COOPERATIVE AGREEMENT ON HUMAN SETTLEMENTS AND NATURAL RESOURCE SYSTEMS ANALYSIS

A REVIEW OF IOWA STATE UNIVERSITY'S TECHNICAL ASSISTANCE CONTRIBUTIONS TO THE INTEGRATED AREA DEVELOPMENT STUDIES PROJECT IN GUATEMALA

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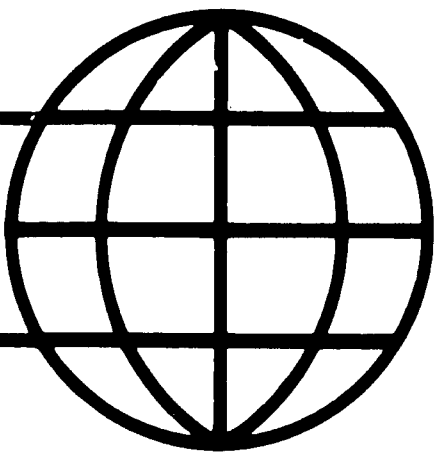

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I Introduction

In August, 1979, Iowa State University (ISU) was placed under contract to provide technical assistance to the Integrated Area Development Studies (IADS) project. The project, operating in Guatemala, had been established by agreement between AID and the government of Guatemala (GOG). The project's general objective and expected results, stated on page one of the AID/GOG contract, are: 1) "the development and execution of a systematic planning methodology, at the level of the municipality and its subdivisions, which will be used to determine needs and assign priorities for the provision of economic and social infrastructure and services;" and 2) results that "will contribute to improving the quality of life and increasing the incomes of the rural poor through improvements in planning of public investments in infrastructure and services."

The present review chronicles the creation of reports and other instruments associated with the project's development and completion, and it documents some of the salient elements of background thinking as well as the characteristics of a pilot project both of which helped to crystallize the structure of the final project. It also details the five major operations (three Studies and two Activities) with which Iowa State was charged and the Guatemalan government agencies and ISU personnel most directly involved with each operation. Lastly, this report summarizes the results ISU obtained in completing the five operations.

II-A Chronology of Administrative Instruments

April 1978 Project Paper issued by DS/UD in AID/Washington on its proposed Rural Demand for Urban Service Systems (RDUSS) project. Shortly thereafter on the basis of this paper the RDUSS project approved by AID/Washington

May 1978 — Project Paper issued by AID/Guatemala on its proposed Integrated Area Development Studies (IADS) project

July 1978 — General Agreement issued with respect to combining various aspects of these two complementary projects

Aug. 1978 — Agreement, USAID/GOG to proceed with what was by then referred to as the IADS project. USAID supplies US$ 640,000; GOG, through its National Institute for Municipal Development (INFOM), supplies US$ 378,000

Subsequently two other GOG agencies became involved in the IADS project: the National Planning Council (CNPE), through its General Secretariat, and the Ministry of Agriculture (MinAg)

Oct. 1978 — Scope of work defined by AID/Guatemala which laid out 3 studies and 2 activities and designated which Guatemalan government agencies to be involved in which activity

Aug. 1979 — Contract, USAID/Iowa State University to provide technical assistance called for in the scope of work. Jerry Knox, as Regional Planning Advisor leads 11 person ISU team

Jan. 1982 — Evaluation of project progress in Riordan and McKee report

II-B Instruments Presenting Project Results

Oct. 1981 — INFOM report in Spanish entitled "Organizacion del Espacio en la Franja Central de la Republica de Guatemala" (The Organization of Space in the Central Belt of Guatemala)

1981 — K. L. and Stephen E. Carey report entitled "An Opportunity for Development: Local Participation in Highland Guatemala"

Feb. 1982 — Rolando Jiron, Charles Hoch, Jerry Knox, Paul Anderson draft article "Spatial Analysis as a Planning Tool: The Case of Guatemala"

May 1982 — Jerry Knox, "Spatial Analysis of Public Investment Priorities" (no author given but appears under Knox cover letter)

July 1982 GEOCODE6 file print-out

Oct. 1982 Riad Mahayni paper "Transportation in Rural Guatemala: presented at Conference of the Association of Collegiate Schools of Planning

Nov. 1982 Paul Anderson and Jerry Knox are presumed to be authors of "A Rural Development Planning Program for Guatemala. Technical Report: Data Processing Procedures"

Anderson and Knox are authors of "Codebook for Geographic Data on Land Use and Natural Resources in Central Guatemala, C. A."

III Salient Elements in Major Instruments

Project Focus on Spatial Analysis and Central Place

The 1978 Project Paper favored the use of spatial analysis techniques based on central place theory to describe a target area in terms of infrastructure, flows of goods and services and social activity. The appropriateness of spatial technique as a planning tool for determining needs and priorities for establishing infrastructure and services has been demonstrated in numerous cases through its practical application for this purpose in recent years. For Guatemala, it noted the work done by Carol A. Smith which suggested that the use of spatial analysis techniques could provide important insights as to which development strategies could and which could not work. (No citation other than the author's name was given for this work.)

Smith's study consisted of a detailed analysis of the market system in the western highlands which demonstrated that this technique can be used to describe at least two types of spatial economies in Guatemala: permanent markets and periodic markets. The market system studied by Smith surrounds the major economic center for the region of western Guatemala, Quetzaltenango, a central place and the second largest city in the nation. Smith actually found two marketing systems, one essentially superimposed on the other. One was made up of permanent markets distributing goods manufactured outside of western Guatemala and controlled by the Ladino population. This system consisted of a ring of six sizeable Ladino market towns surrounding Quetzaltenango and 12 lesser Ladino market towns peripheral to them. She also found an independent grid of periodic markets dealing primarily in Indian agricultural produce and consisting of 20 major bulking centers. She found that just as Quetzaltenango was central to the network of Ladino markets, a nearby major Indian market town, San Francisco El Alto, was central to the network of bulking centers.

A Pilot Study

The 1978 Project Paper sought to confirm the feasibility of utilizing spatial analysis techniques to develop the urban/rural hierarchy and the infrastructure and services available at each level. The methodology the Paper wanted to have used in the larger project it was proposing was applied to the municipio of Comitancillo in the Department of San Marcos. A questionnaire was developed and tested in the eastern area of Guatemala, then after modification it was again tested in the western highlands. During these tests, Comitancillo and three other municipios were surveyed. Based upon data obtained through the survey and from secondary sources, populated places in the municipio of Comitancillo were ranked using the following criteria:

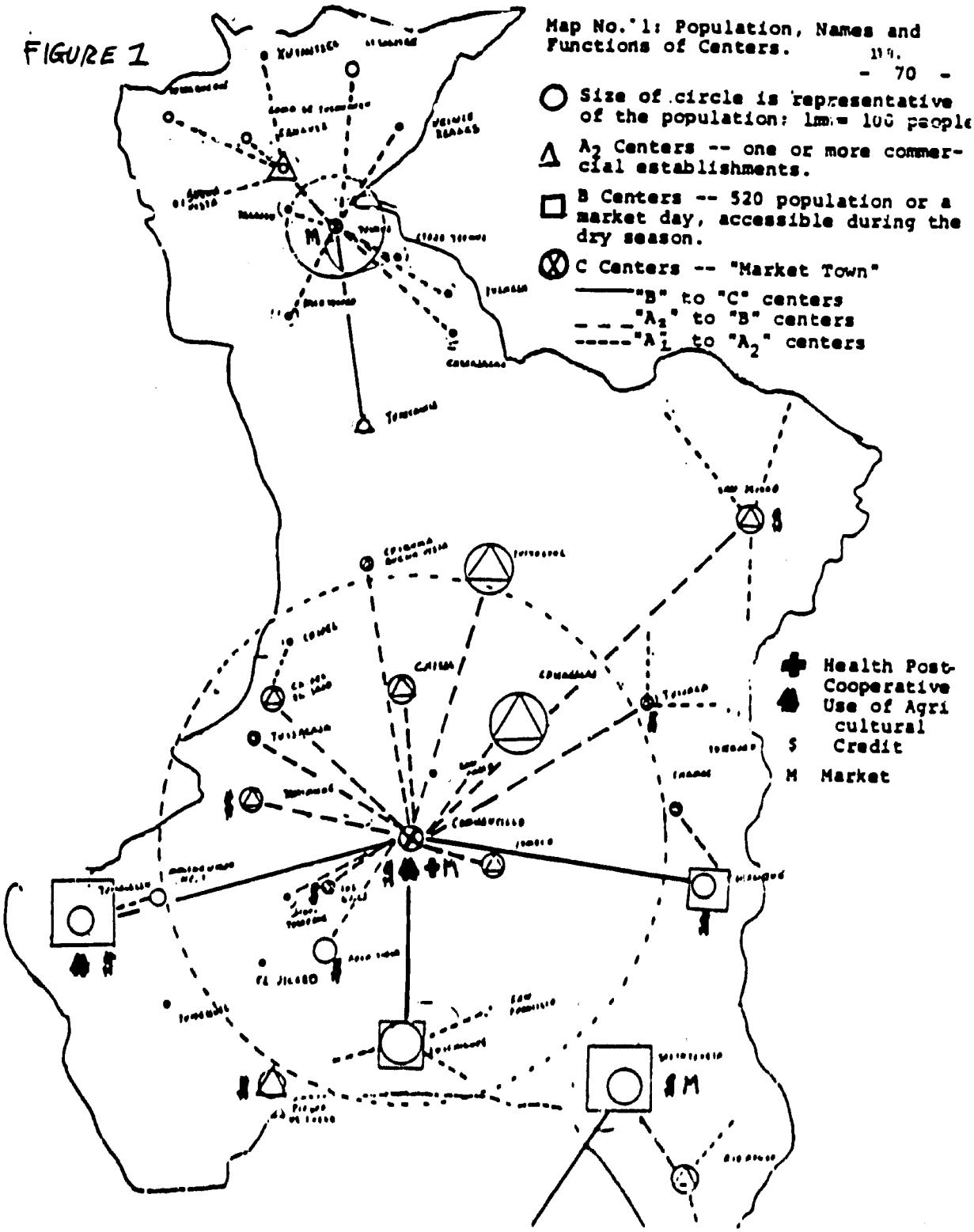
Level of Center	Characteristics	Number
"A" 1 Dispersed Farming Community	Dispersed population, no school, no local market day, no commercial establishments	20
"A" 1 Nucleated Farming Community	Some nucleation of population, a primary school, some commercial establishments	19
"B" Rural Service Center	Nucleated population (100 families or more), market day for surrounding area, commercial establishments offering a variety of goods, a school with at least grades 1-3, center acessible by vehicle at least during dry season	4
"C" Market Town	Market facility serving one or more "B" centers, high level of retail activity and some wholesaling, year round access by vehicle	2

Figure 1 is the Project Paper's sketch map based on these criteria.

IV Iowa State's Charge

Iowa State University was contracted to complete the three studies and two activities. They are listed below together with the GOG agencies and Iowa State personnel most directly involved.

FIGURE 1


Map No. 1: Population, Names and Functions of Centers.
- 70 -
Size of circle is representative of the population: 1mm = 100 people
A_2 Centers -- one or more commercial establishments.
B Centers -- 520 population or a market day, accessible during the dry season.
C Centers -- "Market Town"
"B" to "C" centers
"A_2" to "B" centers
"A_1" to "A_2" centers
Health Post
Cooperative
Use of Agricultural
$ Credit
M Market

	GOG Agency	ISU Personnel
Study One An inventory of available infrastructure and services and the definition of an urban hierarchy in the 206 municipios in the study area. Specific additional data to be gathered included: 1) capacities and rates of utilization of urban based services such as schools, health services, water and sewage systems, public market structures, local transportation systems, electrical energy, agricultural extension and credit services, and similar off-farm agricultural support; 2) local prices of a broad spectrum of agricultural inputs and some measure of local previous-year prices for agricultural products and; 3) more detailed breakdowns of commercial functions than were performed for the pilot study reported in the 1978 Project Paper.	INFOM	Knox
Study Two A natural resource potential survey as a basis for establishing the agricultural potential for each of the 206 municipios in the study area.	MinAg	Knox, Anderson, Schrader
Study Three An intensive survey analysis of two areas comprising 4 or 5 contiguous municipios and designed to determine the tendency for Guatemalans to travel varying distances 1) to acquire or obtain access to each of the full range of urban-based infrastructure and services, and 2) to obtain or sell products. These intensive area surveys, involving up to 200 in-depth interviews with farmers over at least 10 different randomly-selected sub-areas, should be designed to demonstrate the meaning of "effective access" to each type of urban function as a basis for determing the effective area coverage provided by comparable services in other parts of Guatemala.	INFOM	Prescott, Mahayni

	GOG Agency	ISU Personnel
Activity One The creation of an extensive and varied set of experiments with local participation in planning, involving a stratified sample of 20 to 25 communities differing in size, access, ethnic composition and economic base. These experiments will utilize a variety of alternative, carefully-controlled approaches to local participation in order to permit evaluation of the relative effectiveness and generalizability of each. The purpose of these experiments will be threefold: 1) to test alternative methods of eliciting usable information on local felt needs, 2) to involve a sample of Guatemalan communities in the planning of local development investment, and 3) to determine the relationship between local felt needs and planning agency proposals under alternative methods of local participation.	INFOM	Prescott, K. Carey, S. Carey
Activity Two Establishment of a data bank and development of a planning methodology to determine investment priorities for infrastructure and services in highland Guatemala, both based on 1) the urban service and infrastructure data gathered under Study One, 2) the utilization and pricing data gathered as addendum to Study One, 3) the access and travel information found in the access study (Study Three) and 4) the needs expressed in the local participation experiments.	San Carlos University	Knox, Prescott

V Iowa State's Approaches and Results

Study One - Urban Hierarchy

Approaches and results are covered in the UMass translation and precis of "The Organization of Space in the Central Belt of Guatemala." Riordan and McKee in their 1982 critique cite the technically sound nature of the work and question only the exclusion of communities with fewer than 500 inhabitants and the lack of explicit criteria for recommending investment to upgrade the hierarchical positions of 14 urban centers.

Much of the data gathered under the three Study One addends are included in the ISU data bases described under Activity Two.

Study Two - Natural/Agricultural Resources

Knox in 1982 notes that data on soils, existing land use, agricultural production, climate and vegetation were obtained by updating existing sources. A sample survey was made of recent yields for certain crops and the types of technology used on farm units in the .35-5.0 and 5.01-46.0 hectare classes. Ecological zones were finely enough distinguished so that production and yield levels in one zone could be expected to be similar to those in another zone in the same class. Potential land suitability and agricultural productivity were established for a given ecological zone by the outputs of the most productive indigenous farmers in that zone. The 1982 Riordan and McKee evaluation report praises the technical level of this work and the empirical approach to what the "best" farmers were actually producing. The linking of the "potential" with "current" use is continuing.

Study Three - Rural Accessibility

A survey instrument was designed to obtain data on the number, cost, type, mode, frequency, origin and destination of trips taken by all members of 314 households sampled from three subregions on the basis of population and area. Riordan and McKee in 1982 note 1) that confusion still exists as to whether the study was to be representative of the target region as a whole (presumably the 4 or 5 contiguous municipios) when, in fact, it is representative of only three subregions; 2) that there was a lack of adequate communication between INFOM and ISU and insufficient technical assistance was provided by ISU; 3) that the questionnaire was long and cumbersome to administer and many respondents were reluctant to answer the questions asked; and 4) that costs of transport were not gotten directly from the survey but will have to be estimated later as an analytical rather than a statistical exercise.

The 1982 Knox report notes 1) that initial data analyses showed such internal inconsistencies as the cost of walking trips being equal to those taken by taxi, and 2) that general travel patterns can be ascertained by examining the data but more detailed analyses could not be completed. The 1982 Riad Mahayni paper for a professional conference appears to contain the information and conclusions that must have been a part of his finished final report to AID. He concludes that 314 was too small a number of households to produce sufficient trips and that data measuring transport time, distance, cost, et al. are not reliable, citing the walking/taxi trip equivalence noted by Knox above.

The UMass research group is under the impression that the households surveyed were to be rural and headed by farmers. All Study Three descriptions seen by the group, unless they were changed later, specify the need for data on rural farmers travelling to obtain urban-based goods and services or to sell their produce in urban markets. Mahanyi's 1982 paper reports a stratified sampling of households by size of place in the urban hierarchy. He included places in five levels which he refers to as national, large, medium, small and local. The proportion of interviews conducted in the latter three levels was per the distribution of population in those centers. The inclusion of larger centers thus accounts for responses regarding travel by taxi but surely reduces the number of respondents who are market-bound Maya farmers with loads on their backs.

Activity One - Local Participation Experiments/Surveys

This activity, the only part of the original RDUSS project brought into the joint IADS/RDUSS project, was not completed as envisioned by the project planners. In their 1981 report, K. L. and Stephen E. Carey explain why the series of local participation experiments was abandoned. Their reasons include: 1) the increasing level of violence in the highlands; 2) the lack of necessary Guatemalan planning and counterpart personnel before their (Carey's) arrival; and 3) the fact that no development projects in which local participation experiments could be carried out had yet been set up because the IADS program to assist planners in the selection of future projects was still in its early stages.

In lieu of the experiments, the Carey's proceeded to determine the needs and priorities and the degree of local participation in community projects for each community in the study area as perceived by both its leaders and its individual citizens in non-status positions. The leaders' questionnaire was appended to the instrument serving Study One, the urban hierarchy. As a consequence it was administered to mayors, assistant mayors, school teachers, public health nurses and community improvement leaders in all 1,987 communities in the study area with 500 or more inhabitants and in 15 percent of all communities with populations under 500. (This latter 15 percent was excluded from the Study One analysis.) Information was sought about 1) community development

projects that had been carried out in the community in the past two years, and the type and level of local participation in these projects; 2) the leaders' priorities for future development projects needed by their communities; 3) the leaders' opinions concerning the role local participation should play within development projects; and 4) an assessment of the benefits and problems of local participation within projects carried out in the officials' communities.

The local participation questions appended to the Study One survey were also appended to the Study Three interview schedule which dealt with rural dwellers' access to urban functions. Thus, the local participation questionnaire was also administered to a stratified random sample of individuals from 314 households in 94 communities in three subregions of the highlands.

The chief finding was an overwhelming agreement among community leaders and individual citizens alike that water, health care, roads, schools and electrical service were the urgent needs of rural highland communities in Guatemala. The Careys use the term "rural" in reporting their findings but do not indicate in the body of their report that they stratified out of the 2,301 communities (1,987 plus 314) those they defined as rural.

Activity Two - Data Bank Components and Planning Methodology

Rural Infrastructure and Services Component Bank

The 1982 draft article by Jiron et al. reports the creation of a data bank of rural infrastructure and services information for 2,000 settlements in the study area of highland Guatemala. Included are all settlements with 500 or more inhabitants, there are 1,987 of these, plus 15 percent of those under 500, of which there must be 13. The 1982 draft article uses the term "rural" to describe the above data. One of the variables in the bank does allow a settlement to be described by one of 8 classes of settlement patterns so that rural places can be distinguished among the 2,000 centers. The original file contained 1,400 variables for each of the 2,000 settlements but the application of quality controls reduced the number significantly. These are presumably the 494 variables and 1,987 cases contained in the GEOCODE6 file which uses SPSS (Statistical Package for the Social Sciences). A listing

of the 494 variables in Spanish is available in the print-out dated July 7, 1982 which presumably is from the ISU system. GEOCODE6 contains the following data categories:

Characteristics of the place
Settlement pattern
Demographics
Transportation
Water/sewers
Municipal buildings
Markets/commercial establishments
Origin/destination of products sold
Electricity
Communication
Education
Health
Public safety
Cooperatives/financial institutions
Park/recreation/cultural facilities
Economic activity
Migration
Industry/crafts

Natural/Agricultural Resources Component Bank

In their 1982 document, in the section entitled "Codebook for Geographic Data on Land Use and Natural Resources in Central Guatemala, C. A.", Anderson and Knox present the data sets developed for Study Two. The spatial frame in this file is the ecological unit and not the municipio.

Rural Accessibility Component Bank

The physical location of the Study Three data file on accessibility is not known.

Local Participation Component Bank

The 1982 draft article by Jiron et al. reports the inclusion of local participation data in the GEOCODE6 file, but the GEOCODE6 print-out of July 7, 1982 does not list any of the variables used in the Activity One questionnaire.

VI Planning Method Component

The Spatial Approach to Public Investment Priorities

The main product of this planning method is a system for evaluating the suitability of municipios for rural development investment. In order to determine this suitability, variables were selected from those in the infrastructure, services and natural resources data files that could serve as indicators of rural development. These included an indicator of the potential for increased agricultural production and five indicators of infrastructural development:

roads, health facilities, education facilities, potable water and electricity. The relationship between these indicators of development and selected characteristics of each municipio was then measured.

A municipio's suitability for development investment is determined by defining the level of demand for social services that its characteristics are able to support. This calculated demand is then compared to the actual supply of social services to arrive at a measure that is interpreted as a development gap. By combining the standardized values of these gaps for the agricultural potential variable and the five infrastructure variables it is possible to produce for each municipio a composite indicator of its overall suitability for development investment.

The Road Development Gap Example

In both Jiron, et al., 1982, and Knox, 1982, the "road development gap" is used as an example of how this planning method component can be applied to Guatemalan reality. A norm for road kilometrage in the municipios was established by selecting those characteristics in the municipios that best accounted for the road kilometrage and subjecting them to multiple regression analysis. The following equation was developed:

$$R = f(P, A, D, CP, PB)$$

where

R = sum total of a municipio's paved, all-year and seasonal roads

P = total population of a municipio

A = total area of a municipio

D = total number of practicing doctors in a municipio

CP = total number of classrooms in a municipio's primary schools

PB = percentage of a municipio covered with forest

The estimated regression equation and its application to the municipio of San Marcos follow:

1) Regression Model

$$R = 15.624 + .00089\ P + .00065\ A + 6.9007\ D + .3304\ CP\ (-)\ 22.4329\ PB$$

2) San Marcos Actual

24.0 (21,775) (12,965.8) (4) (60) (.573)

3) San Marcos Expected

$$77.8 = 15.624 + 19.380 + 8.252 + 27.602 + 19.824\ (-)\ 12.854$$

The regression model says that as a norm each of the 182 municipios should have 15.624 kilometers of roads and as the population, area, doctors and primary classrooms increase the road kilometrage can be expected to increase, but as the percentage of forest cover increases the road kilometrage can be expected to decrease. For example, if the population (P) increases by one unit (person) then the road average (15.624) increases by .00089 units (kilometers). As the percentage of land in forest increases by one unit (percent) then the road average decreases by 22.4329 units (kilometers).

Line 2 shows that the municipio of San Marcos actually has 24.0 kilometers of roads, a population of 21,775, an area of 12,965.8 square kilometers, 4 doctors, 60 primary classrooms and 57.3 percent of its area covered by forest. Given these actual figures, line 3 shows that San Marcos should expect to have 77.8 kilometers of road. It has 24.0. The gap is 53.8 kilometers.

The road development gap or surplus (some municipios had more kilometrage than the norm) was established in the manner described above for each of the 182 municipios in the study area. The continuum of 182 values from the highest positive (surplus) to the lowest negative (gap) was then divided into five categories. All positive (road surplus) municipios were placed in the first category and the remaining negative (road gap) municipios were placed in one of four categories whose limits were established by dividing the two extreme road gap values by four. Five was deemed the appropriate number of categories because the gaps were to be computer-mapped on a municipio base and in the absence of theoretical or policy rationales cartographic criteria, which hold five to be the maximum number of easily-readable patterns on a map, prevailed.

Calculation of Other Infrastructure Gaps and of Potential Increase in Agricultural Production

The same procedure that was used to establish the road development gap was used to determine the gaps for the four other infrastructure elements. The variables used and the parameters established in the regression equations are shown below.

Health Facilities

$$S = 1.364 + .000115\ POA12 + .00493\ R + .000032\ PD$$

S = total number of health centers & health posts in a municipio
POA12 = population between 0 and 12 years
R = kilometers of road
PD = population density

Education Facilities

$$CP = 6.3436 + .0098\ SAP + .0717\ RPA + .5418\ CV$$

CP = total number of primary classrooms
SAP = school-age population (7-12 years)
RPA = paved and all-year roads
CV = number of classrooms for basic-vocational education

Potable Water

$$WDS = 1.350 + .3040\ PAR + .0015\ PD + .4627\ PWS$$

WDS = percent of settlements in a municipio with water distribution systems
PAR = percent of settlements in a municipio with all-year access by road
PD = population density
PWS = percent of settlements in a municipio with water springs
LA = land area in a municipio

Electricity

$$E = 1.3065 + .4129\ PAR + .00594\ PD\ (-)\ .000047\ LA$$

E = percent of settlements in a municipio with electricity
PAR = percent of settlements in a municipio with all-year access by road
PD = population density
LA = land area of a municipio

The potential increase in the production of corn and beans was developed by first claculating the land area in each ecosystem in each municipio (The ecosystems established in Study Two were not set in the municipio frame and had to be converted) and then multiplying these areas by the yield levels attained by the "best" corn and bean farmers in each ecosystem established in Study Two. The difference between these ideal corn and bean outputs and the

actual outputs reported by municipios in the 1979 Agricultural and Livestock Census was the production potential gap for each municipio. These gaps were arrayed sequentially and divided into five classes.

The Composite Index

Every municipio in the study area fell into one of 5 classes on each of seven criteria: the five infrastructure elements plus the corn and bean production potentials. Each municipio was then assigned a rank score from 1 to 5 (1 = the surplus class and 5 = the largest gap or negative class) depending upon where it fell on each criterion and the sum of these 7 scores produced a municipio composite score. These composites were then standardized as suitability indices and computer mapped on a municipio base. The greater the gaps between the actual and the expected, the higher the suitability index for a municipio. The index links the requirements for infrastructure with the capacity for increased agricultural production. Two municipios with similar infrastructure requirements but different potentials for agricultural production would exhibit different scores on the suitability index. The municipio with the greater potential for agricultural production would be considered more suitable and given a higher score. The assumption is that the benefits to be realized from investment in new infrastructure would be more feasible in a municipio with a greater capacity for agricultural production.

The composite index scores are based on two important decisions that dramatically influence the size of the scores. First is the decision as to what measures to include in the composite. Second is the decision as to what weight or significance to assign each of these measures.

Data Analysis/Mapping and Storage Characteristics

The statistical analysis of these data used SPSS, and the spatial analysis used ISU's MSDAMP(Multi-Scale Data Analysis and Mapping Program). Procedures for linking SPSS and MSDAMP are reported in the November 20, 1982 ISU document. The municipio is the basic unit for analysis but some smaller ones were aggregated with their larger neighbors to produce a total of 182 analysis units, all of which are referred to as "municipios." A total of 406 variables for the 182 "municipios" are found in the print-out of the file MUNI6, dated February 7, 1982.