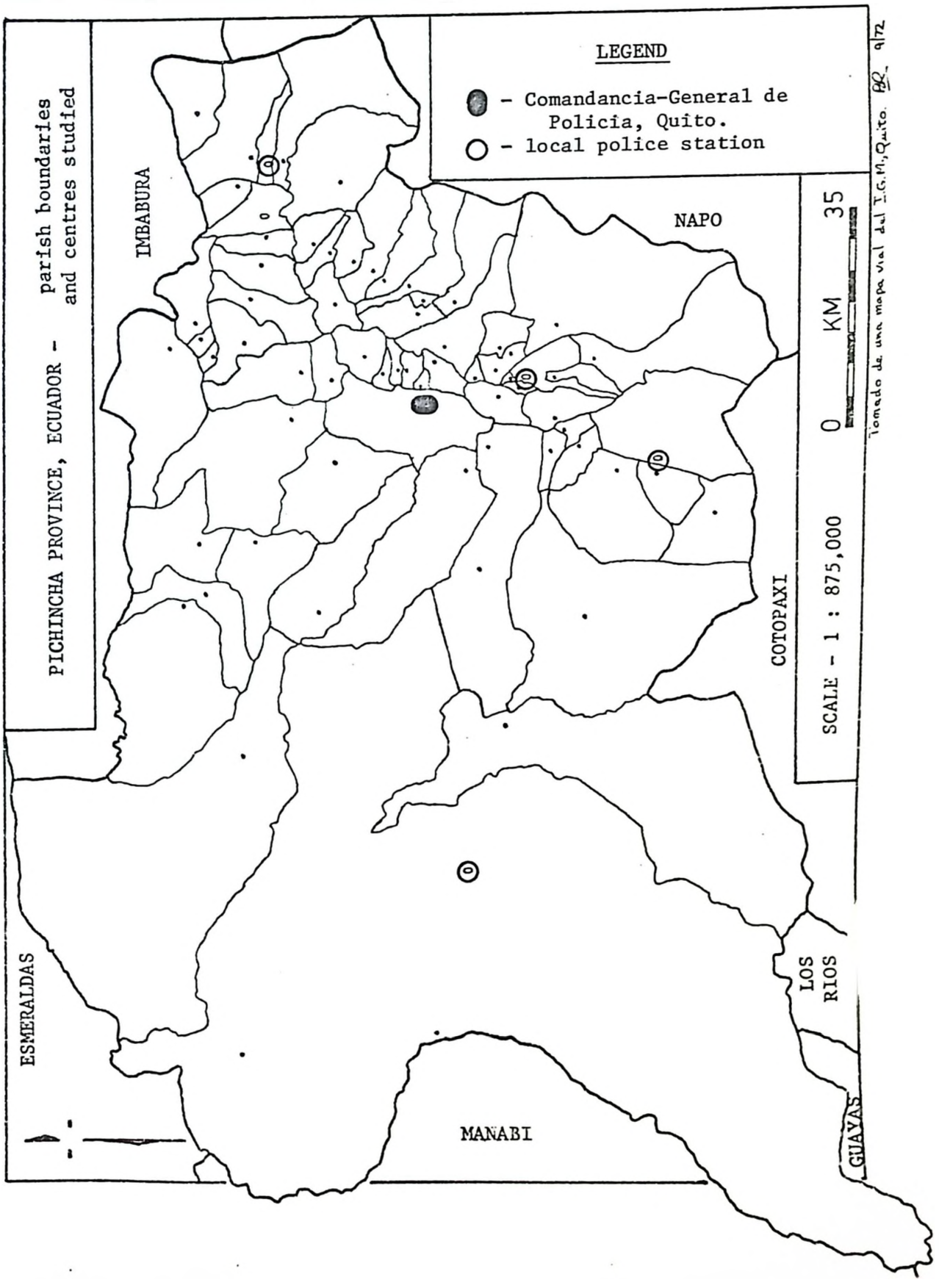
Map 4 - Fire protection service in Pichincha.



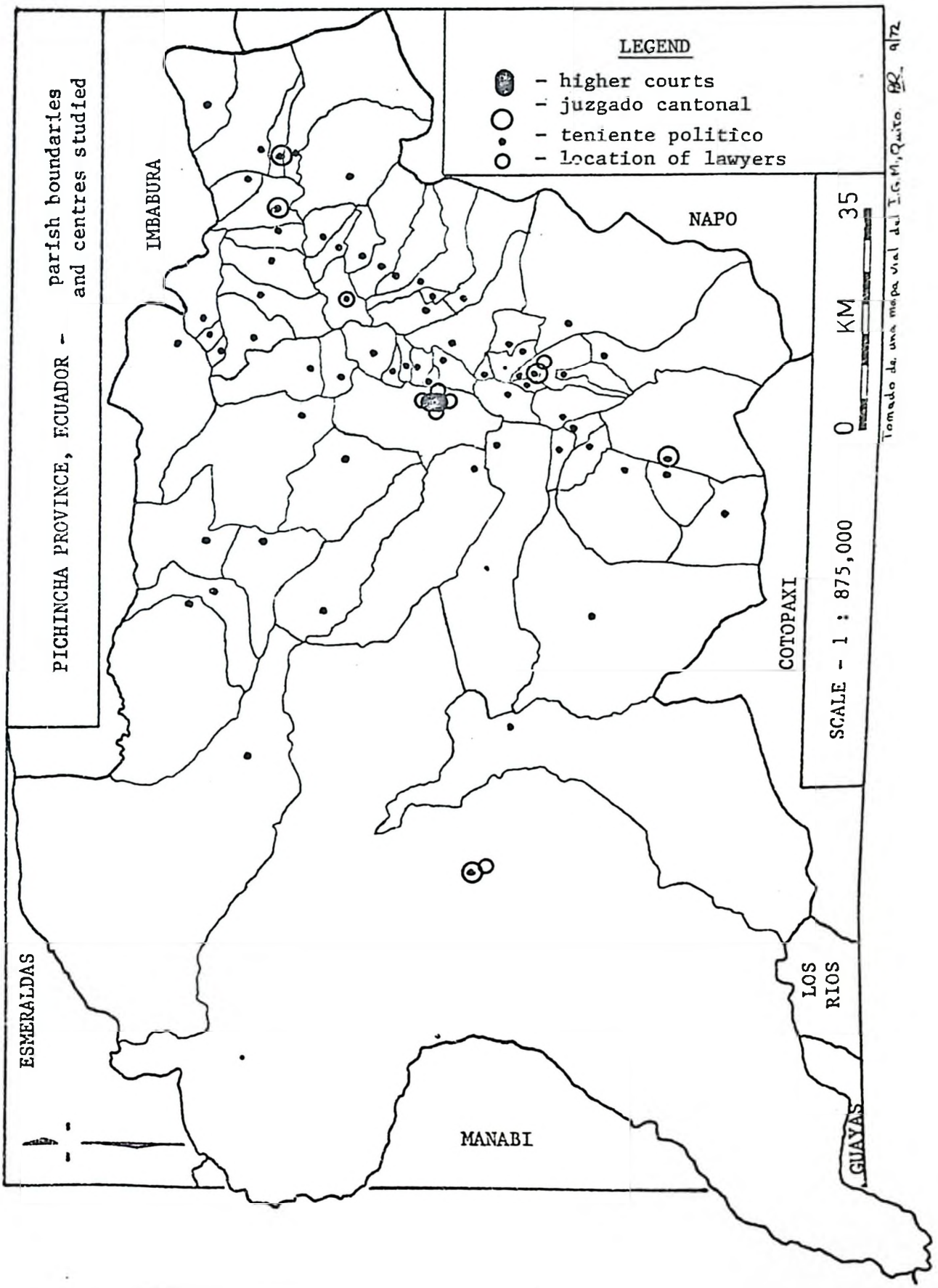
Map 5 - Garbage collection in Pichincha.



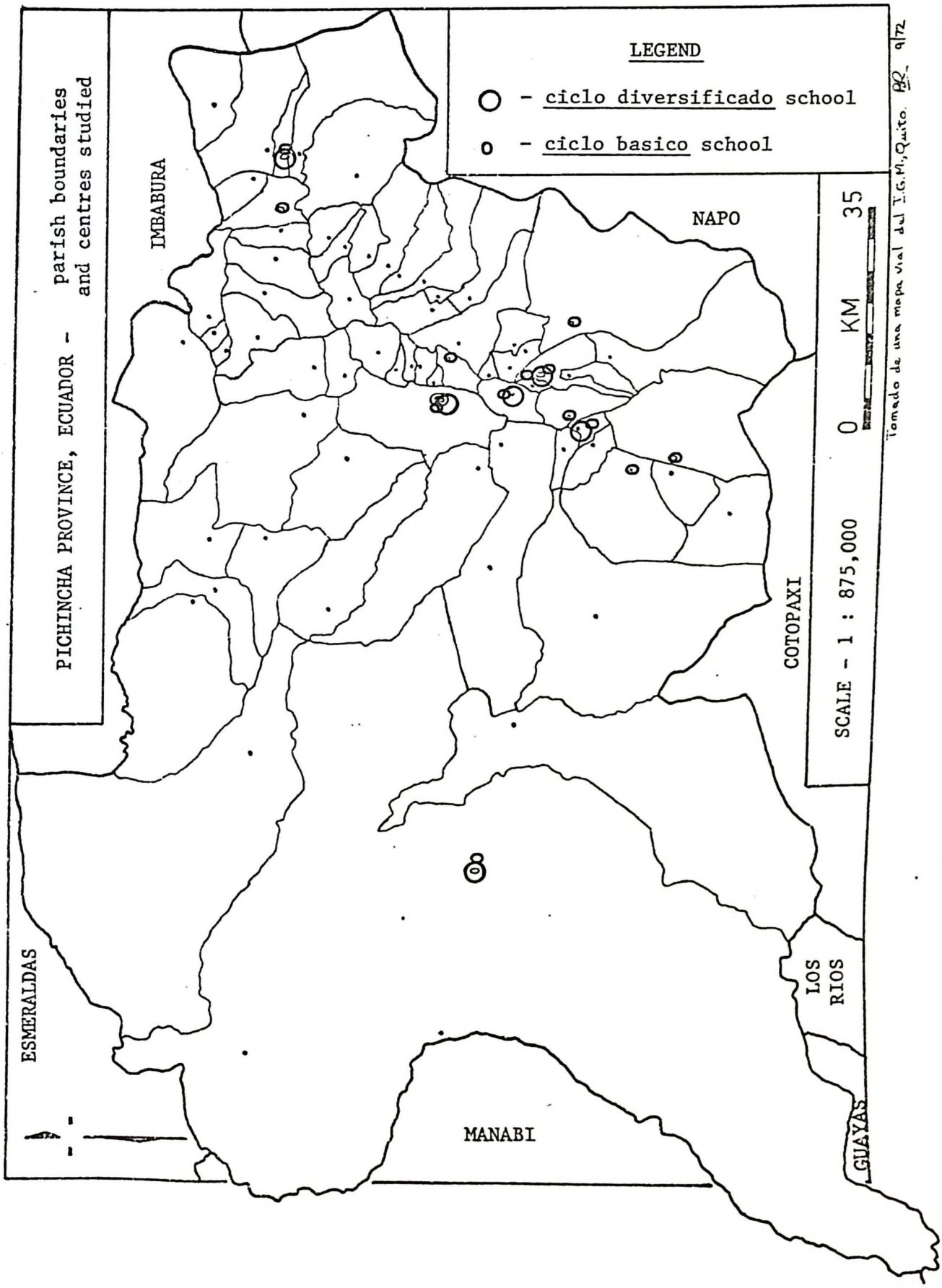
Map 6 - Police stations in Pichincha.



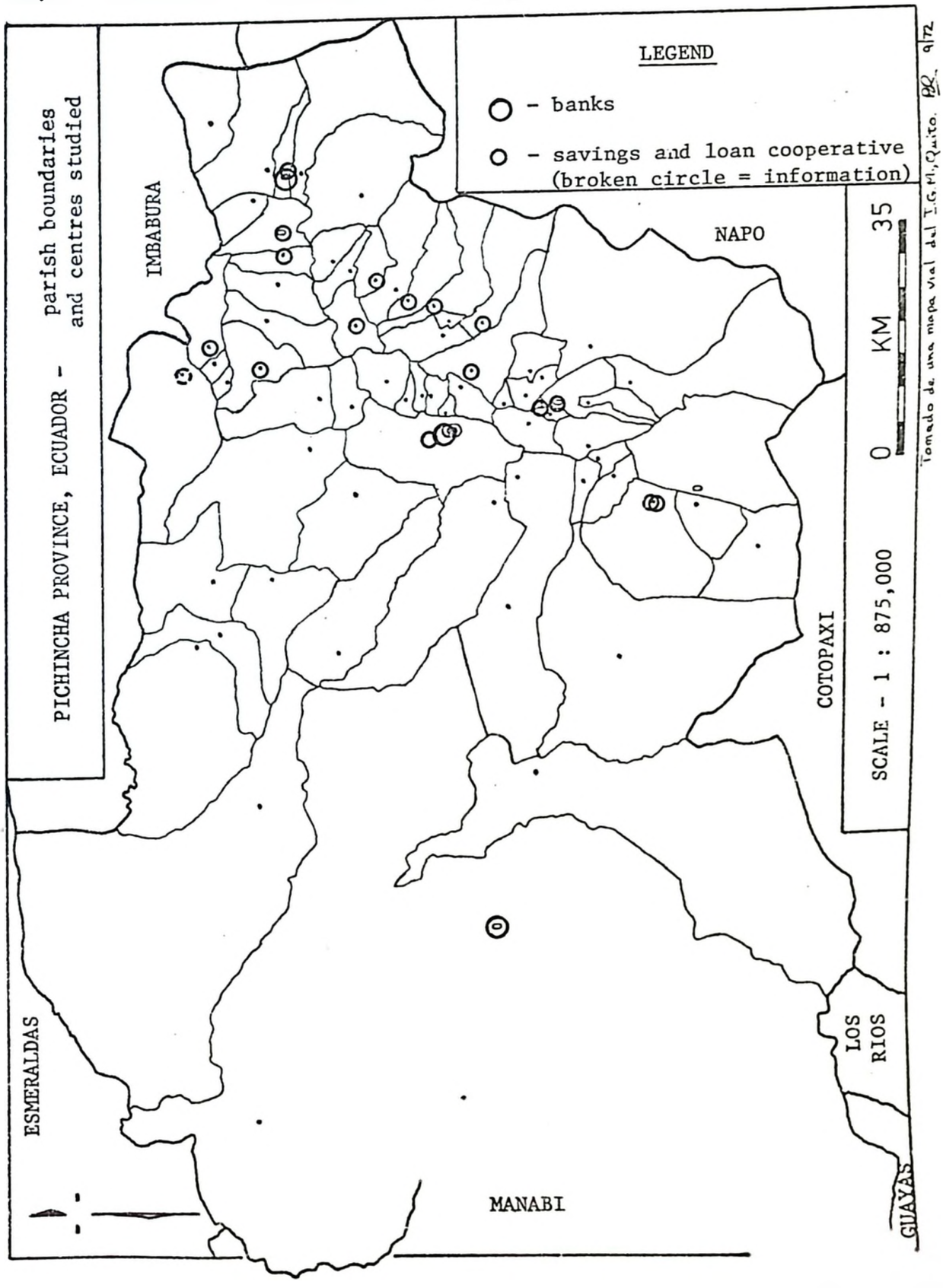
Map 7 - Administration of justice in Pichincha.



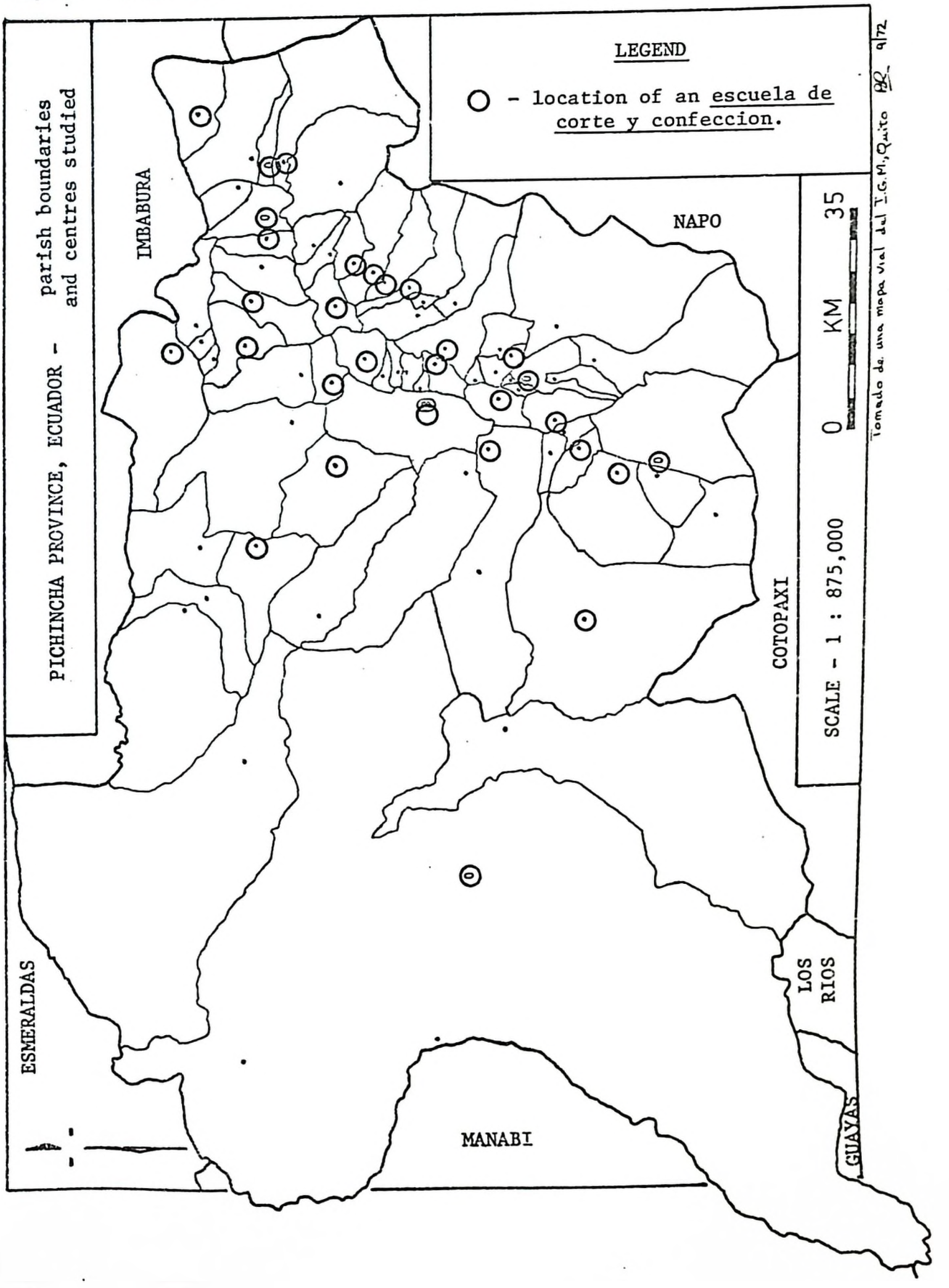
Map 8 - Secondary education in Pichincha.



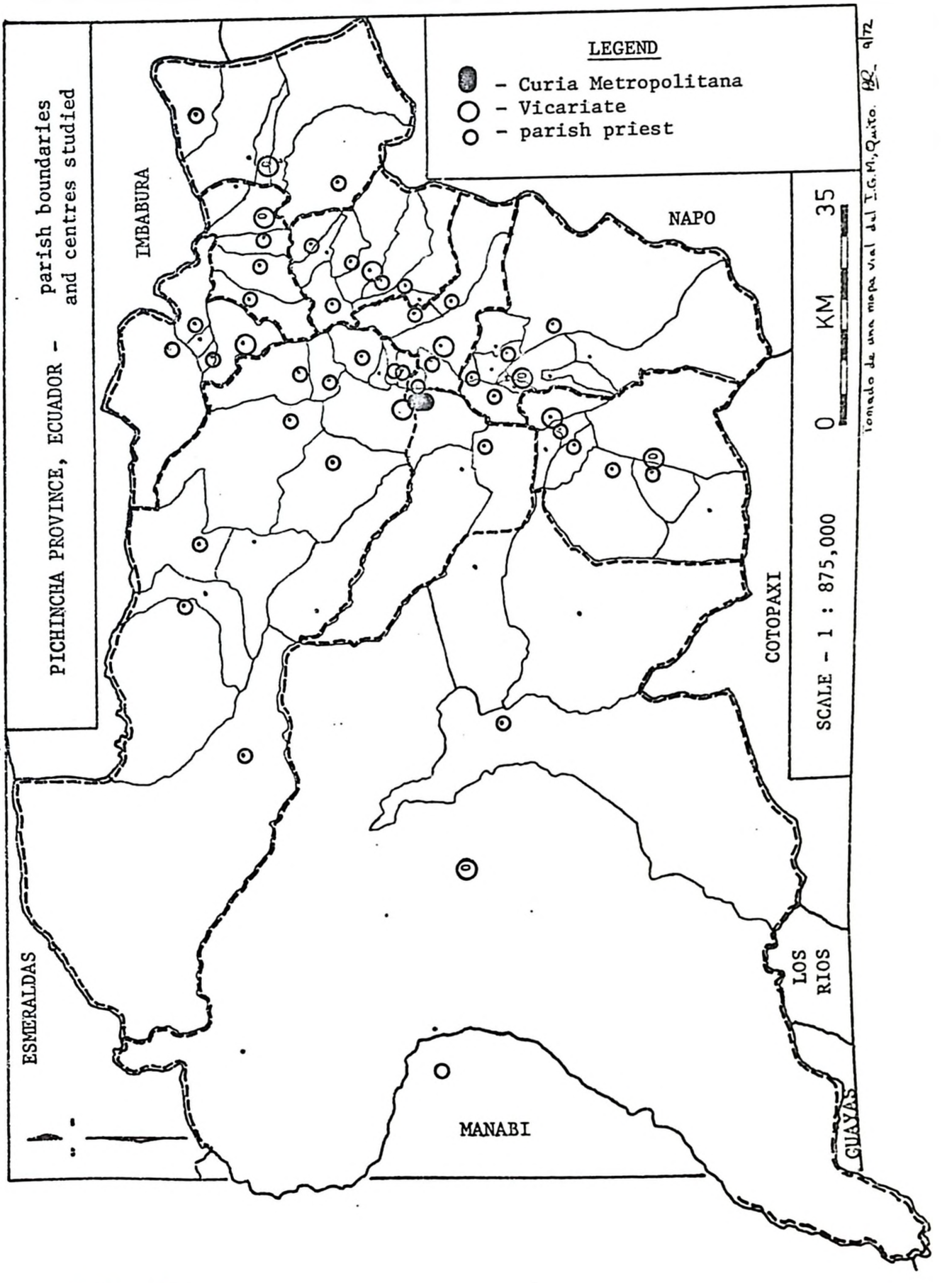
Map 9 - Financial institutions in Pichincha.



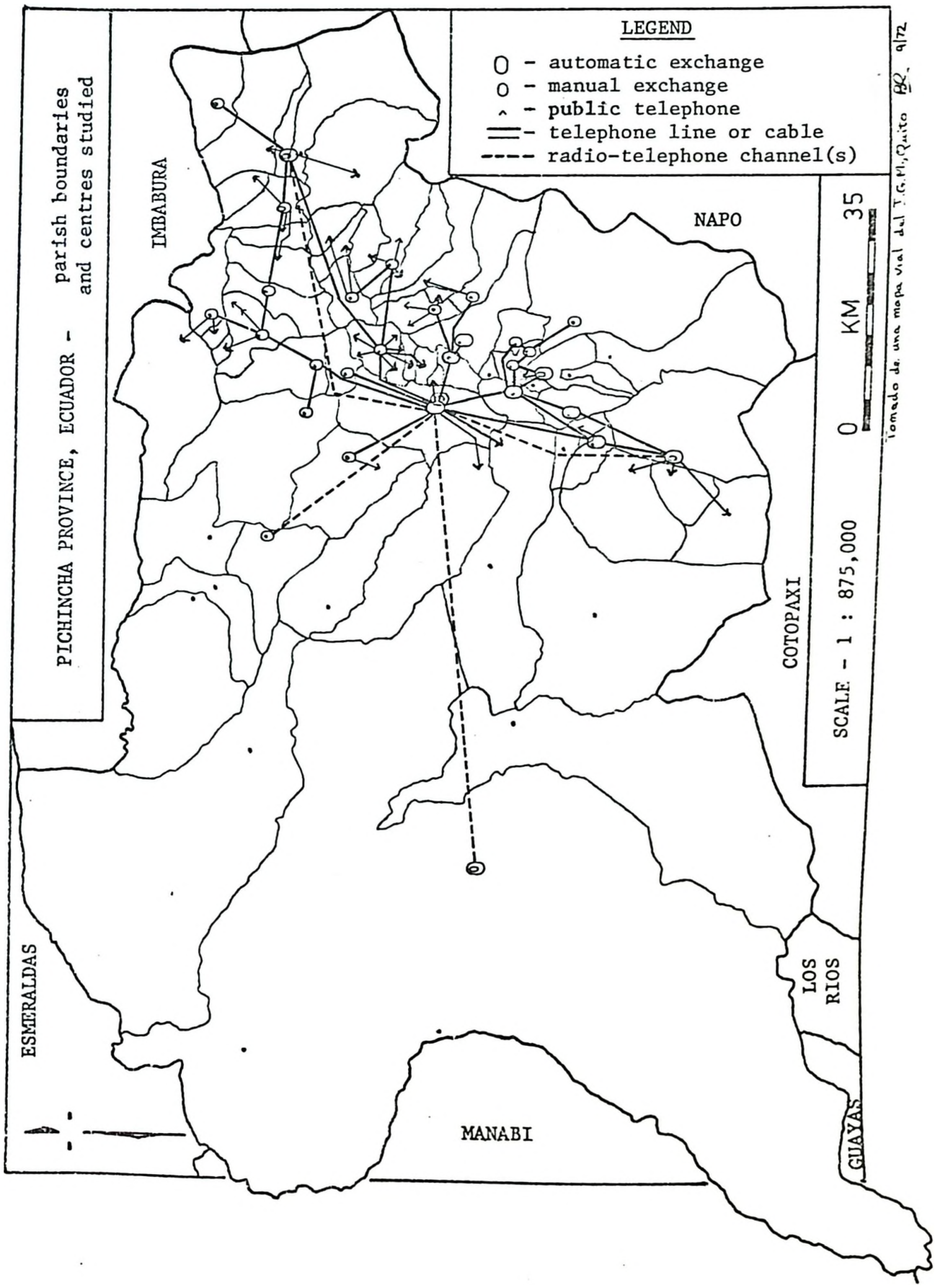
Map 10 - Home economics schools in Pichincha.



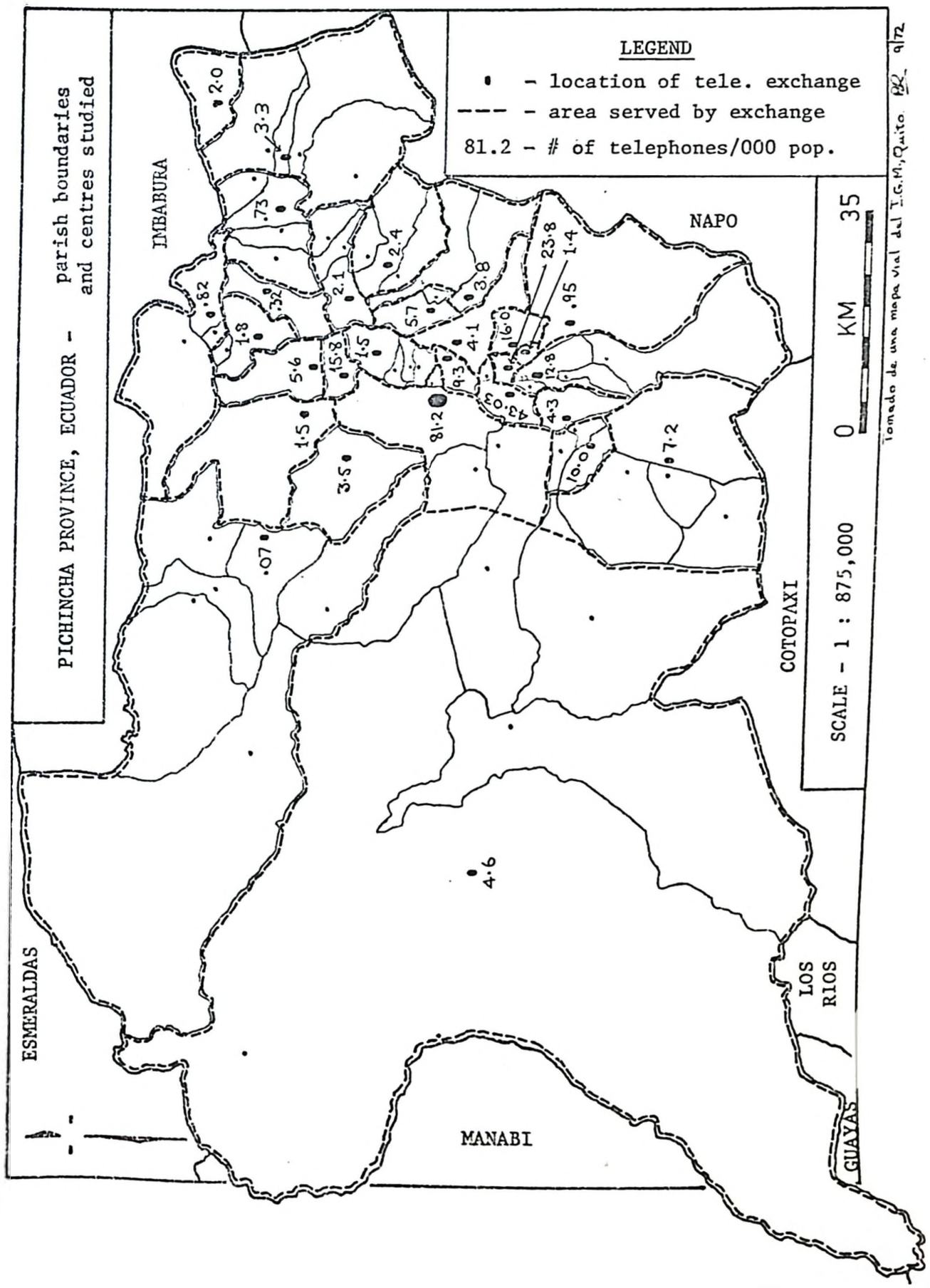
Map 11 - The Catholic Church in Pichincha.



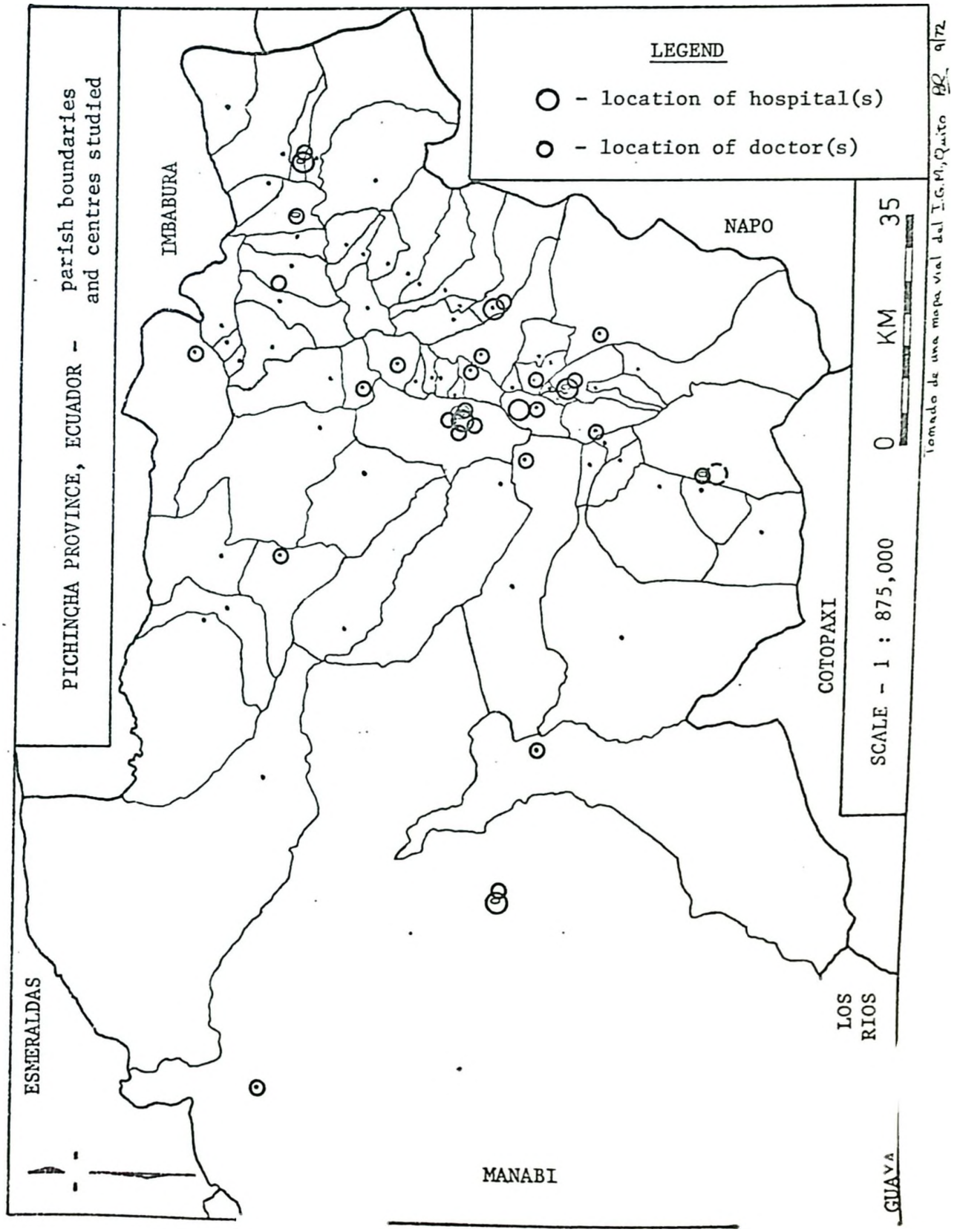
Map 12 - Telecommunications in Pichincha.



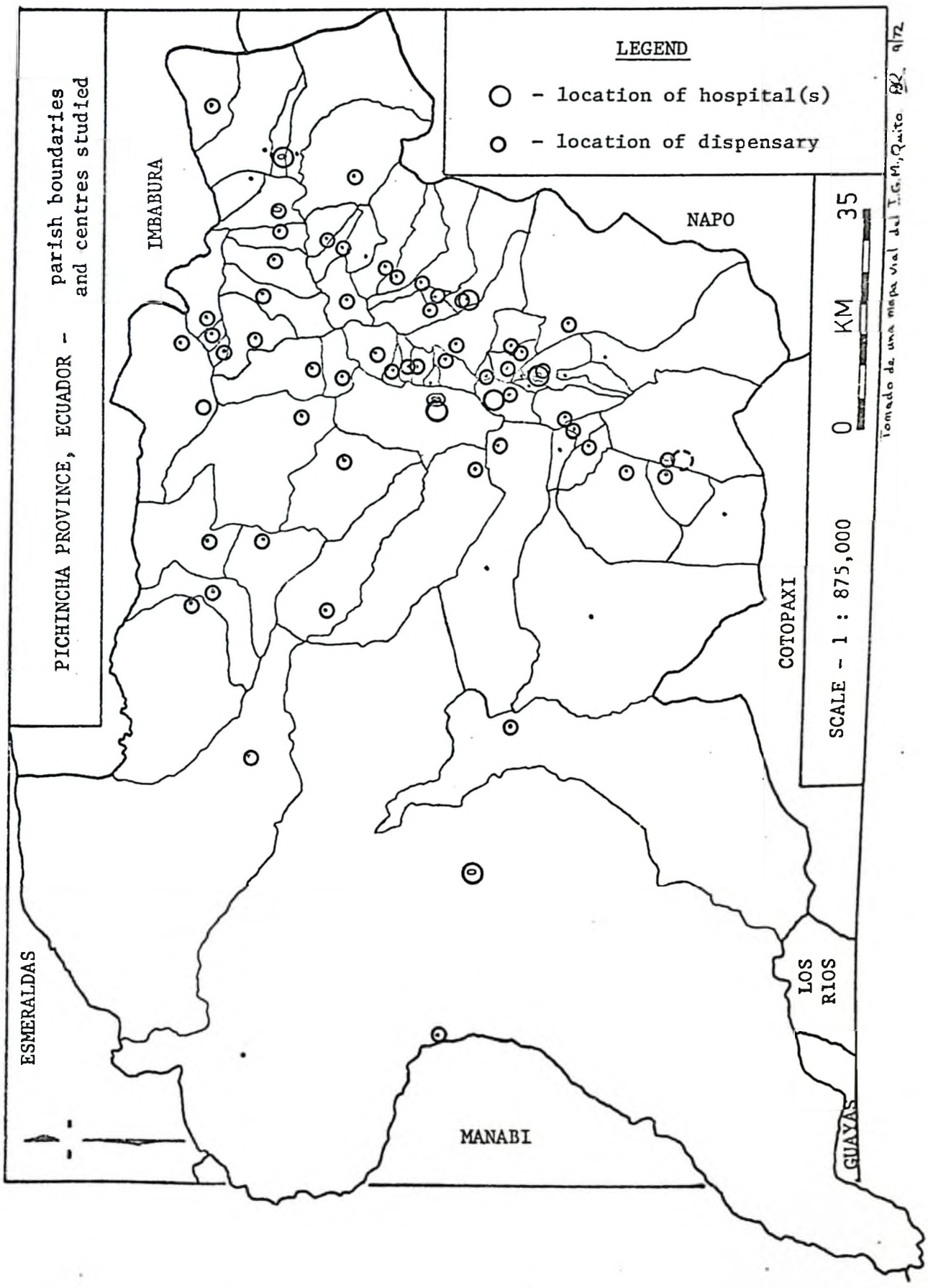
Map 13 - Distribution of telephones per thousand population in Pichincha.



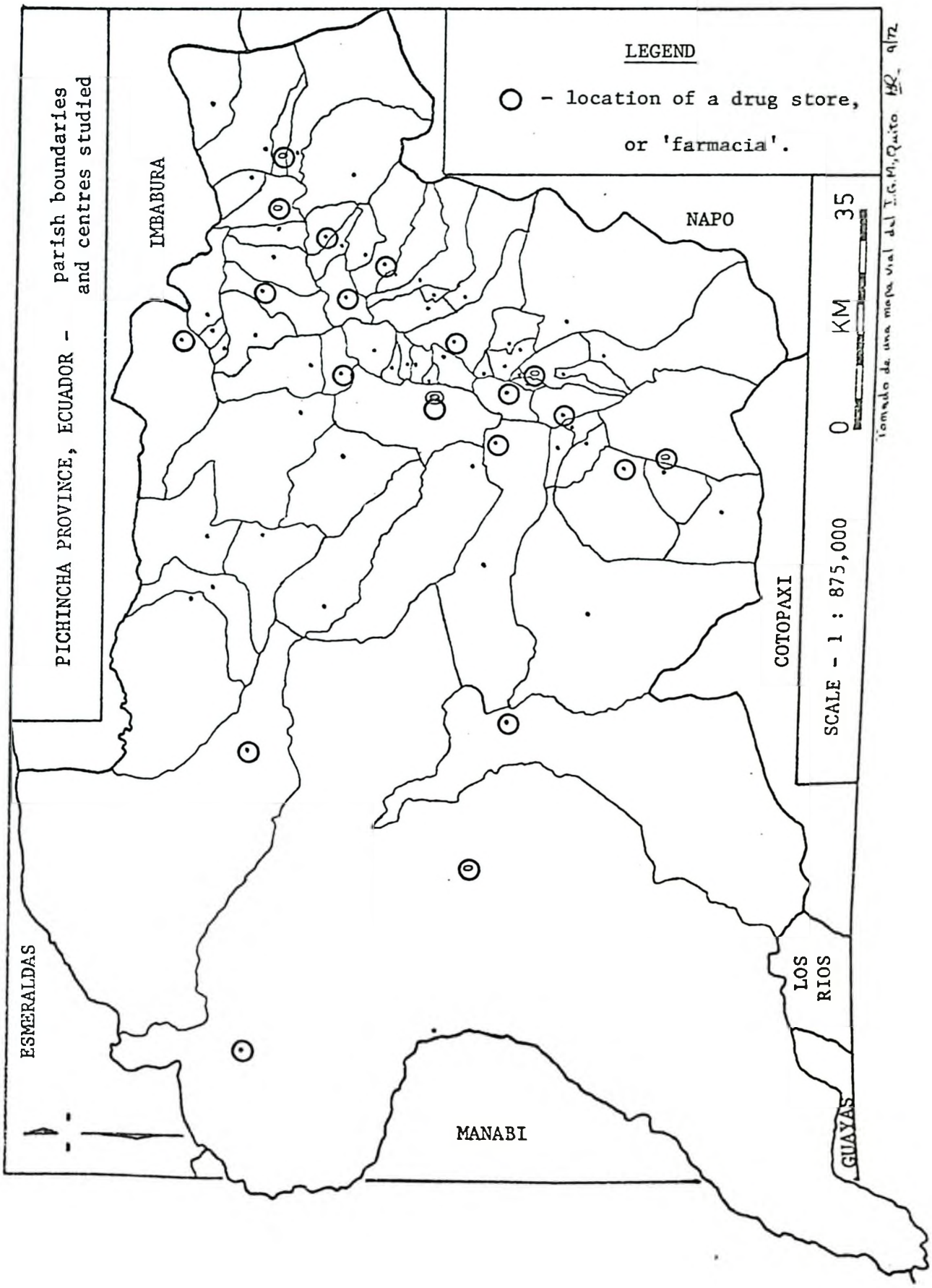
Map 14 - Location of hospitals and doctors in Pichincha.



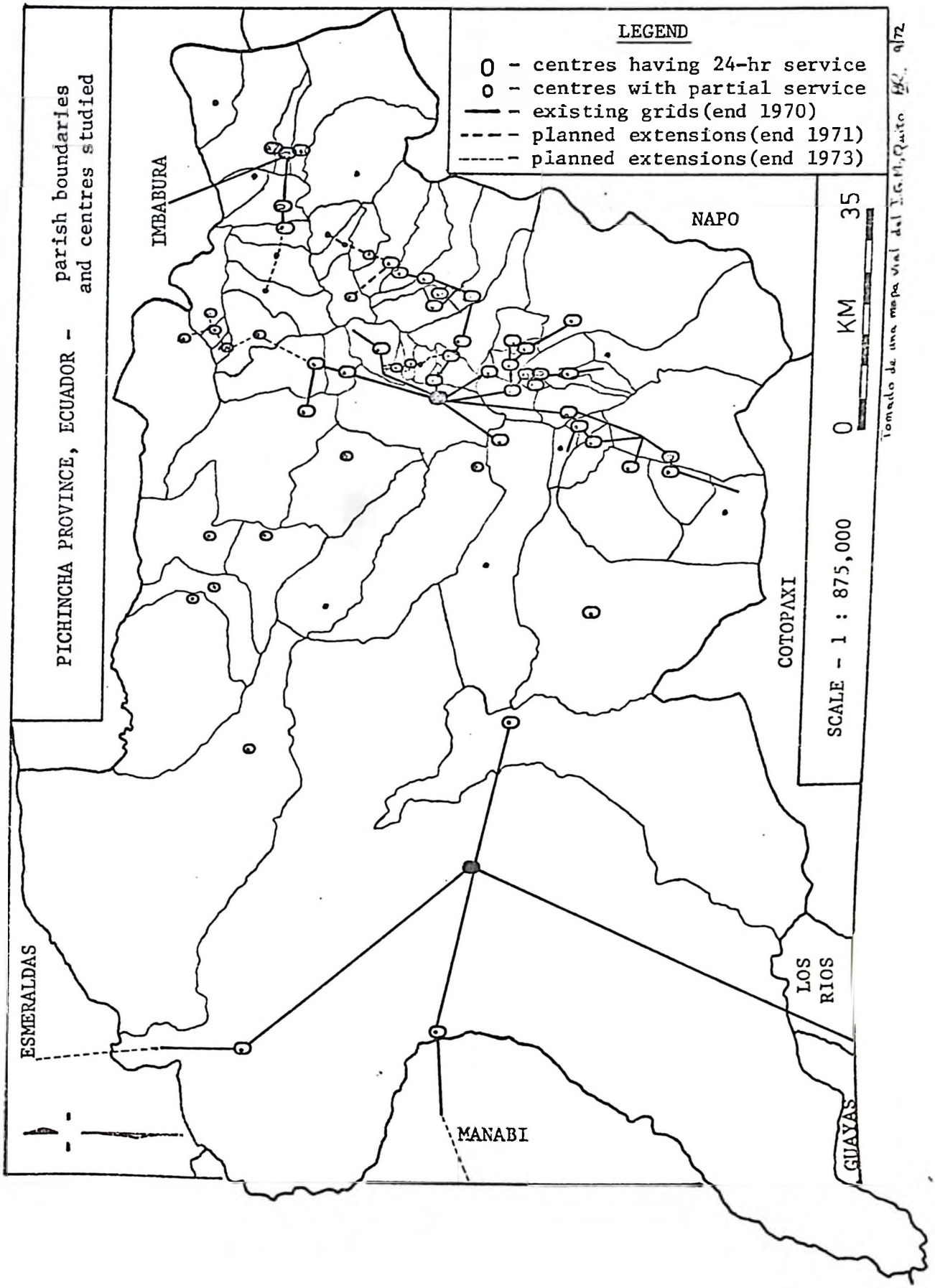
Map 15 - Location of hospitals and dispensaries in Pichincha.



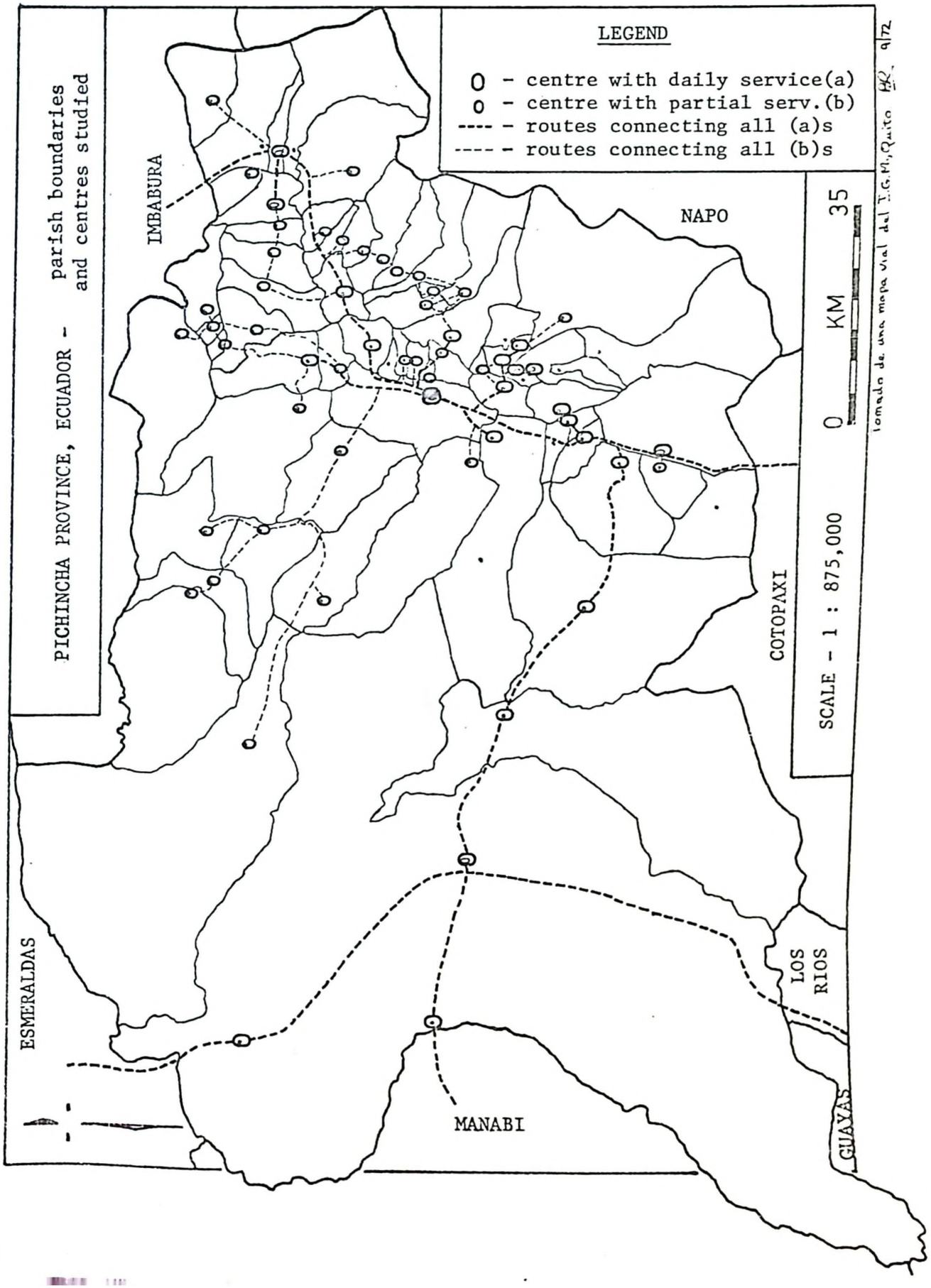
Map 16 - Drug stores in Pichincha.



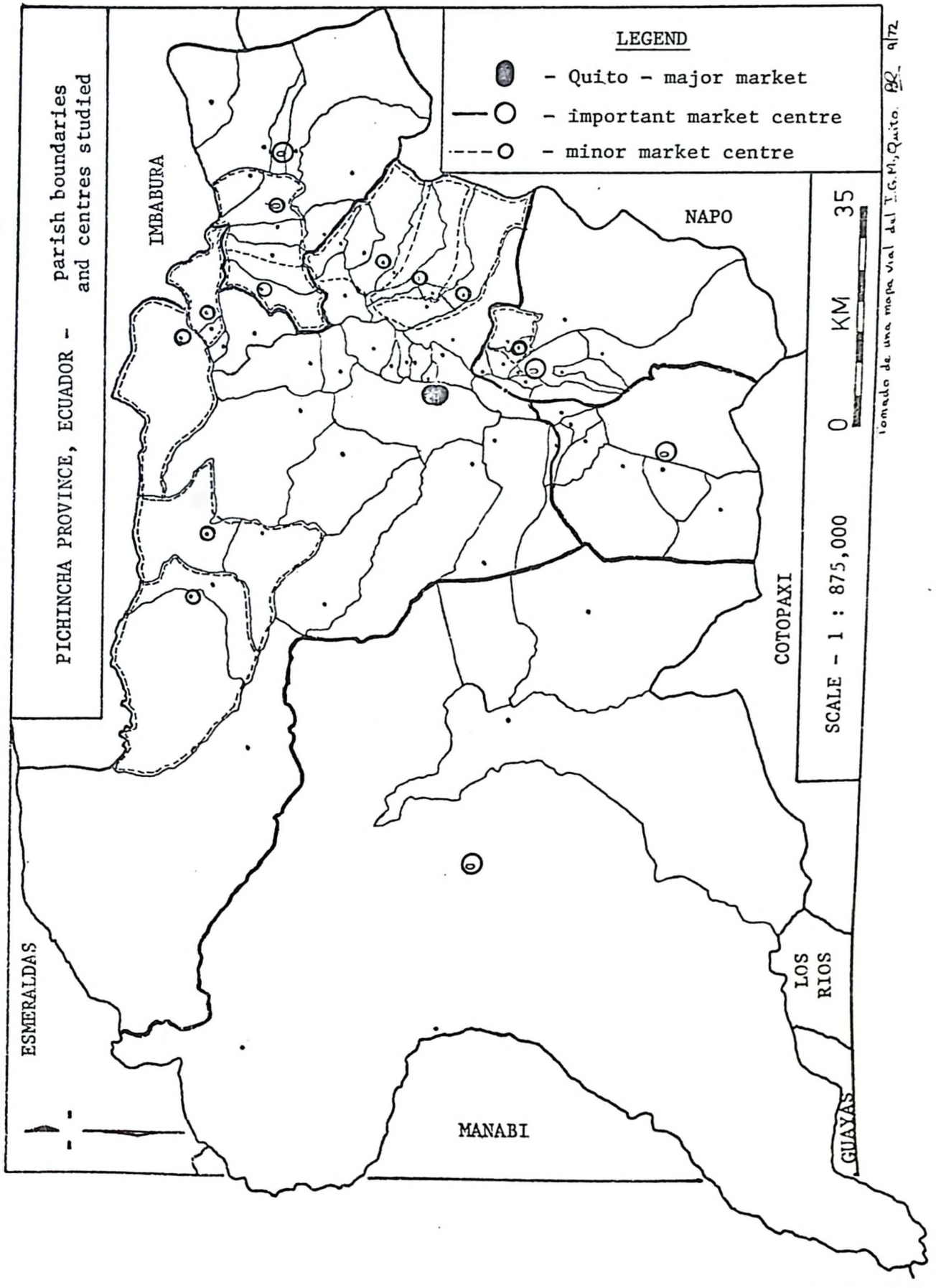
Map 17 - Electricity supply in Pichincha. (Based on 22)



Map 18 - Postal service in Pichincha.



Map 19 - Market areas of Pichincha.



APPENDIX C

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(The number preceding each reference is that by which that particular work is referred to throughout the text.)

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ESMERALDAS
PROV.
Quinindé
2,279
LA CONCORDIA
2,340
N
517
El Carmen
LAS DELICIAS
SANTO DOMINGO DE
LOS COLORADOS
116
MANABI
PROV.
to Chone
96
GUAYAS
LOS RIOS
to Quevedo

PICHINCHA PROVINCE, ECUADOR.

SHOWING ROAD USER COSTS FOR FIVE-TON TRUCKS - BY HIGHWAY SECTION

legend

Connecting Highways
Numerals give driving costs in US Dollars for a 5-ton truck

COMMERCIAL CENTRES

- MALCHINGUI (centre studied)
- TABACUNDO (cantonal centre)
- Otavalo (other important centre)

NOTE: A = SANGOLQUI
O = SAN VICENTE DE TAMBILLO
C = SAN RAFAEL

BOUNDARIES (approximate)

- PROVINCIAL
- CANTONAL
- PARROCHIAL

Principal Rivers

SCALE
1 250,000
KILOMETRES
0 5 10 15 20

Tomado de una mapa vial del I.G.M. QUITO