Relationships Between Social and Economic Development and Access to Rural Roads in Developing Countries

ALI MAZLUMOLHOSSEINI

The relationship between the level of socioeconomic development and the level of transportation activity in rural areas is examined for developing countries. Because access to roads is the most essential element of a transportation system, the degree of accessibility of rural areas is considered a good indicator of the level of development of the transportation system. Degrees of access to rural roads could be determined according to two simple criteria—proximity of the village to the nearest vehicle road and its distance to the nearest town. Villages with identical degrees of accessibility could be arranged in a group, forming access areas, regardless of the geographical location of the component villages. Four access area categories may be created by the proper choice of distance intervals in the application of accessibility criteria. In the order of increasing accessibility, these four access areas may be described as hardly accessible, poorly accessible, fairly accessible, and easily accessible. Each access area would be assigned an access value proportional to some measurable transportation activity (e.g., the number of daily trips per household in that area). The concepts and data used were developed by surveying households in the Philippines in 1983. The survey included 1,002 households with a total of 5,228 individuals living in 25 different villages in five different municipalities of Cebu Island. Study variables obtained from survey responses were then divided into three groups: (a) major components of socioeconomic development including social security, education, income, home comfort, and housing standard; (b) those variables that determined the transportation pattern and ownership of the means of transport; and (c) those variables that described the agricultural situation. Analysis of the study variables as functions of access value revealed that the major elements of socioeconomic development varied sharply with a change in access value and were strongly associated with it. The analysis also found that both the income from the sale of cash crops and the efficiency of agricultural production increased considerably as access value increased. This relationship would indicate that transportation investments may succeed in generating development in other sectors. However, the degree of success would depend on how efficiently the investment is coordinated with other measures to ensure use of the improved transportation facilities by local inhabitants.

Developing countries are typically characterized by the sharp contrast between the relative concentration of wealth and economic power in urban areas and widespread poverty in rural communities. This phenomenon results in marked differences in all economic activities, and in particular, sharp differences may be observed in the transportation patterns of urban and rural areas.

Although cars and buses constitute significant travel modes in urban areas, the travel modes in rural areas are limited to foot, animals, animal-driven carts, bicycles, and locally adapted motorized vehicles, mostly of paratransit type, which vary in number depending on proximity of the area to all-weather roads. Furthermore, a distinctive feature of transportation in rural areas is that person-trips seldom can be differentiated from the transport of goods.

In most developing countries the majority of villages lack access to all-weather roads. Even for areas connected to the main road network by some secondary rural roads, the transportation system may function poorly because of the lack of appropriate vehicles, spare parts, vehicle repair shops, and road maintenance.

TRANSPORTATION INVESTMENTS

Given the fact that the existing state of transportation in rural areas of developing countries suffers from severe deficiencies, it might be easy to assume that in the past transportation might have been neglected by international and national development agencies. However, an examination of past records shows that this assumption is far from true. Figure 1 shows that since the end of World War II, transportation investments have occupied a prominent place in the investment policies of international aid organizations in developing countries. Nearly one-fourth of the loans made by the International Bank for Reconstruction and Development (IBRD) and one-fifth of the credits granted by the International Development Agency (IDA) have been specifically devoted to the transportation sector, with highways accounting for 45.6 and 52 percent of IBRD and IDA transportation investments, respectively.

Further evidence of the importance attached to transportation not only by international aid agencies but also by the developing countries themselves is shown in Figure 2. This figure shows that the investment priorities of developing countries in various public sectors may vary widely from country to country. However, the funds devoted to transportation constitute a considerable portion of the total public sector investments for all the countries involved. Thus, there has

Lund Institute of Technology, Department of Traffic Planning and Engineering, Box 118, S-22100, Lund, Sweden.

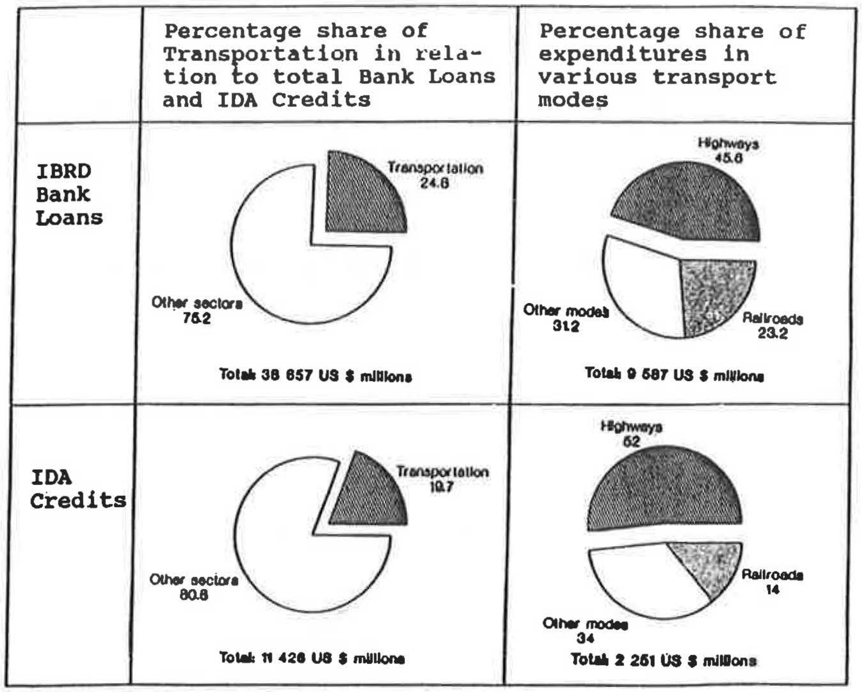
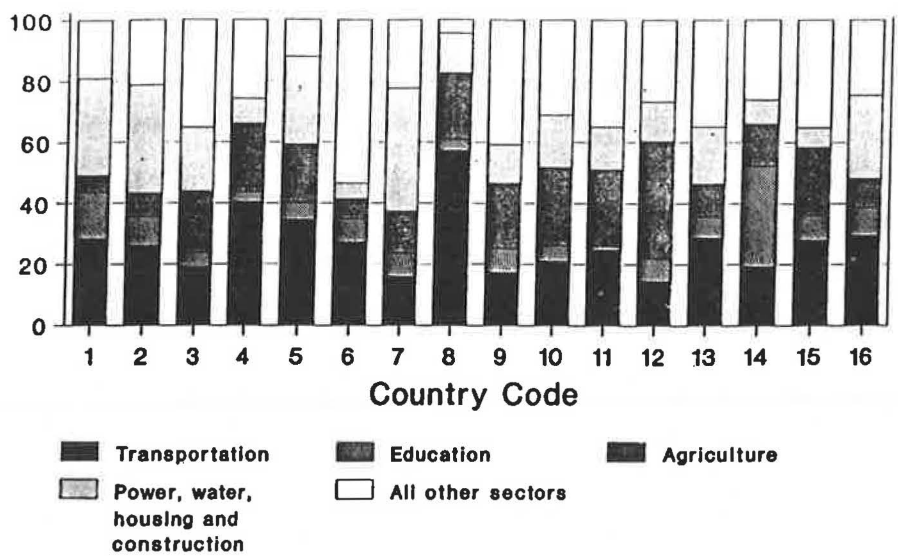


FIGURE 1 IBRD and IDA cumulative lending operations in developing countries to June 1977.



Countries and Corresponding Investment Periods:

1.	Barbados 1973-1977	2.	Botswana 1973-1978	3.	India 1974-1978		
4.	Kenya 1974-1978	5.	Malawi 1971-1980	6.	Nigeria 1975-1980		
7.	Pakistan 1970-1975	8.	Philippines 1971-1974	9.	Senegal 1973-1977		
10.	Sierra Leone 1973-1978	11.	Sri Lanka 1972-1976	12.	Sudan 1970-1975		
13.	Tanzania 1969-1974	14.	Thailand 1972-1976	15.	Uganda 1971-1975		
16.	Zambia 1972-1976						

FIGURE 2 Allocation of investment funds by developing countries to major public sectors.

been a general awareness of the importance of improving the transportation system in developing countries (*1*).

Most of the earlier investments in road construction were concentrated on major roads. However, there has been a gradual change in policy toward favoring minor rural roads (*2,3*). With this trend have appeared numerous research papers dealing with the economic aspects of rural road projects (*4,5*) as well as the planning aspects of transportation investments that consider the needs and problems of small farmers (*6*). Despite the extensive efforts and investments in the transportation sector during the past decades, transportation in rural areas of developing countries is still in very poor shape for a variety of reasons: (a) road length per capita in developing countries is still far below the corresponding value for developed countries (*7*); (b) earlier investments after the end of World War II were mostly devoted to the construction of highways and major roads; and (c) past investments may have disregarded the actual on-farm transport needs of the poorer inhabitants in rural communities (*8,9*). Whatever the underlying reasons for the state of transportation may be, much remains to be done to understand the nature of the problems facing future investments in rural areas of developing countries.

ALTERNATIVE METHODS OF STUDY

The impact of transportation on social and economic development may be examined by either of two classical methods. In the first method, the changes brought about in the social and economic conditions of a certain region in a developing country are observed subsequent to the successful completion of a transportation investment. In the second method, areas characterized by sharp differences regarding the level of development of the transportation system within a given developing country are chosen, in which the existing social and economic conditions are observed and compared with each other.

Each of these methods has its particular advantages and disadvantages. The first method is a direct approach to the problem. Because this method measures changes observed in the value of socioeconomic variables as a function of time, achieving reliable results requires that the initial state be thoroughly defined, that is to say, the starting values of socioeconomic variables must be known in advance before a transportation investment is implemented. This information would distinguish the influence of the transportation project from the impacts of other factors affecting the community simultaneously. Furthermore, the study should span a sufficiently long period of time after the completion of the transportation project to assess the overall effect of the project.

The second method is an indirect approach to the problem. Establishing a correlation between the level of development of the transportation system and the socioeconomic conditions would only determine the degree of association between transportation and socioeconomic development. Whether a planned transportation investment in a remote rural area of a developing country would generate development in other socioeconomic sectors would not have a unique answer. The outcome would depend on how efficiently the transportation investment was coordinated with other measures that would ensure reasonable use of the improved transportation facilities by local inhabitants.

PRESENT APPROACH

The present approach is based on the second method discussed previously and uses data from a survey carried out in the Philippines in 1983 based on interviews at the household level. The survey comprised 1,002 households with a total of 5,228 individuals living in 25 different villages in 5 different municipalities of Cebu Island. Figure 3 shows the location of Cebu Island in the Philippines as well as the study areas on the island. Households in each village were chosen at random whereas the villages were selected to provide a wide range of

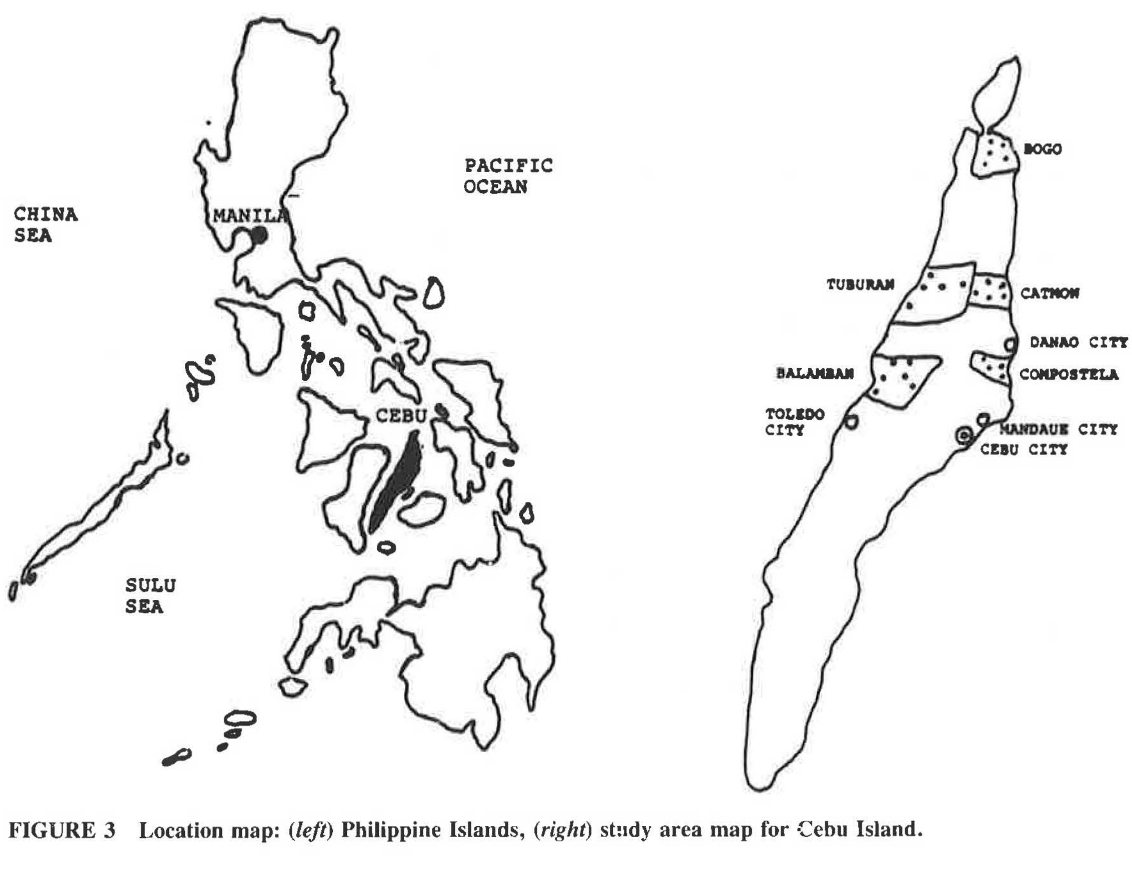


FIGURE 3 Location map: (*left*) Philippine Islands, (*right*) study area map for Cebu Island.

rural areas with varying degrees of access to rural roads. The households interviewed comprised about 10 percent of all households in the chosen villages and about 3 percent of all households in the actual municipalities. Questionnaires were designed to gather information from each household concerning family size, age, education, profession, income, home comfort facilities, housing standard, ownership of means of transport, travel pattern, and trade and agricultural activities.

Because access to roads is the most essential element of a transportation system, the degree of accessibility of each village may be considered as a good measure of the level of development of the transportation system in that village. Therefore, an interval accessibility scale was constructed and the major components of socioeconomic development from the survey (social security, education, income, home comfort, housing standard, and other important study variables related to transportation and agriculture) were studied as functions of accessibility.

The development of new concepts while analyzing the data led to the notion of a socioeconomic development (SED) map for developing countries consisting of an ordinary map of a given country on which individual villages are differentiated by their levels of social and economic development. The concept of SED maps actually evolved from the following question: knowing that social and economic conditions may vary considerably between rural and urban areas of a developing country, would it be possible to identify different levels of socioeconomic development between the villages in rural areas alone? SED maps would be meaningful only if the answer to this question turns out to be positive. Thus, a further objective of this study was to develop a methodology for the determination of the SED map for a developing country.

DEVELOPMENT OF ACCESSIBILITY CONCEPTS

Access Value and Access Area

The degree of access to rural roads for each of the 25 villages was determined according to two simple criteria—the proximity of the village to the nearest vehicle road and its distance to the nearest town. The criteria actually used are presented in Table 1. The notion of far from the road in Table 1 implies approximately more than 3 km from the road. The last column in this table denoted by access value defines the degree of accessibility and is an ordinal accessibility scale consisting of the values 1, 2, 3, and 4. Thus, villages may fall into either one of the four categories with regard to their degree of accessibility. Villages with the same access value may be thought of as being arranged in a group, forming a certain access area, regardless of the geographic position of the component villages. Four access area categories were defined in which the order of increasing accessibility was described as hardly accessible, poorly accessible, fairly accessible, and easily accessible with access values of 1, 2, 3, and 4, respectively. The names of villages studied and corresponding access values and population structure in various access areas are presented in Tables 2 and 3.

Association with Travel Intensity

The relationship between the average number of daily trips per household and access value is shown in Figure 4. The nearly perfect correlation between travel intensity and access value is important because it implies that accessibility in rural areas of a developing country may be directly measured by travel intensity and that the ordinal accessibility scale constructed could actually be considered as an interval scale, which means that it would be mathematically correct to trace the study variables as continuous functions of access value. Furthermore, access value would be exchangeable with travel intensity and the degree of access to rural roads would be measurable by the extent of transportation activity in rural areas.

In all the diagrams that appear in the following discussion, the study variable is always shown on the vertical axis.

MAJOR COMPONENTS OF SOCIOECONOMIC DEVELOPMENT

Social Security

Job and employment opportunities as a function of access value are shown in Figure 5 in which the major single income sources are differentiated. Excluding the zero-income group from calculations, the major income sources of dual type appear in Figure 6. An examination of Figures 5 and 6 reveals that social security expressed in terms of job and employment security is an increasing function of access value. First, this expression may be verified in Figure 5 by observing that the share of the zero-income group (a group with an uncertain income source and insecure job status) decreases rapidly with increasing access values and that the proportion of employees (a group with a secure and steady income source) rises sharply

TABLE 1 CRITERIA FOR ASSIGNING ACCESS VALUES TO VILLAGES

FIRST CRITERION	SECOND CRITERION	
Distance to the nearest town	**Location with regard to the nearest motor vehicle road**	**Access Value**
More than 10 Kilometres	**Far from the road**	**1**
5-10 Kilometres	**Far from the road**	**2**
0-5 Kilometres	**Far from the road**	**3**
More than 5 Kilometres	**Nearby the road**	**3**
0-5 Kilometres	**Nearby the road**	**4**
Zero distance	**(the major town itself)**	**4**

TABLE 2 NAMES OF VILLAGES AND CORRESPONDING ACCESS VALUES AND NUMBER OF HOUSEHOLDS

Name of Municipality	Name of Village	Access Value	Number of Households Interviewed	Total Number of Households (1)	(2)	(3)
Balamban	Balamba	4	18	200	2763	8187
	Nangka	4	41			
	Buanoy	3	58			
	Lamisa	1	24			
	Biasong	2	22			
	Duangan	1	37			
Tuburan	Tuburan	4	24	200	2455	8629
	Mangga	4	24			
	Putat	3	23			
	Taminjao	3	56			
	Montealegre	2	73			
Bogo	Bogo	4	38	202	3065	8305
	Dakit	4	30			
	La Paz	3	34			
	Gairan	3	52			
	Odlot	2	48			
Catmon	Catmon	4	38	200	1491	3421
	Catmanda-an	4	53			
	Duyan	3	22			
	Cabunga-an	2	29			
	Agsowao	1	58			
Compostela	Compostela	4	42	200	1193	3333
	Estaca	4	56			
	Cambayog	3	67			
	Dapdap	2	35			
Total No of Households in All Five Municipalities				1002	10976	31875

(1) Households included in the survey
(2) All households in the chosen villages
(3) All households in the municipality

TABLE 3 POPULATION STRUCTURE STUDIED IN VARIOUS ACCESS AREAS

Access Areas	Households Interviewed No	%	Inhabitants Interviewed No	%	Average Family Size	Men %	Women %	Children age below 15 years %
1	192	19.2	991	19.0	5.16	28.8	30.5	40.8
2	190	19.0	953	18.3	5.02	30.3	29.0	40.7
3	256	25.5	1364	26.0	5.33	28.1	27.5	44.4
4	364	36.3	1920	36.7	5.27	28.4	32.2	39.4
Summary: Total study	1002	100	5228	100	5.22	28.8	30.0	41.2

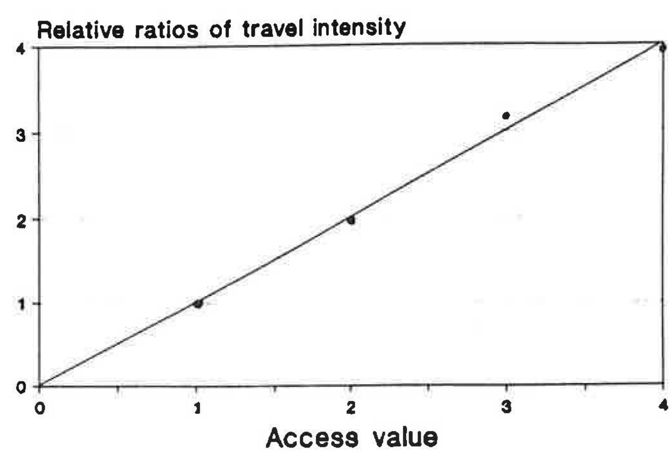


FIGURE 4 Travel intensity per household versus access value.

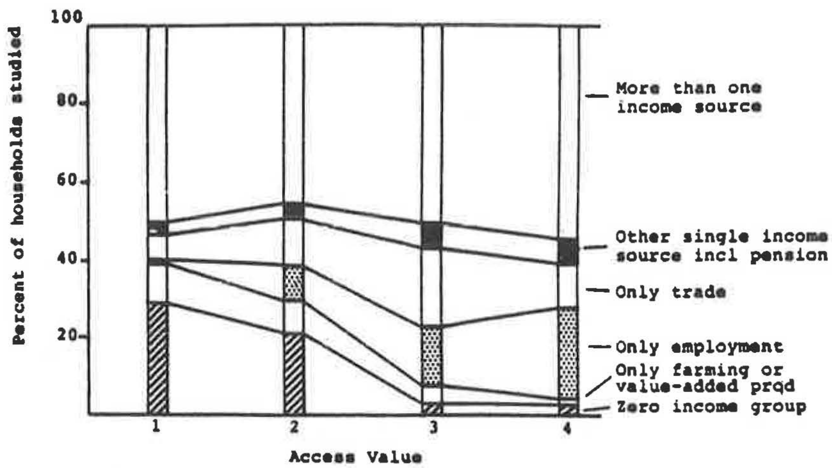


FIGURE 5 Percentage share of households by income source.

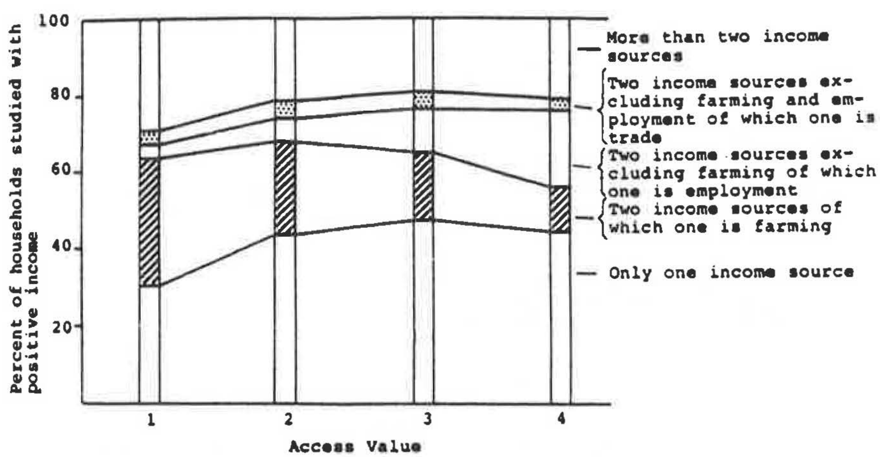


FIGURE 6 Percentage share of households by combination of income sources.

as access value increases. Second, Figure 6 shows that the percentage share of households with a single income source (a group with secure job status) is an increasing function of access value, and that the percentage share of households with more than two income sources (a group with rather insecure and unsteady job status) is a decreasing function of access value.

Main Profession

Most of the local inhabitants lack well-defined single jobs. Nevertheless, there may be only one job that could be considered as a citizen's main occupation. A picture of how the percentage share of both male and female inhabitants engaged in a certain profession may vary with access value is shown in Figure 7. This figure shows that with increasing access values, employment and study opportunities increase considerably for both men and women, whereas small-scale business activities, including farming for men and household work for both men and women, tend to decrease. The number of women doing household work is more than 10 times larger than their male counterparts in all access areas.

Education

For educational levels, by increasing access values the study variable falls rapidly for primary school education and rises sharply for completed high school and university level education (Figure 8). Incomplete high school education appears to be the borderline above which the proportion of higher-educated people sharply declines in less-accessible rural areas. This study shows that the average educational level in the Philippines is relatively high, whereby it could be expected that in most other developing countries, the borderline noted might fall far below the incomplete high school studies.

Income

All income components except farming tend to increase with increasing access value. In fact, total household income and income from employment are sharply increasing functions of access value (Figure 9). In calculating farming income, the value of home consumption of crops has been taken into account, whereby the words farming benefit may replace farming income. In addition, by increasing access value, the per-

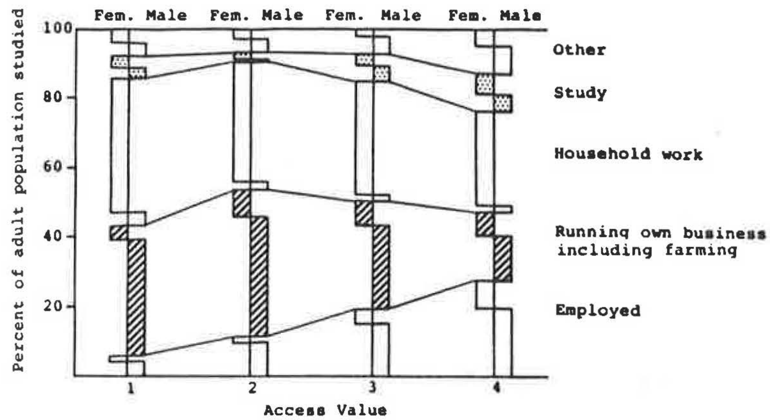


FIGURE 7 **Percentage share of adult inhabitants by main profession.**

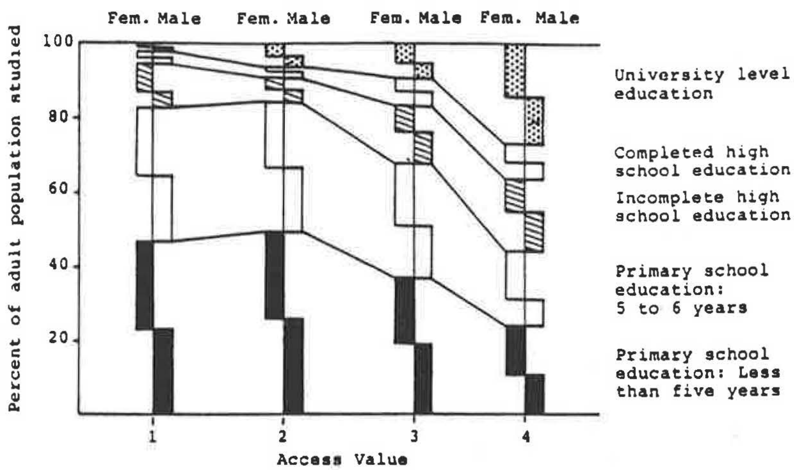


FIGURE 8 **Percentage share of adult inhabitants by education level.**

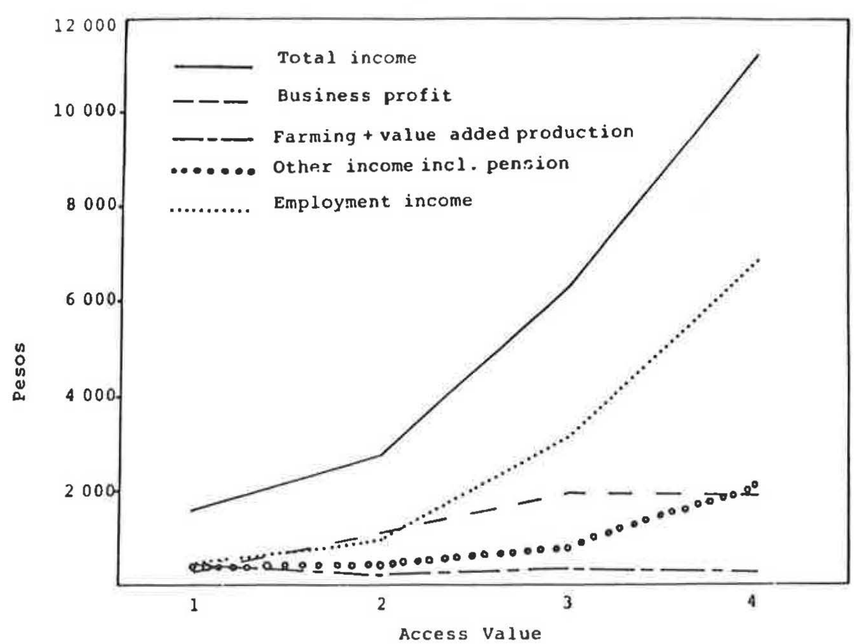


FIGURE 9 **Household income versus access value.**

centage share of households falls very rapidly for farming benefit plus income from processing farm products (value-added production) and increases sharply for employment income (Figure 10). Components of income generated by running a self-owned business (farming) and the manner in which the components vary with access value is shown in Figure 11 The percentage share of income from agriculture, fishery, and forestry together is a rapidly decreasing function of access value, whereas the share of income from all other trades counted together tends to increase sharply with increasing access value. For income distribution, Figure 12 shows that by increasing access value, the share of households in the

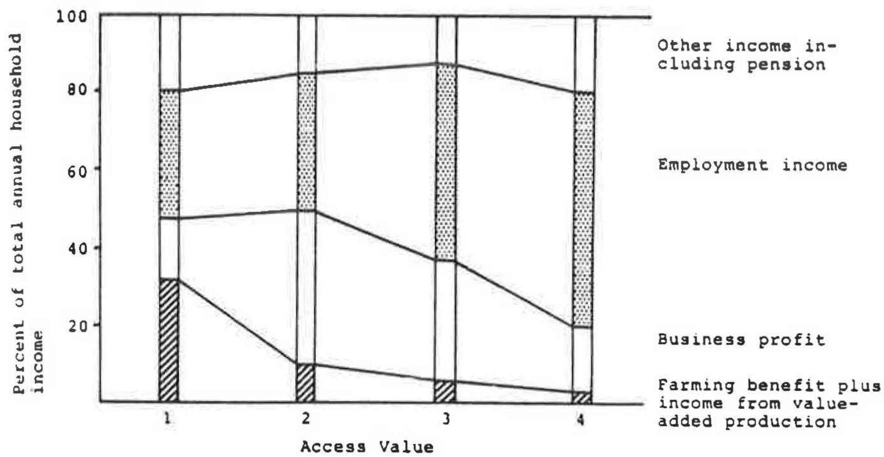


FIGURE 10 Percentage distribution of household income by income source.

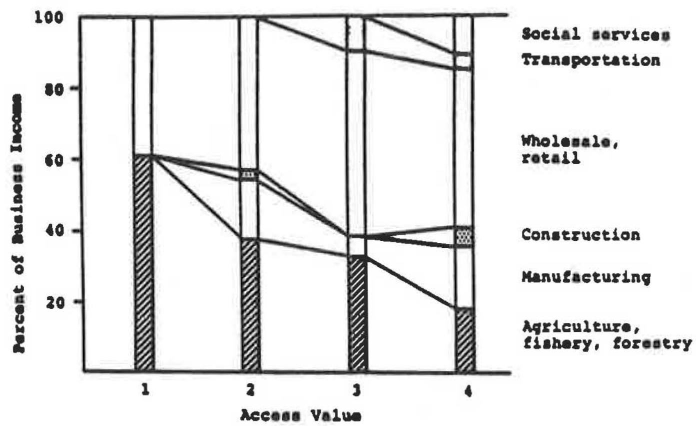


FIGURE 11 Percentage distribution of business income by business type.

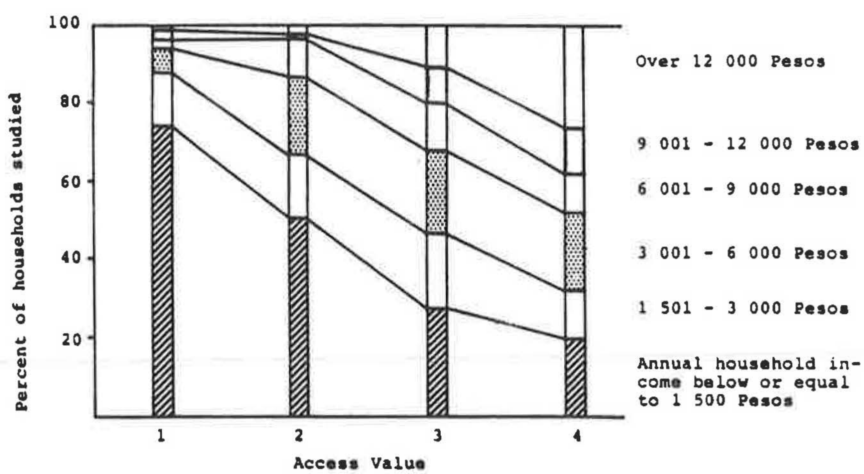


FIGURE 12 Percentage distribution of households by income group.

lowest income group (below 1,500 pesos per household per year) declines rapidly and increases sharply for the highest income category (over 12,000 pesos per household per year).

Housing

The extent of home comfort facilities, water and electricity, and their variation with access value indicates that by increasing access value, the percentage share of households falls sharply for the lowest home comfort level (neither water nor electricity) and tends to rise for medium and high levels of home comfort, a tendency shown to vary greatly for households enjoying the highest home comfort, both water and electricity (Figure 13). Housing standard, measured by the condition of the building's roof and structure, declines rapidly for the poorest housing standard—poor roof and poor structure. For the medium housing standard there is no obvious trend in either direction, but for the highest housing standard—fair roof and fair structure—there is a sharp increase (Figure 14).

TWO IMPORTANT SOCIOECONOMIC SECTORS

Transportation

Ownerships of cars, Jeepneys, trucks, motorcycles, bicycles, carts, and wagons are all increasing functions of access value, whereas ownership of animals as means of transport declines sharply as access value increases (Figure 15). A diagrammatic representation of the percentage share of trips carried out for various aims and purposes and its variation with access value is shown in Figure 16. The shares of work trips, business trips, and trips to school are all increasing functions of access value, particularly for work trips, which have a small share in the most remote villages and a larger share as accessibility improves. Figure 17 shows that with an increase in access value, the share of trips rises sharply when the mode is car or taxi, bus or Jeepney, trimobile, or motorcycle, as well as bicycle. In fact, the share of trips by public transport services including bus, Jeepney, and trimobile and the share of trips by motorized vehicles taken together are both sharply increasing functions of access value. When the transport mode is walk, the share of trips falls very conspicuously.

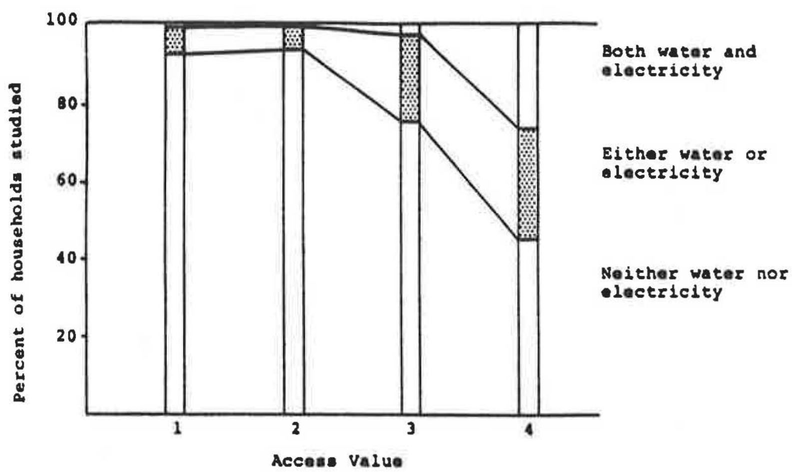


FIGURE 13 Percentage share of households by home comfort standard.

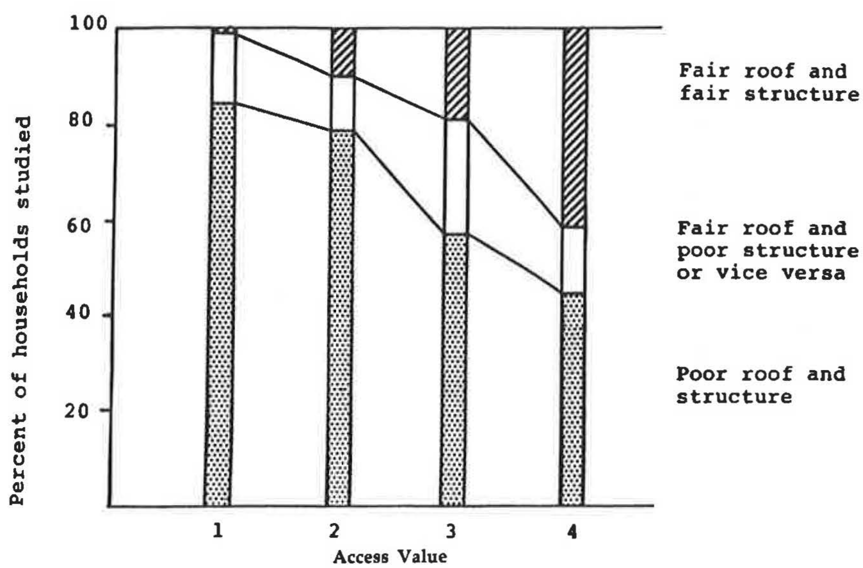


FIGURE 14 Percentage share of households by housing standard.

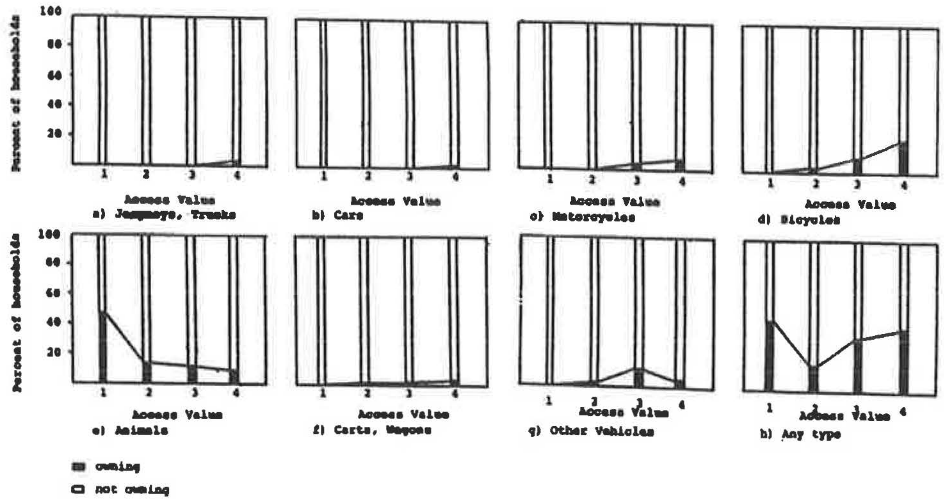


FIGURE 15 Ownership of means of transport.

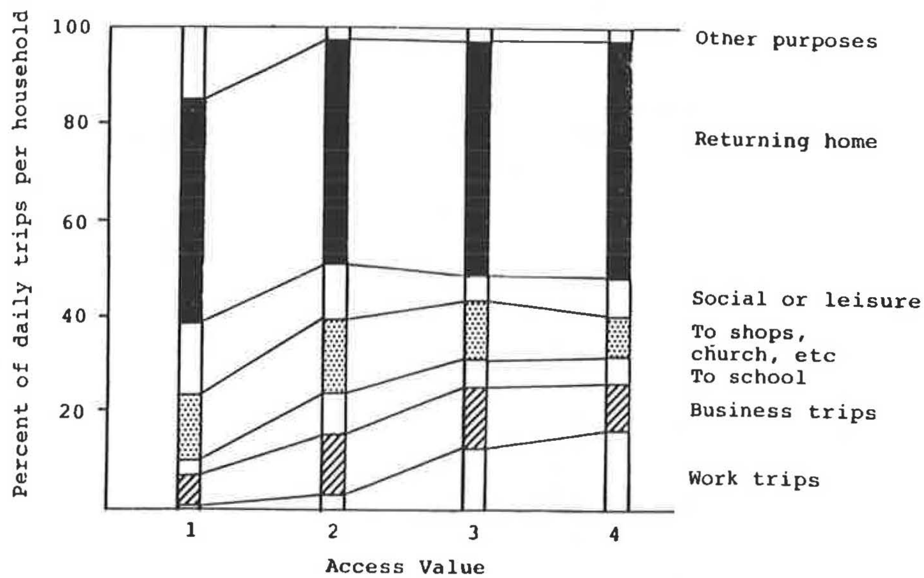


FIGURE 16 Percentage distribution of trips by purpose.

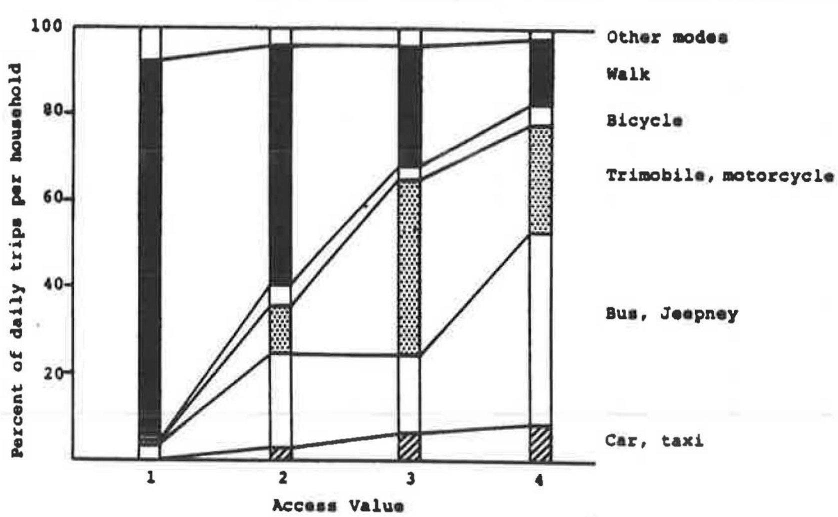


FIGURE 17 Percentage distribution of trips by mode.

The importance of accessibility for the transport of goods by various modes is shown in Figure 18. Transactions are defined as business deals involving the sale or purchase of a commodity that requires to be transported from the market to where it is finally consumed. The figure clearly shows that the share of transactions for goods transported by motorized vehicles, taken all together, is a markedly increasing function of access value, whereas it declines sharply when the transport mode is walk, consisting of head-loading, shoulder-loading, and back-loading. The shares of transactions, both for business site markets and interregional markets, are increasing functions of access value (Figure 19).

Agriculture

Agriculture is an important source of subsistence in rural areas of developing countries. Even households whose main source of income is not farming may own a small plot on which they grow crops for home consumption. Among the 1,002 households studied were 621 families who were concerned with agriculture in one way or another. The extent of farming activities is shown in Figure 20 by three categories of households—no farming activity, producing only for home consumption, or producing both for home consumption and sale. It may be seen that for no farming activity, the share of households is a sharply increasing function of access value, constituting a vanishingly small portion of inhabitants in the most remote villages and the vast majority of people in easily accessible areas. For the other two categories, the share of households turns out to be sharply falling functions of access value.

Farm size and the percentage share of farmers surveyed actually owning a farm of various sizes is shown in Figure 21. The share of farms is an increasing function of access value both for the smallest farms not larger than 49 ares (about half a hectare) and for the largest farms exceeding 500 ares (5 hectares). This relationship implies that both very small and very large farms are more numerous in more accessible areas with very small farms accounting for crops used only for home consumption and very large farms accounting mostly for cash crops. Average farm size, both for farmers who produce cash crops and for those who produce only for home consumption, is a decreasing function of access value in the first three access areas and in the last access area shows a substantial increase for farmers producing cash crops (Figure 22).

Average annual farm income per household as function of access value is shown in Figure 23 for the three categories of farm households defined previously. The figure shows that the average annual farm income for households producing

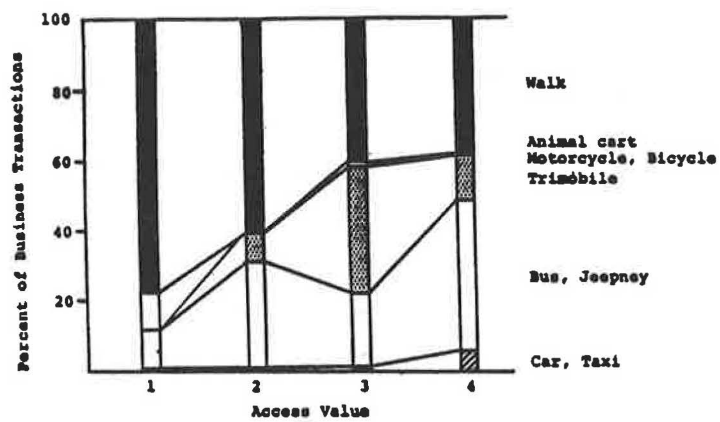


FIGURE 18 Percentage distribution of trade transactions by mode.

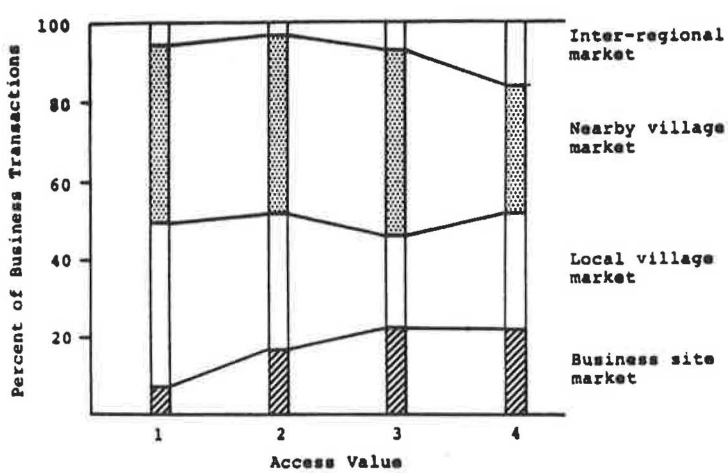


FIGURE 19 Percentage distribution of trade transactions by market.

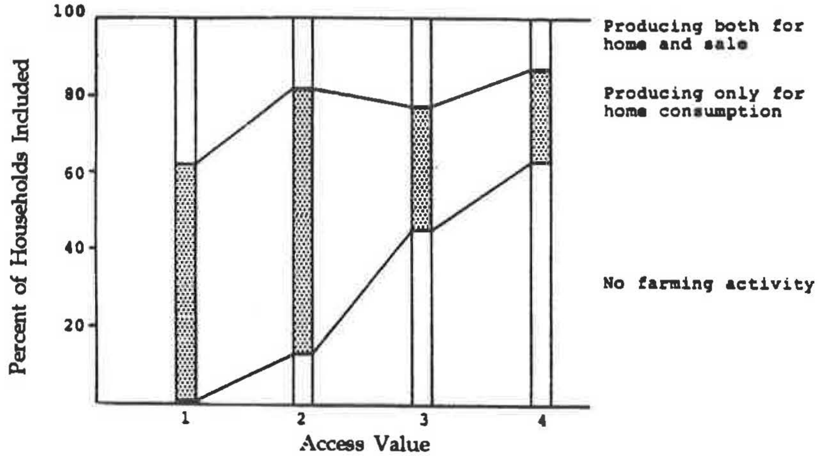


FIGURE 20 Percentage distribution of households by farming activity.

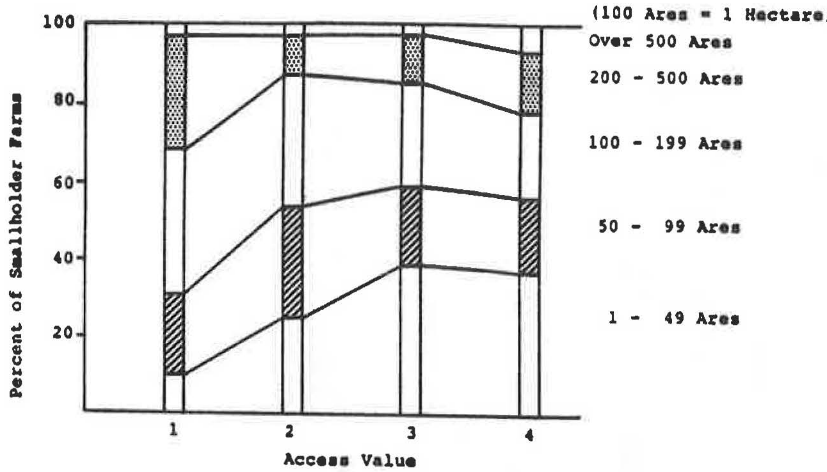


FIGURE 21 Percentage share of farms by farm size category.

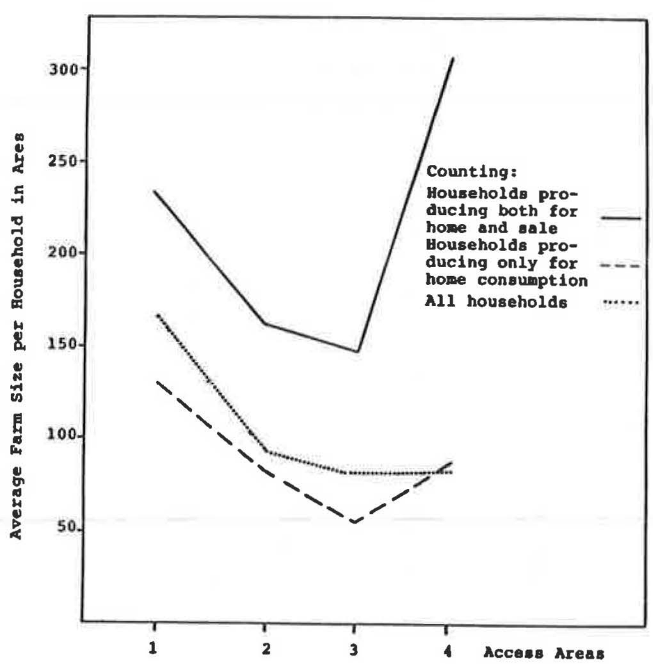


FIGURE 22 Average farm size versus access value.

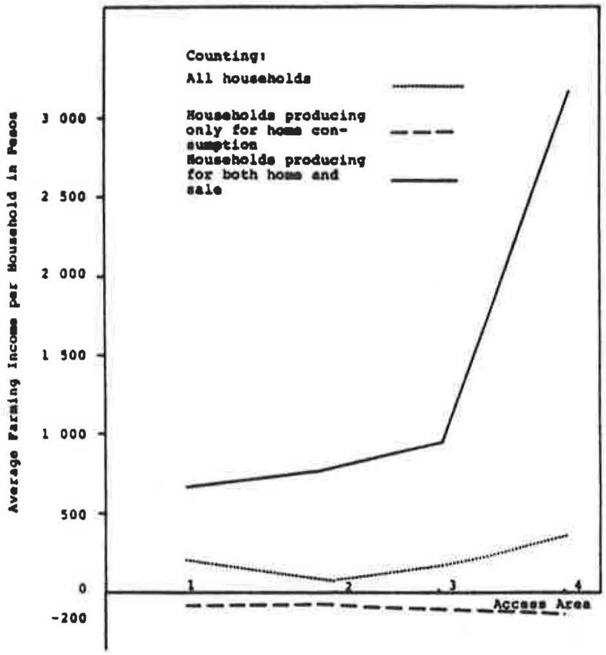


FIGURE 23 Average annual farming income per household versus access value.

cash crops is a continuously increasing function of access value, and in particular, it increases remarkably when the access value increases from 3 to 4. Dividing average farm income by average farm size for households producing cash crops would result in Figure 24, which shows that the efficiency of agricultural production increases considerably with an increase in access value.

CONCLUSIONS

Extension of the Results

The results shown in the previous figures are based on data from the study of a sample survey of the population on Cebu Island. Households were chosen at random in the actual survey and constituted around 10 percent of all households in

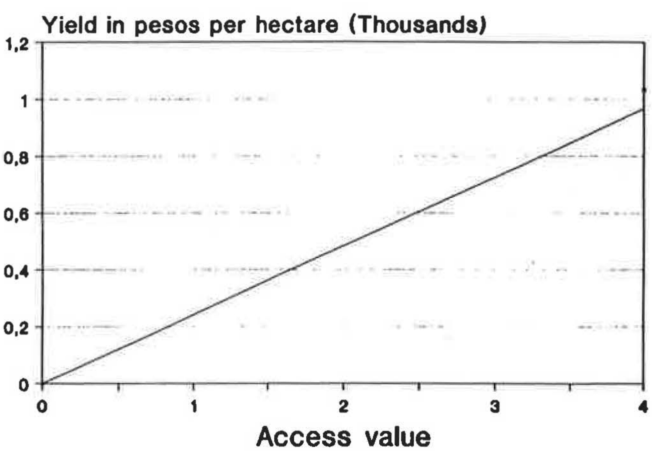


FIGURE 24 Yield per hectare versus access value.

the villages studied. However, the survey raises the question of how far the results obtained from the Cebu study could be extended to rural areas in other developing countries with similar socioeconomic structure. This question is actually the classical inference problem of generalizing conclusions from samples to populations.

Given the assumption that there are no definite relationships between the study variables and access value, a null hypothesis, then the knowledge of the sample size and observations of the actual results displayed in the previous sections would lead to the conclusion that the null hypothesis would be highly improbable if this judgment were based on earlier experiences of statistical analysis of problems involving similar sample sizes and similar relationships. The null hypothesis was tested using the contingency table of modal split corresponding to Figure 17 and the contingency table of the extent of farming activities corresponding to Figure 20. The application of a chi-square test of independence would lead to a significance level probability of approximately 10^{-10} in both cases. In other words, despite the relationships observed in Figures 17 and 20, the chances of the null hypothesis being true are less than 1 in 1 billion.

Impact of Transportation

The results of the study disclosed that major components of socioeconomic development and selected study variables in two economically vital sectors, transportation and agriculture, of rural areas of developing countries are strongly associated with accessibility and may vary sharply with a change of access value. Determining whether investments in the transportation sector generate development in other socioeconomic fields would require a closer examination of the results obtained in the agricultural sector.

Both the income obtained from the sale of cash crops and the efficiency of agricultural production are sharply increasing functions of access value. This relationship implies that an improvement of the existing transportation system would create a potentially new situation where all the local inhabitants, including poorer farmers, could gain advantage by selling their cash crops at higher prices and buying input products both cheaper and at the right time, assuming that everybody would have the possibility to use the newly created transportation facilities. Thus, optimal transportation investments in rural areas would take into account both the on-farm transportation needs involving shorter distances and the inability of poorer farmers to pay for the cost of transporting crops longer distances to bigger markets. Coping with these two problems through a sound financial and management plan would lead to a gradual increase of the farmers' income. Consequently, farmers would be wealthier and more inclined to increase spending on the education of their children and on raising the living standard of their families. Farmers may even be able to buy better and more efficient vehicles for transporting their cash crops to other markets.

Therefore, investments in the transportation sector may generate development in other socioeconomic fields provided that additional effective measures are taken simultaneously in order to ensure the proper use of the improved transportation system.

CONCEPT OF SOCIOECONOMIC DEVELOPMENT MAP

A review of the results obtained reveals that the study variables, which are positively correlated to socioeconomic development, such as social security, education, and so forth, change steadily in the same direction as access value. This relationship is shown in Figure 25 in which the level of advancement of favorable elements of socioeconomic development in the four access areas are assigned rank scores based on the results of the previous sections. The idea conveyed in Figure 25 leads to the conclusion that for a given part of a developing country as small as Cebu Island, it may be possible to identify different groups of villages denoted by SED zones with entirely different levels of social and economic development and that the SED zones would coincide with access areas. This result is particularly striking because in a small island of the size of Cebu, the existence of SED zones in rural areas cannot be explained by any ethnic reason, any unusual natural or social phenomenon, or any other extraordinary cause. SED zones in the order of increasing development level may be described as hardly developing, poorly developing, fairly developing, and easily developing with corresponding development scores of 1, 2, 3, and 4, respectively. Development scores are analogous to access values and have the similar function of ranking development levels as access values measure accessibility.

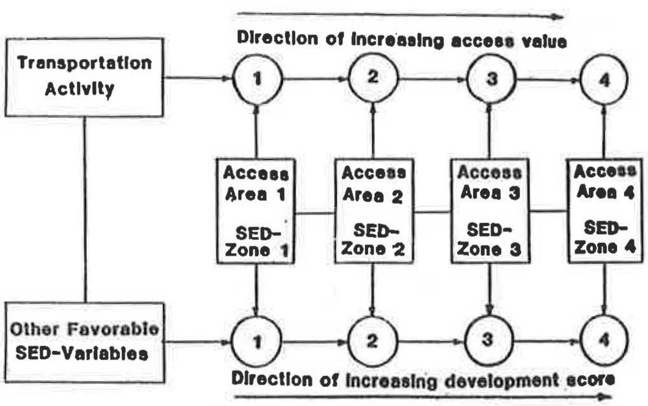
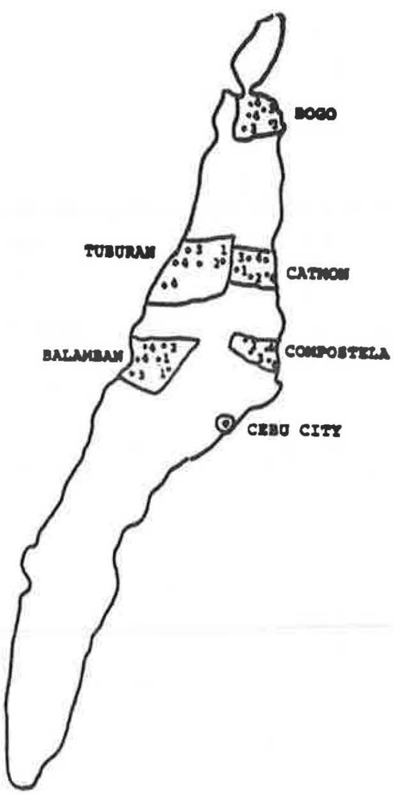


FIGURE 25 Rank scores of SED variables.

The most useful application of SED zones may be in constructing SED maps of developing countries. SED maps are simply an ordinary map of a country on which all individual villages are marked by their development scores. SED charts would always consist of a SED map plus an arbitrary number of other diagrams conveying desired information in percentage form about strategically important variables describing the SED zones. In Figure 26 the SED chart is made up of the SED map of the villages included in the survey plus two piecharts (SED pies). The first gives the percentage distribution of all inhabitants studied, and the second, the percentage distribution of those households earning more than 6,000 pesos per year (approximately the average income of the households studied) in the SED zones. SED pies for other variables are shown in Figure 27.

SED maps may be useful in planning and implementing investments in rural regions of developing countries because they pinpoint the neediest areas where greater investments are needed. A desirable long-term investment strategy should lead to a situation where the development scores of 1 and 2 would completely disappear from the SED map. Thus, the SED map and associated SED pies may also be used as val-



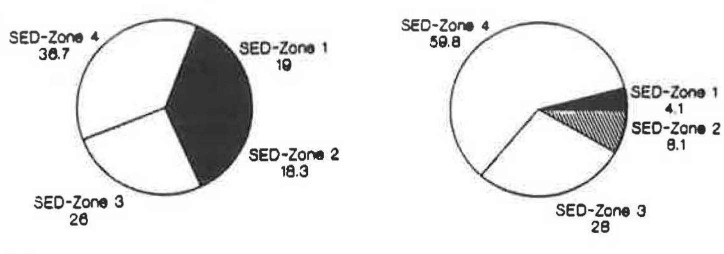


FIGURE 26 A socioeconomic development chart of the study villages in Cebu Island: (*left*) Cebu Island, (*middle*) population SED pie—percentage distribution of inhabitants by SED zone, (*right*) income SED pie—percentage distribution of households earning more than average income by SED zone.

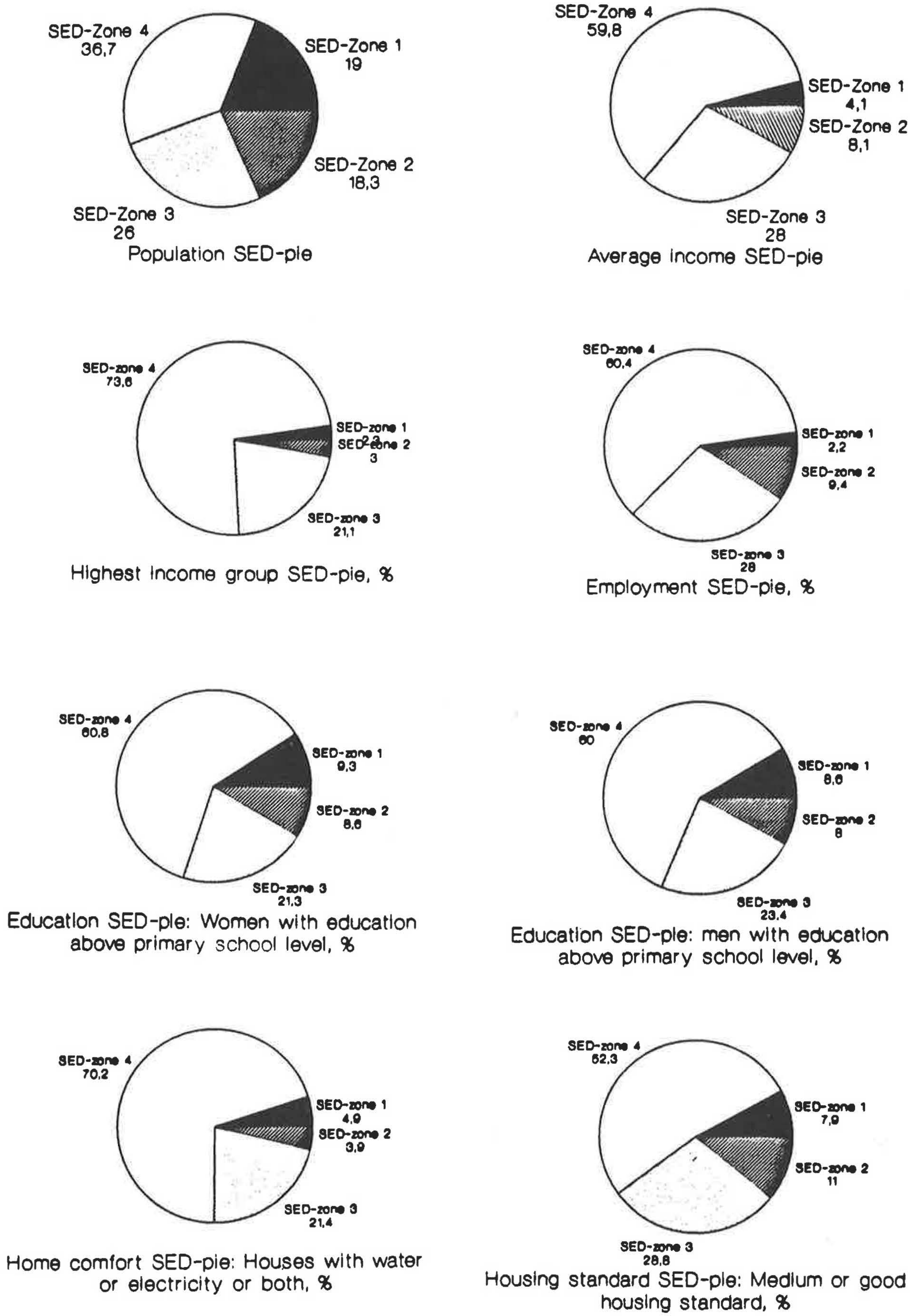


FIGURE 27 SED pies for individual study variables.

uable tools for observing the extent of achievements of past investments in rural areas of developing countries.

ACKNOWLEDGMENTS

This research work was financed by a grant from Swedish Agency for Research Cooperation with Development Countries (SAREC). Arne Hansson prepared the questionnaire and supervised the task of interviewing the households in the Philippines in 1983. Gösta Lindhagen's valuable help, expert advice, and continuous interest have been indispensable in the completion of the work. Special thanks are extended to Birgitta Åkerud, whose devoted work in drawing the diagrams and typing the manuscript was essential for the preparation of this paper.

REFERENCES

1. World Bank. *Transportation: Sector Working Paper*. International Bank for Reconstruction and Development, Washington, D.C., Jan. 1972.
2. World Bank. *Note on Rural Road Lending*. Transportation Department, International Bank for Reconstruction and Development, Washington, D.C., Dec. 1977.
3. C. Carnemark. Rural Roads and the World Bank. Presented at the first meeting of the OECD Joint Working Group on Rural Roads in Developing Countries, United Kingdom, March 1975.
4. C. Carnemark et al. *Economic Analysis of Rural Road Projects*. Staff Working Paper 241, World Bank, Washington, D.C., 1976.
5. H. L. Beenhakker and A. M. Lago. *Economic Appraisal of Rural Roads: Simplified Operational Procedures for Screening and Appraisal*. Staff Working Paper 610, World Bank, Washington, D.C., 1983.
6. S. Carpetis, H. L. Beenhakker, and I. D. F. Howe. *The Supply and Quality of Rural Transport Services in Developing Countries: A Comparative Review*. Staff Working Paper 654, World Bank, Washington, D.C., 1984.
7. A. M-hosseini and R. Lippoy. *Public Transportation in Developing Countries*. Literature Survey, Bulletin 73, Department of Traffic Planning and Engineering, Lund Institute of Technology, Lund, Sweden, 1987.
8. I. J. Barwell and J. D. G. F. How. *Appropriate Transport Facilities for the Rural Sector in Developing Countries*. World Employment Program, International Labour Organisation, Great Britain, Jan. 1979.
9. I. J. Barwell et al. *Rural Transport in Developing Countries*. World Employment Program, International Labour Organisation, Great Britain, 1985.